



**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA
(JHAJJAR)**

An Autonomous Institute

‘A’ GRADE ACCREDITED BY NAAC

**Evaluation Scheme and Syllabus for
Bachelor of Technology (Civil Engineering)
Third Year (A-Scheme)
(Effective from the session: 2026-27)**



APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MDU, ROHTAK

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA,
JHAJJAR (HR.)**

**Scheme of Studies and Examinations
B.Tech (Civil Engineering) – 5th Semester
w.e.f. 2026-27**

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-CE-301A	Design of Steel Structures	3	0	0	3	3	40	60	–	100	3
2	Professional Core Courses	PCC-CE-303A	Hydrology & Water Resource Engineering	3	0	0	3	3	40	60	–	100	3
3	Professional Core Courses	PCC-CE-305A	Soil Mechanics	3	0	0	3	3	40	60	–	100	3
4	Professional Core Courses	PCC-CE-307A	Highway Engineering - I	3	0	0	3	3	40	60	–	100	3
5	Professional Core Courses	PCC-CE-309A	Water Supply and Treatment	3	0	0	3	3	40	60	–	100	3
6	Professional Elective Course Courses	Refer Table 2	Professional Elective-II	3	0	0	3	3	40	60	–	100	3
7	Professional Core Courses / (Lab Course)	LC-CE-311A	Computer-Aided Civil Engineering Drafting Lab (CAD Lab)	0	0	2	2	1	25	–	25	50	-
8	Professional Core Courses / (Lab Course)	LC-CE-313A	Soil Mechanics Lab	0	0	2	2	1	25	–	25	50	-
9	Professional Core Courses / (Lab Course)	LC-CE-315A	Highway Engineering - I Lab	0	0	2	2	1	25	–	25	50	-
10	Project	PROJ-CE-327A	Survey Camp	–	–	–	2	1	25	–	25	50	–
11	Practical Training	PT-CE-329A	*Practical Training - I	0	0	2	2	1	25	–	25	50	*Refer Note 2
Total Credits								23				850	

Note-1: Students will be allowed to use non-programmable scientific calculator. However, sharing of Calculator and other materials will not be permitted in the examination.

Note-2: The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students.

Note-3: Students must choose one course from the Professional Elective-II category (Table 2). They may also opt for Massive Open Online Courses (MOOCs) offered through the SWAYAM, SWAYAM Plus, or NPTEL platforms, subject to the approval of the concerned Chairperson, Board of Studies/Head of the Department.

Table 2 Professional Elective – II

S. No	Course Code	Course Name
1	PEC-CE-317A	Advanced Structural Analysis
2	PEC-CE-319A	Air and Noise Pollution
3	PEC-CE-321A	Formwork Engineering and Design
4	PEC-CE-323A	Traffic Engineering
5	PEC-CE-325A	Engineering Geology
6	-----	MOOCs offered through SWAYAM, SWAYAM Plus, or NPTEL platforms

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA,
JHAJJAR (HR.)**

**Scheme of Studies and Examinations
B.Tech (Civil Engineering) – 6th Semester
w.e.f. 2026-27**

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-CE-302A	Irrigation Engineering and Design	3	0	0	3	3	40	60	–	100	3
2	Professional Core Courses	PCC-CE-304A	Foundation Engineering - I	3	0	0	3	3	40	60	–	100	3
3	Professional Core Courses	PCC-CE-306A	Highway Engineering - II	3	0	0	3	3	40	60	–	100	3
4	Professional Core Courses	PCC-CE-308A	Waste - Water Treatment	3	0	0	3	3	40	60	–	100	3
5	Professional Elective Course Courses	Refer Table 3	Professional Elective-III	3	0	0	3	3	40	60	–	100	3
6	Open Elective Course	Refer Table 4	Open Elective-I	3	0	0	3	3	40	60	–	100	3
7	Professional Core Courses / (Lab Course)	LC-CE-310A	Foundation Engineering lab	0	0	2	2	1	25	–	25	50	-
8	Professional Core Courses / (Lab Course)	LC-CE-312A	Highway Engineering - II Lab	0	0	2	2	1	25	–	25	50	-
9	Professional Core Courses / (Lab Course)	LC-CE-314A	Environmental Engineering Lab	0	0	2	2	1	25	–	25	50	-
10	Professional Core Courses / (Lab Course)	LC-CE-316A	Structural Analysis and Design Lab	1	0	2	3	1	25	–	25	50	-
Total Credits								22				800	

Note-1: At the end of the 6th Semester, each student shall undergo 4–6 weeks of Industrial/Practical Training in a Civil Engineering organization and submit a training report along with a training certificate from the organization. The evaluation shall be carried out in the 7th Semester.

Note-2: Students must choose one course from the Professional Elective–III category (Table 3) and one course from the Open Elective–I category (Table 4). They may also opt for Massive Open Online Courses (MOOCs) offered through the SWAYAM, SWAYAM Plus, or NPTEL platforms, subject to the approval of the concerned Chairperson, Board of Studies/Head of the Department.

Table 3 Professional Elective – III

S. No	Course Code	Course Name
1	PEC-CE-318A	Advanced Steel Structures
2	PEC-CE-320A	Pre-Stressed Concrete
3	PEC-CE-322A	Contracts Management
4	PEC-CE-324A	Hydro-Power Engineering
5	-----	MOOCs offered through SWAYAM, SWAYAM Plus, or NPTEL platforms

Table 4 Open Elective Courses – I

Sr. No.	Code	Subject	Offered by	Departments Eligible to Choose the Course
1	OEC-01A	Engineering Ethics	Department of Electronics and Communication Engineering	All Engineering Departments
2	OEC-02A	Waste Management	Department of Civil Engineering	All Engineering Departments except the Department of Civil Engineering
3	OEC-03A	Internet of Things and Edge Computing	Department of Computer Science and Engineering	All Engineering Departments
4	OEC-04A	Project Management	Department of Mechanical Engineering	All Engineering Departments
5	OEC-05A	Renewable Energy Resources	Department of Electrical Engineering	All Engineering Departments
6	OEC-06A	United Nation's Sustainable Development Goals	Department of Electronics and Communication Engineering	All Engineering Departments
7	OEC-07A	Computer Aided Risk Analytics	Department of Fire Technology and Safety	All Engineering Departments
8	OEC-08A	Health, Safety and Environment	Department of Fire Technology and Safety	All Engineering Departments except the Department of Fire Technology and Safety
9	OEC-09A	Fundamentals of Additive Manufacturing	Department of Mechanical Engineering	All Engineering Departments except the Department of Mechanical Engineering
10	-----	MOOCs offered through SWAYAM, SWAYAM Plus, or NPTEL platforms	Online Platforms	All Engineering Departments

Course Code	PCC-CE-301A				
Category	Professional Core Course				
Course Title	Design of Steel Structures				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: • 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.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the properties of structural steel, limit state design concepts, and relevant provisions of Bureau of Indian Standards IS 800:2007.	Level 1: Remember
CO2	Explain the behavior and design requirements of bolted and welded connections, tension members, and compression members.	Level 2: Understand
CO3	Design beams, beam-columns, and basic steel structural members using codal provisions.	Level 3: Apply
CO4	Analyze and design advanced steel structures such as roof trusses, plate girders, and gantry girders.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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: Behavior 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 of 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.

Suggested Readings

- 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.

Useful Video Links

Unit No.	Topic	Link
I	Introduction to Structural Steel, Stress-Strain Curve, Properties of Steel	https://youtu.be/5h2V7Xx9mS4
	Riveted, Bolted and Welded Connections	https://youtu.be/X4kQ2zP8mLs
II	Design of Tension Members	https://youtu.be/K6nW8pQ2tXs
	Design of Compression Members and Buckling	https://youtu.be/L8vR3mQ6tWg
III	Design of Laterally Supported and Unsupported Beams	https://youtu.be/J6qV4nP8mRt
	Design of Slab Bases and Gusseted Bases	https://youtu.be/C7vN5mP4xLs
IV	Plastic Analysis and Design	https://youtube.com/playlist?list=PLwBjRwvqBNT3cEx6GL3lQ3dvGfoBaZzUY&si=THBKB-0U9nsaLEhN

Course Code	PCC-CE-303A				
Course Category	Professional Core Course				
Course Title	Hydrology and Water Resource Engineering				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: - To introduce the fundamental concepts of hydrology and hydrological processes involved in the water cycle. - To develop understanding of precipitation, infiltration, runoff, hydrograph analysis, and flood estimation techniques.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the basic concepts of hydrology.	Level 1: Remember
CO2	Explain hydrological parameters.	Level 2: Explain
CO3	Apply hydrological concepts.	Level 3: Apply
CO4	Analyze hydrological processes.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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 their Reduction, Evapotranspiration and its Measurement, Evapotranspiration Equations, Potential Evapotranspiration over India, Actual Evapotranspiration, Interception, Infiltration Process, Initial Loss, Infiltration Capacity, Factors Affecting Infiltration, Measurement of Infiltration. Module 4 : Runoff : Types of Runoff, Runoff Characteristics of Streams, Runoff Volume , Factors 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, 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. Module 6: Floods and their 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.

Suggested Readings

- 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.

Useful Video Links

Unit No.	Topic	Link
Unit I	Introduction to Hydrologic Cycle and Water Budget Equation	https://youtu.be/unvEFwDg9Fw?si=fW-rdYHcRiS0u2yy
	Precipitation Measurement and IDF Curves	https://youtu.be/hv1y8hVHpiU?si=d_hVL1Rggx7Zprfu
Unit II	Hydrological Abstractions: Evaporation, Infiltration and Evapotranspiration	https://youtu.be/y7Qv3lGr4B4?si=yXqbQNav43JSIEZu
	Runoff Estimation and SCS-CN Method	https://youtu.be/55U7OEWXG18?si=uNcYoFt6K8Xo_Dcy
Unit III	Hydrograph and Unit Hydrograph Analysis	https://youtu.be/B9hMtK-zKOA?si=RIF0wdsGLnucVmhs
	Flood Estimation and Frequency Analysis	https://youtu.be/9HFj8ZrAVeA?si=YBpruTEX4NK-mu2X
Unit IV	Water Resource Planning and System Analysis	https://youtu.be/vDr1PiNhYz8?si=cIErPcdeUuq_LB-h
	Reservoir Planning and Sedimentation Analysis	https://youtu.be/vDr1PiNhYz8?si=9gD82maY0jL5sBK3

Course Code	PCC-CE-305A				
Category	Professional Core Course				
Course Title	Soil Mechanics				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: • To introduce the fundamental engineering properties and classification of soils. • To develop understanding of compaction, permeability, seepage, and effective stress concepts in soils. • To analyze stress distribution, consolidation, and settlement behavior of soil masses. • To study shear strength characteristics and laboratory testing methods for geotechnical analysis and design.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the basic concepts of soil mechanics.	Level 1: Remember
CO2	Explain the engineering properties of soils.	Level 2: Understand
CO3	Apply soil mechanics principles to engineering problems.	Level 3: Apply
CO4	Analyze the behavior of soils under different conditions.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Basic Soil Properties: Introduction to Soil Mechanics; Origin and Formation of Soils; Residual and Transported Soils; Soil Profile; Soil Structure; Types of Soils; Three-Phase System; Index Properties; Weight–Volume Relationships; Grain Size Analysis (Sieve and Hydrometer Analysis); Grain Size Distribution Curve. Module 2: Soil Classification & Clay Mineralogy: Index Properties; Atterberg Limits; Clay Mineralogy (Kaolinite, Illite and Montmorillonite); Activity of Clay; Soil Classification Systems (USCS, ISSCS and AASHTO); Plasticity Chart; Engineering Properties of Fine-Grained Soils.
Unit-II	Module 3: Fundamentals of Compaction: Compaction Principles; Compaction and Consolidation; Standard and Modified Proctor Tests; Compaction Characteristics (OMC and MDD); Zero Air Voids Line; Factors Affecting Compaction; Field Compaction; Field Density Tests (Sand Replacement and Core Cutter Methods); Relative Compaction and Quality Control. Module 4: Permeability & Seepage: Permeability of Soils; Darcy's Law; Laboratory Determination of Permeability (Constant Head and Falling Head Tests); Equivalent Permeability of Layered Soils; Seepage Analysis; Flow Nets; Seepage Velocity and Discharge Velocity; Hydraulic Gradient; Seepage Pressure; Quick Sand Condition; Piping; Capillarity.

Unit-III	Module 5: Effective Stress in Soil Mass: Total, Neutral and Effective Stress; Terzaghi's Effective Stress Principle; Effective Stress under Submerged, Seepage and Capillary Conditions; Critical Hydraulic Gradient; Seepage Force; Sensitivity of Soils. Module 6: Stress Distribution in Soil: Boussinesq and Westergaard Theories; Stress Distribution due to Point, Line, Strip and Circular Loads; Pressure Bulbs; Isobars; Newmark's Influence Chart; Contact Pressure under Rigid and Flexible Footings.
Unit-IV	Module 7: Consolidation of Soil: Consolidation Theory; Compression and Swelling Indices; Terzaghi's One-Dimensional Consolidation Theory; Consolidation Parameters; Oedometer Test; Normally Consolidated and Over-Consolidated Soils; Over-Consolidation Ratio (OCR); Preconsolidation Pressure; Settlement Analysis (Immediate, Primary and Secondary Settlement). Module 8 :Shear Strength of Soil: Shear Strength Theory; Mohr-Coulomb Failure Criterion; Mohr Circle; Shear Strength Parameters; Stress–Strain Behaviour of Soils; Direct Shear, Triaxial, Unconfined Compression and Vane Shear Tests; Drained and Undrained Shear Strength; Stress Path (Introduction).

Suggested Readings

- Bolton, M. D., A guide to soil mechanics (2nd ed.). Macmillan Education.
- Lambe, T. W., & Whitman, R. V., Soil mechanics. Wiley.
- Coduto, D. P. (2001). Foundation design: Principles and practices (2nd ed.). Prentice Hall.
- Venkatramaiah, C. (2006). Geotechnical engineering (3rd ed.). New Age International Publishers.
- Arora, K. R. (2019). Soil mechanics and foundation engineering (8th ed.). Standard Publishers Distributors.
- Garg, S. K. (2018). Soil mechanics and foundation engineering (9th ed.). Khanna Publishers.
- Mitchell, J. K., & Soga, K. (2005). Fundamentals of soil behavior (3rd ed.). Wiley.
- Schofield, A. N., & Wroth, C. P., Critical state soil mechanics. McGraw-Hill.
- Das, B. M. (2016). Principles of foundation engineering (8th ed.). Cengage Learning

Useful Video Links

Unit No.	Topic	Link
Unit-I	Basic Soil Properties	https://youtu.be/afirGWlleSM?si=T7PcZ76V3tCSeJIB
	Soil Classification & Clay Mineralogy	https://www.youtube.com/live/u2KhP8DuMJI?si=LiiGg-XiprgAg78n
Unit-II	Fundamentals of Compaction	https://youtu.be/A7eiLKx3mc?si=23Lnj_aFDkzUHLzj
	Permeability & Seepage	https://youtu.be/TYBhuXspwpE?si=bWmiyo_9OOnoahVA
Unit-III	Effective Stress in Soil Mass	https://www.youtube.com/live/m5wWNxi1Y2g?si=iolh94FHHAm66OE1
	Stress Distribution in Soil	https://www.youtube.com/live/14gPn0upVH0?si=tKcF-PX3UhtCwgtJ
Unit-IV	Consolidation of Soil	https://www.youtube.com/live/l0Kac4zuhOg?si=9jF7hWqUx9yN0Gvp
	Shear Strength of Soil	https://www.youtube.com/live/K-6Gs5hlFyg?si=uvNGPJhgM7QgUKbh

Course Code	PCC-CE-307A				
Category	Professional Core Course				
Course Title	Highway Engineering - I				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: • To understand fundamentals of highway engineering, planning, design and materials. • To apply design principles and traffic studies for safe roads. • To evaluate modern techniques like traffic control and ITS.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basics of highways, materials and traffic engineering.	Level 1: Remember
CO2	Explain planning, alignment and geometric design.	Level 2: Understand
CO3	Apply design principles and traffic/material testing methods.	Level 3: Apply
CO4	Analyze traffic, safety and material performance.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	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 – I : 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 – II : 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.

Suggested Readings

- Khanna, S.K. and Justo, C.E.G., Highway Engineering, Nem Chand & Bros.
- Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers.
- Partha Chakraborty and Animesh Das, Principles of Transportation Engineering, PHI Learning.
- Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall.
- Sharma, S.K., Principles, Practice and Design of Highway Engineering, S. Chand Publications.
- IRC Codes and Specifications, Indian Roads Congress.
- Relevant publications of Ministry of Road Transport and Highways

Useful Video Links

Unit No.	Topic	Link
Unit-I	Introduction to Highway Engineering and Road Development in India	https://www.youtube.com/live/JZQSidZQRj8?si=KW5cH30rbL15TS05
	Highway Planning and Alignment Surveys	https://youtu.be/Co4ZKhY2E1Q?si=vo-RSLV3nWMXaGg5
Unit-II	Highway Cross-Section Elements	https://youtu.be/ynae0uz2qYs?si=TNeK1XWtI37YdqxW
	Horizontal Curve Design, Super Elevation and Extra Widening	https://youtu.be/tIkBEky7WsY?si=2ztxA7HWIEVx6KVx
Unit-III	Soil and Aggregate Testing for Highway Materials	https://youtu.be/959mcz2nX9k?si=jTwaAZP5NOB1RLLo
	Bituminous Materials and Testing Methods	https://youtu.be/8DkY55EKKR4?si=exnkVheYx0zkDFpL
Unit-IV	Traffic Engineering Studies and PCU Analysis	https://youtu.be/dc1ndNtjwP8?si=vqcqFWUVRgqmcYGe
	Intelligent Transportation Systems (ITS)	https://youtu.be/OnjX0O9dPMc?si=f_lkt4Yx0o0fHZJ

Course Code	PCC-CE-309A				
Course Category	Professional Core Course				
Course Title	Water Supply and Treatment				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: • 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.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the concepts of water demand estimation, source selection, water quality characteristics, and standards for water supply systems.	Level 1: Remember
CO2	Explain water treatment processes, advanced treatment methods, and the operational principles of various treatment units.	Level 2: Understand
CO3	Apply principles of water conveyance, pumping, and distribution system design for efficient water supply management.	Level 3: Apply
CO4	Analyze water pollution issues and evaluate suitable treatment, distribution, and control measures for sustainable water supply systems.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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.

Suggested Readings

- 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.

Useful Video Links

Unit No.	Topic	Link
I	Water Supply System	https://youtu.be/zu6UfycMkw4?si=FyRtdTBkghPbVY9b
	Sources of Impurities	https://youtu.be/bu609FNz6VI?si=kYw9VzMCIHegUBzS
II	Water Treatment	https://youtu.be/jvQn9lMI79M?si=uVsstS95bLUQrWfK
	Advanced Water Treatment	https://youtu.be/4-SRMmqH2s4?si=GnmECJao0hpO8Wep
III	Water Conveyance System	https://youtu.be/zu6UfycMkw4?si=r11ZWAXwhwHEZnBP
	Pumps and Pumping Stations	https://youtu.be/u9cbqLCylf4?si=us_1A2dIKq9eECAr
IV	Water Distribution System	https://youtu.be/zVZ9c6EXfTA?si=s5ZnBOBW_TaEjKKo
	Sources of Water Pollution	https://youtu.be/t1xu2A8ItNE?si=ue-YjkfbZC7o1tmF

Course Code	LC-CE-311A				
Category	Lab Course				
Course Title	Computer-Aided Civil Engineering Drafting Lab (CAD Lab)				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are: • To familiarize students with AutoCAD and drafting standards used in civil engineering. • To develop skills in preparing 2D and 3D architectural drawings. • To impart knowledge of structural detailing of steel members and foundations. • To enable students to prepare professional engineering drawings using CAD tools.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall AutoCAD commands and drafting standards.	Level 1: Remember
CO2	Interpret engineering drawings and drafting conventions.	Level 2: Understand
CO3	Apply AutoCAD tools to prepare architectural drawings.	Level 3: Apply
CO4	Analyze and develop detailed structural and civil engineering drawings.	Level 4: Analyze

List of Experiments

- Study and application of basic AutoCAD commands, layers, dimensioning, hatching, blocks, and plotting techniques.
- Preparation of 2D architectural drawings of a residential building including plan, elevation, and section.
- Preparation of detailed working drawings of a residential building including doors, windows, and staircase details.
- Preparation of 3D architectural models and rendered views of a residential building.
- Preparation of detailed drawings of bolted and welded steel connections.
- Preparation of detailed drawings of beam-to-column connections and column base connections (slab base and gusseted base).
- Preparation of detailed drawings of laced and battened columns and built-up steel beams.
- Preparation of detailed drawings of grillage foundations and other steel foundation systems.
- Preparation of detailed drawings of plate girders and gantry girders.
- Preparation of circular and rectangular water tank drawings
- Preparation of detailed drawings of roof trusses and industrial steel roof systems.

Useful Video Links

Exp. No	Topic	Link
1	Study of AutoCAD commands, layers, dimensioning, hatching, blocks, and plotting	AutoCAD Basic Tutorial for Beginners
2	Preparation of 2D architectural drawings of a residential building	2D Building Plan in AutoCAD

3	Preparation of detailed working drawings of a residential building	House Plan Drawing in AutoCAD
4	Preparation of 3D architectural models and rendered views	AutoCAD 3D Modeling Tutorial
5	Preparation of detailed drawings of bolted and welded steel connections	Steel Connection Detailing in AutoCAD
6	Preparation of beam-to-column and column base connections	Beam Column Connection AutoCAD Tutorial
7	Preparation of laced and battened columns and built-up steel beams	Steel Structure Detailing in AutoCAD
8	Preparation of grillage foundation drawings	Grillage Foundation Drawing in AutoCAD
9	Preparation of plate girder and gantry girder drawings	Plate Girder Detailing in AutoCAD
10	Preparation of circular and rectangular water tank drawings	Water Tank Drawing in AutoCAD
11	Preparation of roof truss and industrial roof system drawings	Roof Truss Drawing in AutoCAD

Course Code	LC-CE-313A				
Category	Lab Course				
Course Title	Soil Mechanics Lab				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are: • To develop the ability to identify and classify soils, • To understand and perform standard laboratory and field tests, • To apply effective application of geotechnical principles in engineering practice. • To analyze key soil properties such as moisture content, density, permeability, compaction, and shear strength,				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basic soil properties, definitions, and standard test procedures.	Level 1: Remember
CO2	Understand principles of soil tests like sieve analysis, Atterberg limits, compaction, permeability, and shear strength.	Level 2: Understand
CO3	Conduct soil tests to determine index properties, density, compaction, and strength parameters.	Level 3: Apply
CO4	Analyze results to classify soil and evaluate its engineering behavior and suitability.	Level 4: Analyze

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.

Useful Video Links

Exp. No	Topic	Link
1	Moisture content (water content) of a given soil sample.	https://youtu.be/N2J-tvEel4c?si=HPmyFt2nGdz5ZWrn
2	Sand replacement method	https://youtu.be/YejCi5SEOAU?si=c2whwbxWVkt67wZ
3	Maximum dry density of soil by Standard Proctor Test.	https://youtu.be/c4i_y6utsE?si=XQMzJcCMbRInI7NF
4	Direct shear test.	https://youtu.be/bmpn5oNDvOs?si=JaBs4NQWphAlzx_W

Course code	LC-CE-315A				
Category	Lab Course				
Course title	Highway Engineering-I Lab				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are: - 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				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to:

COs	Skills Demonstrated	RBT Level
CO1	Recall standard laboratory procedures and testing methods for aggregates, soils, and pavement materials.	Level 1: Remember
CO2	Explain engineering properties of aggregates and pavement materials based on experimental observations.	Level 2: Understand
CO3	Perform laboratory and field tests to evaluate strength, durability, and performance characteristics of transportation materials.	Level 3: Apply
CO4	Analyze test results and assess the suitability of construction materials and traffic parameters for pavement and highway engineering applications.	Level 4: Analyze

List of Experiments

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

Useful Video links:

Virtual Lab : <https://ts-nitk.vlabs.ac.in/List%20of%20experiments.html>

Exp. No	Topics	Links
1	To determine the flakiness index and elongation index of aggregates.	https://youtu.be/Rx9Fvvxepmw?si=f-GsxdNwhwpuYYRz

2	To determine the California Bearing Ratio (CBR) value of soil and aggregate.	https://youtu.be/fCmMW73rP64?si=8-3Vn_FlkLpEWO-g
3	To determine the impact value of aggregate and composite material.	https://youtu.be/Mn7aeorMpTs?si=HYMOilC2QMRYb7i
4	To determine the crushing strength of aggregate and composite material.	https://youtu.be/1E7LFOuGKyI?si=EFz0BMZL0Aj6K3Oz
5	To determine the abrasion and attrition value of aggregate by using Los Angeles abrasion test	https://youtu.be/k6wXH50Kwkw?si=nQ-Vfy_awfjTO5Y6
6	To determine the water absorption of aggregate.	https://youtu.be/hqXFPq676iM?si=SkcZEamwpa0FCORy
7	To find out the durability of aggregate.	https://youtu.be/4OY03u4B4t4?si=nhLRN7cEjss9H-mx

Course Code	PROJ-CE-327A				
Category	Project				
Course Title	Survey Camp				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are: • 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.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the principles, methods, and instruments used in field surveying practices.	Level 1: Remember
CO2	Explain the procedures involved in leveling, triangulation, contouring, and plane table surveying.	Level 2: Understand
CO3	Apply surveying techniques using appropriate instruments to collect field data and locate control points accurately.	Level 3: Apply
CO4	Analyze field observations and prepare topographic maps representing physical features of the surveyed area.	Level 4: Analyze

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 Code	PEC-CE-317A				
Category	Professional Elective courses				
Course Title	Advanced Structural Analysis				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	1	0	4	
Course Objectives	The objectives of this course are: • To develop understanding of advanced structural analysis methods for indeterminate structures. • To introduce matrix methods for analysis of trusses, frames, and curved structures. • To study flexibility and stiffness approaches for structural system analysis. • To develop analytical and computational skills for solving practical structural engineering problems.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the theoretical concepts of arches, matrix methods, structural indeterminacy, and energy principles.	Level 1: Remember
CO2	Explain stiffness and flexibility methods for analysis of framed structures under various loading conditions.	Level 2: Understand
CO3	Apply matrix methods to analyze arches, plane trusses, frames, partially discontinuous structures, and curved beams.	Level 3: Apply
CO4	Analyze complex structural systems using computational techniques and interpret results for engineering applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Fundamentals of Matrix Structural Analysis: Structural idealization, coordinate systems, degrees of freedom, static and kinematic indeterminacy, generalized forces and displacements, flexibility and stiffness concepts, strain energy principles, force-displacement relationships.. Module 2: Matrix Stiffness method: Development of element stiffness matrices by physical approach, stiffness matrices for truss, beam and frame elements, displacement transformation matrix, equivalent joint loads, assembly of global stiffness matrix, analysis of plane trusses and plane frames..
Unit-II	Module 3: Matrix Flexibility method: Development of flexibility matrices, flexibility matrices for truss and frame elements, force transformation matrix, assembly of global flexibility matrix, analysis of statically indeterminate trusses and frames.

	Module: Advanced Matrix Analysis: Analysis of structures subjected to nodal loads and member loads, temperature effects, lack of fit, support settlement, comparison of flexibility and stiffness methods.
Unit-III	Module 5: Advanced Analysis of Arches: Analysis of two-hinged and fixed arches, elastic centre, effects of rib shortening, temperature variation and yielding of supports, tied arches, influence lines for two-hinged arches. Module 6: Curved Beams: Analysis of beams curved in plan, stress resultants in curved members, radial bending moments, torsional effects, semicircular beams subjected to concentrated loads and uniformly distributed loads.
Unit-IV	Module 7: Advanced Structural Systems: Partially restrained and partially discontinuous members, development of stiffness matrices for partially discontinuous members, substructure technique, structural condensation, effects of axial force on flexural stiffness. Module 8: Applications of Matrix Methods: Application of matrix stiffness and flexibility methods to complex trusses and frames, interpretation of structural response, comparison of classical and matrix methods of structural analysis.

Suggested Readings

1. Matrix Analysis of Structures, Gere & Weaver, CBS Publishers and Distributors, Delhi 110032.
2. Structural analysis, T.S. Thandavamoorthy, Oxford University Press.
3. Concepts and applications of finite element analysis Robert D. Cook, Wiley India Pvt. Ltd.
4. Advanced Structural Analysis, Ashok K. Jain, Nem Chand and Bros., Roorkee. H. C. Martin,
5. Introduction to Matrix Methods of Structural Analysis. McGraw Hill. Amin Ghali, Adam Neville, Tom G. Brown
6. Structural Analysis: A Unified Classical and Matrix Approach, CRC Press

Useful Video Links

Unit No.	Topic	Link
Unit-I	Arches	https://www.youtube.com/live/Z1p2PYAlaVw?si=ab89RA6qP_cUhZi7
	Stiffness method	https://youtu.be/2-7G35K_KD8?si=yZvPKRLqfB2hFBkm
Unit-II	Basic Principles of Matrix Method	https://youtu.be/58DrizBBo7s?si=zOHhvSEKVeON4pup
	Flexibility method	https://youtu.be/dlCHBu2aODQ?si=baHq0N6C8ObFgowI
Unit-III	Partially Discontinuities Structures	https://youtu.be/zNoBjMcsQck?si=2PY12ISVTJKvM7tp
	Method of Sub-structure Analysis and stresses:	https://www.youtube.com/live/goEfXwQLmqI?si=U8K2mVfoqhsRwgRI
Unit-IV	Beam of Curved in Plan	https://youtu.be/JDkb5sfU4rk?si=YB8QdNaBza3P-jcP
	Computer Programs for Matrix Structural Analysis	https://youtu.be/XZ5FMKUnrpI?si=eeC1Q3z4rNPHbLNH

Course Code	PEC-CE-319A				
Course Category	Professional Elective Course				
Course Title	Air and Noise Pollution				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: • 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.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the fundamentals of air and noise pollution, atmospheric composition, pollutant sources, standards, and environmental regulations.	Level 1: Remember
CO2	Explain pollutant dispersion mechanisms, air quality assessment methods, and the environmental impacts of air and noise pollution.	Level 2: Understand
CO3	Apply air quality monitoring techniques, dispersion models, and pollution control technologies for environmental management.	Level 3: Apply
CO4	Analyze air and noise pollution problems and evaluate suitable control measures for sustainable environmental protection.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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, it's 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.

Suggested Readings

- 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

Useful Video Links

Unit No.	Topic	Link
I	Air Pollution	https://youtu.be/5dukz1UOtKA?si=BDfmh2fxkAJ8v35Z
	Sources, Classification and Effects	https://youtu.be/0pkcaLyNuCE?si=dZ3KAWWGOHPnqH5j
II	Pollutant Dispersion	https://youtu.be/2adBRvVp8VA?si=ujYCUIBMdwW0Ccfr
	Air Quality	https://youtu.be/YrI8r_xOzpY?si=S0BsFMt4gXM0q2oL
III	Impacts of Air Pollution	https://youtu.be/4AuwG2G_ERU?si=RLgQ6LrC1o3uySSp
	Air Pollution Control	https://youtu.be/qPEDRZoVr1Y?si=qHrg2BAlgwgMpwbe
IV	Noise Pollution	https://www.youtube.com/live/9qWB1sMnfLE?si=teyLqrjwTXuwZ9FQ
	Control Methods	https://youtu.be/DLJhIJjJHus?si=fz9STbqN027Y9GDB

Course Code	PEC-CE-321A				
Course Category	Professional Elective Course				
Course Title	Formwork Engineering and Design				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: • To introduce the fundamentals, materials, and functional requirements of formwork systems in construction. • To develop understanding of design principles for various formwork components under different loading conditions. • To study conventional, modular, and advanced formwork systems used in modern construction practices. • To develop practical knowledge of formwork erection, dismantling, safety, quality control, and special applications.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the basic concepts, materials, requirements, and classification of formwork systems.	Level 1: Remember
CO2	Explain the design principles, loading conditions, and construction procedures of various formwork systems.	Level 2: Understand
CO3	Apply formwork design principles for beams, slabs, columns, walls, and other structural components.	Level 3: Apply
CO4	Analyze modern formwork systems, safety requirements, and advanced applications for complex construction projects.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Basics and Requirements: Formwork engineering, definition of formwork, objectives of formwork, requirements of good formwork, functions of formwork, classification of formwork systems. Module 2: Materials for Formwork: Timber formwork, plywood formwork, steel formwork, aluminium formwork, plastic formwork, composite formwork systems, properties of formwork materials, selection criteria of formwork materials.
Unit-II	Module 3: Design Principles: Loads on formwork, vertical loads, lateral loads, pressure of fresh concrete, factors affecting formwork pressure, design of formwork components, safety considerations in design.

	Module 4: Design of Elements: Design of beam formwork, slab formwork, column formwork, wall formwork, footing formwork, design of formwork supports, bracing and ties.
Unit-III	Module 5: Conventional and Modern Systems: Conventional formwork systems, modular formwork, table formwork, tunnel formwork, slip formwork, jump formwork, climbing formwork. Module 6: Erection and Dismantling: Erection of formwork, alignment and levelling, inspection of formwork, stripping of formwork, de-shuttering time, reuse of formwork, maintenance of formwork.
Unit-IV	Module 7: Safety and Quality Control: Safety in formwork construction, quality control measures, common formwork failures, prevention of failures, inspection and monitoring. Module 8: Advanced and Special Formwork Applications: Formwork for high rise structures, formwork for bridges, formwork for tunnels, formwork for curved and shell structures, use of mechanized and automated formwork systems.

Suggested Readings

- Peurifoy, R.L. and Oberlender, G.D., Formwork for Concrete Structures, McGraw Hill.
- Hurd, M.K., Formwork for Concrete, American Concrete Institute.
- Kumar Neeraj Jha, Construction Project Management, Pearson Education.
- Punmia, B.C., Building Construction, Laxmi Publications.
- Chudley, Roy, Construction Technology, Pearson Education.
- Relevant standards of Bureau of Indian Standards and American Concrete Institute.

Useful Video Links

Unit No.	Topic	Link
I	Basics and Requirements of Formwork	https://youtu.be/t2q8jzkHK8E?si=NPq0kPVu5BSaj-MF
	Formwork Materials and Selection Criteria	https://youtu.be/6HkflfpGSrs?si=q1dIOKCf9E9hRXBk
II	Loads on Formwork and Design Principles	https://youtu.be/xSCYsb_d3Ao?si=gNsos3lEE9yMCE33
	Design of Beam, Slab and Column Formwork	https://youtu.be/blRjnui_dE8?si=fzWrm6Dw-vysPNbV
III	Modular, Tunnel and Slip Formwork Systems	https://youtu.be/bA3OsOsrRgc?si=EsUQRC8bB5xsyxOW
	Erection and Dismantling of Formwork	https://youtu.be/Avt7Ydmfo8M?si=ref3s4Ecjo9SvVnX
IV	Formwork Safety and Quality Control	https://youtu.be/AVLM5UnaCy0?si=qgfEJlzmCTIk8OZX
	Formwork for High-rise and Bridge Construction	https://youtu.be/geRS0SJMBKs?si=2hHP7nn-tGtwqIxu

Course Code	PEC-CE-323A					
Course Category	Professional Elective Course					
Course Title	Traffic Engineering					
Scheme and Credits	L	T	P	Credits	Semester-V	
	3	0	0	3		
Course Objectives	The objectives of this course are: • To understand traffic characteristics, traffic studies and traffic control for efficient road transportation. • To develop knowledge of road safety, capacity analysis and environmental aspects of traffic engineering.					
Assessment	40 Marks					
End Semester Examination	60 Marks					
Total	100 Marks					
Duration of Exam	03 Hours					

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define traffic characteristics, road user and vehicular characteristics.	Level 1: Remember
CO2	Explain traffic studies and effects on road design elements.	Level 2: Understand
CO3	Apply methods of traffic surveys (volume, speed, O-D, delay).	Level 3: Apply
CO4	Analyze traffic flow, capacity, level of service and safety aspects.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Traffic Characteristics: Importance of traffic characteristics. Road user characteristics. Vehicular characteristics. Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road. Traffic Studies: volume study, speed study and origin and destination study. Speed and delay study. Use of photographic techniques in traffic surveys.
Unit-II	Traffic Accidents: Accident surveys. Causes of road accidents and preventive measures, Capacity and Level of Service: Fundamental diagram of traffic flow. Relationship between speed, volume and density, Level of service, PCU, Design service volume, Capacity of non-urban roads. IRC recommendations, Brief review of capacity of urban roads.
Unit-III	Traffic Control Devices: Signs, Signals, markings and islands. Types of signs, Types of signals, Design of Signal, Intersections at grade and grade separated intersections. Types of grades separated intersections, Parking surveys: On street parking, off street parking.
Unit-IV	Road safety audit: RSA team, RSA Report, Elements of RSA, and Detrimental effects of traffic. Vehicular air pollution and Situation in India, Motor vehicle act, Vehicular emission norms in India and abroad. Alternate fuels. Factors affecting fuel consumption.

Suggested Readings

- Principles of Transportation Engineering by Chakraborty & Das, Prentice Hall, India.
- Highway Eng. by S.K. Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.
- Traffic Eng. and Transport Planning by L.R. Kadiyali, Khanna Publishers, Delhi.
- Principles of Transportation and Highway Engineering by G.V. Rao, Tata McGraw
- Hill Publishing Co. Ltd. N. Delhi.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Traffic Characteristics	https://www.youtube.com/watch?v=3XaTwQIugJ4
	Traffic Studies	https://youtu.be/0yzgMc1l0po?si=A3PZFpRSkvgcewNd
Unit-II	Traffic Accidents	https://youtu.be/VhuZ6M7a8N8?si=xRE5Z3HH408GvAmK
	Relationship between speed, volume and density	https://youtu.be/MOxya1UVxgc?si=MFCiHslh7lzyo6E6
Unit-III	Traffic Control Devices	https://youtu.be/eiKvXlpRVq8?si=L3SJM2YSXONsrhiz
	Design of Signal	https://youtu.be/-cqxQepo01o?si=9dP_TvQItknLXZu8
Unit-IV	Road safety audit	https://youtu.be/qRJ_ayWjn04?si=HhQTtflUfrvDEWJV
	Motor vehicle act	https://www.youtube.com/live/C2AD3wFAuy0?si=4iy77sZeLzeAVvkf

Course Code	PEC-CE-325A				
Category	Professional Elective Course				
Course Title	Engineering Geology				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are: - To provide fundamental knowledge of geology, minerals, rocks, and geological processes relevant to civil engineering. - To develop skills for map interpretation, rock analysis, and evaluation of geological conditions in engineering projects and hazards.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basic concepts of geology, minerals, rocks, and earth structure.	Level 1: Remember
CO2	Understand geological processes like weathering, erosion, petrology, and structural geology.	Level 2: Understand
CO3	Apply geological knowledge to map interpretation, identification of minerals/rocks, and engineering evaluation of rock properties.	Level 3: Apply
CO4	Analyze geological conditions in civil engineering projects (dams, slopes, earthquakes) and assess hazards with suitable measures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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.

Suggested Readings

- 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

Useful Video Links

Unit No.	Topic	Link
Unit-I	Scope, Subdivision of Geology	https://youtu.be/ksJpBG0R5pM?si=5cOmhlDq6Xb0awyf
	Weathering, Erosion and Denudation of the Surface of the Earth	https://youtu.be/GCiSOGweitU?si=ic3lArR5MbmJW8k3
Unit-II	Origin and Composition of Minerals	https://youtu.be/kVopWFgOcrU?si=f3pJdh4aNfhq2-DZ
	Sedimentary Petrology	https://www.youtube.com/live/ezqUycfNlzE?si=obAP9KAHLAakI1Rz
Unit-III	Dip and Strike, Bedding Planes and Outcrops	https://youtu.be/WdBtwf3vl_0?si=y3aNj_0tu0CX2MBD
	Sub Surface Investigations of Rocks	https://youtu.be/ZLmqtF2FtkU?si=fs6mlkfDoktkC3cO
Unit-IV	Dam and Reservoir Site	https://youtu.be/bDwow2-WzHo?si=drnCdqXbKE1C8YEU
	Earthquake: Magnitude and Intensity of Earthquake	https://youtu.be/mWXpUo-KOw?si=LPPrSZANDX9MDRCx

Course Code	PCC-CE-302A				
Course Category	Professional Core Course				
Course Title	Irrigation Engineering And Design				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	1	0	4	
Course Objectives	The objectives of this course are: • To develop a comprehensive understanding of irrigation systems, crop water requirements, canal regulation works, cross drainage works, spillways, weirs, river training works, flood routing, dams, water logging and drainage, and • To apply, analyze, evaluate and integrate their design principles, hydraulic behaviour and functional performance for efficient and sustainable water resources and irrigation engineering solutions.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall fundamental concepts of irrigation, water resources, and related structures.	Level 1: Remember
CO2	Explain crop water requirements, irrigation methods, and soil-water relationships.	Level 2: Understand
CO3	Apply principles of canal works, cross drainage works, and dam engineering in practical situations.	Level 3: Apply
CO4	Analyze the design and performance of spillways, river training works, and flood management systems.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Introduction to Irrigation: Scope and Necessity of Irrigation, Water Resources and Irrigation Potential in India, Development of Irrigation, Irrigation Systems and their Classification, Benefits and Impacts of Irrigation, National Water Policy. Module 2: Water Requirement of Crops & Methods of Irrigation: Crop Seasons; Soil–Water–Plant Relationship; Field Capacity; Wilting Point; Consumptive Use; Evapotranspiration; Duty, Delta and Base Period; Irrigation Efficiencies; Frequency and Scheduling of Irrigation; Methods of Irrigation (Surface, Sprinkler and Drip Irrigation).
Unit-II	Module 3: Canal Regulation Works: Canal Alignment; Canal Losses, Canal fall – necessity and location, types of canal falls, Sarda type fall and its design, sloping glacis fall, cross regulator, distributory head regulator, silt control devices, canal escapes and their types, operation and maintenance of canals. Module 4: Canal Outlets and Cross Drainage Works: Requirements and Classification of Canal Outlets; Pipe Outlet; Adjustable Proportional Module (APM); Open Flume Outlet;

	Flexibility, Sensitivity and Proportionality of Outlets; Need and Classification of Cross Drainage Works; Aqueduct; Syphon Aqueduct; Super Passage; Canal Syphon; Level Crossing; Hydraulic Design Principles.
Unit-III	Module 5: Spillways and Hydraulic Structures: Need and types of spillways, design of ogee spillway, energy dissipaters and stilling basins. Need of weirs and barrages, components of weirs, Bligh's creep theory, Khosla theory, critical exit gradient and design of weirs. Module 6: River Training Works and Flood Routing : River Behaviour; Objectives and Classification of River Training Works; Guide Banks; Spurs; Marginal Embankments; Bank Pitching; Launching Apron; Meandering Rivers; Flood Routing (Hydrologic and Hydraulic Routing); Flood Control Measures.
Unit-IV	Module 7: Gravity Dams: Planning and Investigation of Dam Sites; Classification and Selection of Dams; Gravity Dams; Forces Acting on Gravity Dams; Stability Analysis; Modes of Failure; Elementary Profile of Gravity Dam. Module 8: Earth Dams, Water Logging and Drainage: Earth Dams; Components; Types; Seepage through Earth Dams; Phreatic Line; Kozeny Parabola; Filters and Drains; Causes and Control of Seepage; Water Logging; Land Reclamation; Surface and Subsurface Drainage.

Suggested Readings

- Chawla, K. K. (2017). *Irrigation Engineering and Hydraulic Structures*. Standard Publishers Distributors, New Delhi.
- Punmia, B. C., Pande, B. B., & Jain, A. K. (2016). *Irrigation Engineering and Water Power Engineering*. Laxmi Publications, New Delhi.
- Asawa, G. L. (2014). *Irrigation and Water Resources Engineering*. New Age International Publishers.
- Garg, S. K. (2017). *Irrigation Engineering and Hydraulic Structures*. Khanna Publishers, New Delhi.
- Varshney, R. S., Gupta, S. C., & Gupta, R. L. (2015). *Theory and Design of Irrigation Structures*. Nem Chand & Bros.
- Arora, K. R. (2013). *Irrigation, Water Power and Water Resources Engineering*. Standard Publishers Distributors.
- Central Water Commission (CWC). (Latest Edition). *Manuals and Guidelines for Irrigation and Hydraulic Structures*. Government of India.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Introduction	https://youtu.be/ibzY0LjHu38
	Crop water requirement	https://youtu.be/e7pckUDQ9oI
Unit-II	Design of Sarda type Fall	https://youtu.be/REK--iUi_xE
	Canal Outlets	https://youtu.be/ps8HUDWU1fg
Unit-III	Design of aqueducts	https://youtu.be/iJzuYICZzTU
	Design of ogee spillway	https://youtu.be/QIJ6Rb8wz80
Unit-IV	Methods of River training	https://youtu.be/LmE-9TId6Wk
	Water logging	https://youtu.be/0i896NelJ3A

Course Code	PCC-CE-304A				
Course Category	Professional Core Course				
Course Title	Foundation Engineering - I				
Scheme and Credits	L	T	P	Credit	Semester VI
	3	0	0	3	
Course Objectives	The objectives of this course are: - To develop understanding of earth pressure theories and their application in retaining structures. - To study slope stability concepts and methods for analyzing slope failures. - To introduce the principles of shallow foundation design and bearing capacity analysis.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the concepts of lateral earth pressure, slope stability, bearing capacity, and soil exploration methods.	Level 1: Remember
CO2	Explain earth pressure theories, slope failure mechanisms, and shallow foundation behavior under various loading conditions.	Level 2: Understand
CO3	Apply bearing capacity theories and site investigation methods for the analysis and design of shallow foundations.	Level 3: Apply
CO4	Analyze slope stability, retaining structures, and foundation performance for geotechnical engineering applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Earth Pressure Theories: Lateral Earth Pressure, At-rest earth pressure, Active earth pressure, Passive earth pressure, Rankine's Theory, Cohesionless backfill, Cohesive backfill, Coulomb's Theory, Wall friction effects, Inclined backfill, Earth Pressure Diagrams, Retaining wall applications.
Unit-II	Stability of Slopes: Types of Slopes, Infinite slopes, Finite slopes, Slope Failure Mechanism, Rotational failure, Translational failure, Stability Analysis, Swedish circle method, Bishop's simplified method, Taylor's stability number, Factor of Safety, Stability charts.
Unit-III	Shallow Foundations: Types of shallow foundations, Bearing Capacity Theories, Terzaghi's bearing capacity theory, Meyerhof theory, Hansen theory, Vesic theory, Bearing Capacity Factors, Shape factors, Depth factors, Inclination factors, Effect of Water Table Corrections in bearing capacity, Settlement of Foundations, Settlement in clay Settlement in sand.
Unit-IV	Site Investigation & Soil Exploration: Subsurface Investigation, Objectives of exploration, Methods of Exploration, Open pits, Borings, Wash boring, Rotary drilling, Sampling Techniques,

	Disturbed samples, Undisturbed samples, In-situ Tests, Standard Penetration Test (SPT), Cone Penetration Test (CPT), Plate Load Test, Vane Shear Test, Geophysical Methods, Seismic refraction, Electrical resistivity.
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Suggested Readings

1. Das, B. M. (2015). Principles of geotechnical engineering (9th ed.). Cengage Learning.
2. Ranjan, G., & Rao, A. S. R. (2016). Basic and applied soil mechanics (3rd ed.). New Age International Publishers.
3. Punmia, B. C., Jain, A. K., & Jain, A. K. (2017). Soil mechanics and foundations (17th ed.). Laxmi Publications.
4. Budhu, M. (2015). Soil mechanics and foundations (3rd ed.). Wiley.
5. Terzaghi, K., Peck, R. B., & Mesri, G. (1996). Soil mechanics in engineering practice (3rd ed.). Wiley.
6. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (2011). An introduction to geotechnical engineering (2nd ed.). Pearson Education.

Useful Video Links

Unit No.	TOPIC	Link
Unit-I	Earth Pressure Theories	https://youtu.be/pH7Ly8KCR3E?si=WMWi6oZ_ZaqK6kAZ
Unit-II	Stability of Slopes	https://youtu.be/e8WUMP6Rt94?si=JtufcWJJtHM-G9Qv
Unit-III	Shallow Foundations	https://youtu.be/lsYFtwwlHIw?si=h0olF1s3zcuaZQYp
Unit-IV	Site Investigation & Soil Exploration Subsurface	https://youtu.be/P0j_pt4BLS0?si=FNGA2HcUua8OK_1N

Course Code	PCC-CE-306A				
Course Category	Professional Core Course				
Course Title	Highway Engineering - II				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are: • To understand the principles of design, construction, and performance of flexible and rigid pavements. • To apply standard methods (IRC, CBR, AASHTO) for pavement design, evaluation, and strengthening. • To analyze pavement failures, drainage, and economic aspects for efficient highway engineering.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basic concepts of pavement types, components and materials.	Level 1: Remember
CO2	Explain design principles of flexible and rigid pavements.	Level 2: Understand
CO3	Apply IRC/CBR and AASHTO methods for pavement design and construction.	Level 3: Apply
CO4	Analyze pavement performance, failures and evaluation methods.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: 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 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

Suggested Readings:

- Highway Engg by S.K.Khanna & C.E.G. Justo, Veeraragavan A., Nem Chand Bros., Roorkee, 2014.
- Principles and Practice of Highway Engg. By L.R.Kadiyali, N.B. Lal, Khanna Publishers, Delhi, 2008.
- 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. Bindra, Dhanpat Rai Delhi

Useful Video Links

Unit No.	Topic	Link
Unit I	Design of Flexible Pavements (CBR Method as per IRC)	https://youtu.be/9BL6rl6hPQ0?si=VNJW3MmXBSJa805z
	Design of Rigid Pavements (Westergaard Theory)	https://youtu.be/AJLAFAOcSIM?si=esuTiHkjKJu5F82I
Unit II	Construction of Bituminous Pavements	https://youtu.be/Ky-z2QRe_eU?si=0bHJvkpoApKKyxex
	Construction of Non-Bituminous Pavements	https://youtu.be/smPaOcM1Xc8?si=fP0tBBlduEnmWyMn
Unit III	Pavement Failures and Maintenance Techniques	https://youtu.be/kKmG5qMZcAc?si=SYmeDnClbZs00ruh
	Pavement Strengthening and Overlay Design	https://youtu.be/cQMwDnnwWzk?si=GY01u9Z0MhrK7DF2
Unit IV	Highway Drainage and Hill Roads	https://youtu.be/O2hHrg6DH8k?si=av7M5RBHhvZdj9aO
	Highway Economics and Finance	https://youtu.be/zAwa2_BTu_Q?si=WpiWvoZc4W53zdnv

Course Code	PCC-CE-308A				
Course Category	Professional Core Course				
Course Title	Waste Water Treatment				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are: • 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				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the fundamental concepts of sanitation, sewerage systems, wastewater characteristics, and design terminology.	Level 1: Remember
CO2	Explain the principles of sewer design, house drainage, wastewater treatment processes, and sludge treatment methods.	Level 2: Understand
CO3	Apply engineering principles for the design and analysis of sewerage systems and wastewater treatment units.	Level 3: Apply
CO4	Analyze wastewater treatment, sludge disposal, and reuse strategies for sustainable environmental sanitation and pollution control.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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.

Suggested Readings

- 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.

Useful Video Links

Unit No.	Topic	Link
I	Importance and Necessity of Sanitation	https://youtu.be/3J7n_2_6iCw?si=j_ulAsYT357zkugP
	Dry Weather Flow	https://youtu.be/CgHmPXrBeCM?si=nC32d4teYFsmz75X
II	House Drainage	https://youtu.be/oPKyZCbK1Pc?si=EVmOd5p2GLxTWnSb
	Wastewater Characteristics	https://youtu.be/wwSetkwdiMc?si=RF5VRbTD30Xk9Zrr
III	Primary Sewage Treatment	https://youtu.be/S2hF1AqelJg?si=Q0yplxvoNvskeVjg
	Concept of Organic Matter Removal	https://youtu.be/5qR5d1uQnd8?si=9NQihqYBACJXYGA0
IV	Objectives, Sludge Digestion	https://youtu.be/zXqnDzqJPSE?si=gHKIVz4VAPV-IQ2y
	Sewage Farming	https://youtu.be/JWtciKYJou4?si=5MTxbJjbVP8lmp8Q

Course Code	LC-CE-310A				
Category	Lab Course				
Course Title	Foundation Engineering lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives	The objectives of this course are: •To develop the ability to understand and apply soil testing methods. •To analyze laboratory and field data •To evaluate engineering properties of soils for geotechnical design and foundation assessment.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall basic concepts of soil properties and testing methods used in geotechnical engineering.	Level 1: Remember
CO2	Explain the principles of hydrometer analysis, relative density, shrinkage limit, triaxial, and consolidation tests.	Level 2: Understand
CO3	Perform laboratory and field tests to determine shear strength, consolidation, and bearing capacity parameters of soils.	Level 3: Apply
CO4	Analyze and interpret test results for assessing soil behavior and foundation suitability.	Level 4: Analyze

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.

Useful Video Links

Exp. No	Topic	Link
1	Grain Size Analysis using Hydrometer Method	https://youtu.be/zVmK5bvzbZ8?si=D_69eXdHnUA_OIqJ

2	Relative Density Test of Granular Soils	https://youtu.be/9uZgZxRCDYE?si=bsonTb3Gx056cyYh
3	Shrinkage Limit Test of Fine Grained Soil	https://youtu.be/t4FZ4J4pHUA?si=WZwDiFP_oRjub9vy
4	Triaxial Test (Consolidated Drained Condition)	https://youtu.be/uW-6acy5-fU?si=ITHR4SNriZCnXdB-
5	Triaxial Test (Consolidated Undrained Condition)	https://youtu.be/nwFxK2gPmik?si=quJcyr5RoQtuoz93
6	Consolidation Test using Consolidometer	https://youtu.be/DGEzIKBbz5M?si=07KxC_SFgwHYHHZ7
7	Standard Penetration Test (SPT)	https://youtu.be/duLjQsKfstM?si=4dytvA2api9vqFMR
8	Demonstration of Undisturbed Sampling	https://youtu.be/XiMOTe_YZaw?si=UKJP_C0DgdNBru3Y
9	Cone Penetration Test (CPT) Demonstration	https://youtu.be/ujDEhBroPo8?si=6VYBRhQB1WHulp3p
10	Model Plate Load Test	https://youtu.be/TXyuxcfJFS8?si=mjybyDUfWByylmjj

Course code	LC-CE-312A				
Category	Lab Course				
Course title	Highway Engineering-II Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives:	The objectives of this course are: - To understand the properties and behavior of bituminous materials used in pavements. - To perform standard laboratory tests and mix design procedures. - To evaluate and analyze pavement materials for suitability and performance.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to:

COs	Skills Demonstrated	RBT Level
CO1	Recall the testing procedures and standards related to bituminous materials, aggregate	Level 1: Remember
CO2	Explain the engineering properties of bituminous binders and pavement materials	Level 2: Understand
CO3	Perform laboratory tests for mix design and evaluation of bituminous and concrete pavement materials	Level 3: Apply
CO4	Analyze laboratory results to assess pavement material suitability and design performance for highway construction applications.	Level 4: Analyze

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.

Reference Books:

- 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.

Useful Video links:**Virtual Lab :** <https://ts-nitk.vlabs.ac.in/List%20of%20experiments.html>

Exp. No	Topics	Links
1	Flash and Fire Point Test of Bituminous Material	https://youtu.be/s5OnzI0B2vY?si=oB_wmCzv5TtmSIoS
2	Softening Point Test of Paving Bitumen	https://youtu.be/WkJuGGGmYhQ?si=qRcKYv0AsLG_vUzG
3	Specific Gravity Test of Bituminous Material	https://youtu.be/o1BgC0em2X0?si=6pNX5oq_oJnf1Bnf
4	Ductility Test of Bitumen	https://youtu.be/TE8zYxUJHt0?si=fMfKBxeuVmiC_b6v
5	Penetration/Hardness Test of Bitumen	https://youtu.be/9HZE6DNf5U?si=KnyI_oj10hJcnM7
6	Determination of Bitumen Binder Grade	https://youtu.be/CRopmpsDyBQ?si=oXlfwwFkpAX9ekdC
7	Viscosity Test of Bituminous Material	https://youtu.be/TE8zYxUJHt0?si=WivAlovjdr8cXUup
8	Granular Mix Design	https://youtu.be/BYxWW_3YnOA?si=nqICmctRc_qljmC
9	Marshall Mix Design Method	https://youtu.be/zMgLPRnwDAk?si=nO-CIzRvGeH5aNw7
10	Cement Concrete Mix Design for Pavements	https://youtu.be/VBrP_vm2YsA?si=XeXhpf-SpUZXoky
11	Demonstration of BBD and Bump Integrator	https://youtu.be/MAaSolK_qSU?si=ZaZNSGAJ0JnNhBYQ

Course code	LC-CE-314A				
Category	Lab Course				
Course title	Environmental Engineering Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives:	The objectives of this course are: •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				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to:

COs	Skills Demonstrated	RBT Level
CO1	Recall standard laboratory procedures and water quality parameters.	Level 1: Remember
CO2	Explain the significance of physical, chemical, and biological characteristics of water and wastewater.	Level 2: Understand
CO3	Perform laboratory tests for assessment of water and wastewater quality using standard methods.	Level 3: Apply
CO4	Analyze experimental results to evaluate water quality and recommend suitable treatment measures for environmental applications.	Level 4: Analyze

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.

Useful Video links:

Exp. No	Topics	Links
1	Determination of Turbidity of Water	https://youtu.be/LeKqhMqEoKQ?si=CsWPx14nfp9ayYAj

2	Determination of pH of Water Sample	https://youtu.be/3gHqji3inmc?si=WhAo28tgLABuHWdC
3	Determination of Hardness of Water	https://youtu.be/FCQ26RQBZLg?si=EtXK4z7kpZtiN7w8
4	Determination of Residual Chlorine	https://youtu.be/zelRO_lmDdc?si=VkyJVH4jna3gh8d4
5	Determination of Total Suspended and Dissolved Solids	https://youtu.be/ojjna1xtVzQ?si=24Vm9paqWh7hn32_
6	Determination of Biochemical Oxygen Demand (BOD)	https://youtu.be/sSPtpGguO5A?si=nybLfxkvw0M1hwfF
7	Determination of Chemical Oxygen Demand (COD)	https://youtu.be/1kd18-L8c3o?si=dAc0uAEW1qBOv7U3
8	Determination of Conductivity of Water	https://youtu.be/9gzMc9UQAe4?si=z9W28GpzJDpCwIS1
9	Determination of Chlorides in Water Sample	https://youtu.be/2kSJPyMspAo?si=YaXt_All-pHx5zFa
10	Determination of Alkalinity and Acidity	https://youtu.be/INFu8uMeRqw?si=9SpIhkTAaX3PTFj1
11	Determination of Dissolved Oxygen (DO)	https://youtu.be/Rf7ByPaUmuM?si=5quxsoskjZbRGzut

Course code	LC-CE-316A				
Category	Lab Course				
Course title	Structural Analysis and Design Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives:	The objectives of this laboratory are: •To familiarize students with STAAD.Pro for structural modeling, analysis, and design. •To develop skills in analyzing RCC, steel, and composite building structures. •To enable students to apply relevant IS codes in structural design. •To provide hands-on experience in computer-aided building analysis and design.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to:

COs	Skills Demonstrated	RBT Level
CO1	Recall the features, commands, and workflow of STAAD.Pro.	Level 1: Remember
CO2	Explain the structural behavior of building components using analysis results.	Level 2: Understand
CO3	Apply STAAD.Pro for modeling, analysis, and design of RCC, steel, and composite structures.	Level 3: Apply
CO4	Analyze the performance of multi-storey building structures under gravity, wind, and seismic loads.	Level 4: Analyze

List of Experiments

- Introduction to STAAD.Pro interface, structural modeling, load assignment, analysis, and interpretation of results.
- Modeling and analysis of RCC beams and continuous beams used in building structures.
- Modeling and analysis of RCC columns and beam-column frames under gravity loads.
- Modeling and analysis of a G+1 RCC building under dead and live loads.
- Modeling and analysis of a multi-storey RCC building under gravity loads.
- Analysis of multi-storey RCC buildings subjected to wind loads as per IS 875.
- Analysis of multi-storey RCC buildings subjected to earthquake loads as per IS 1893.
- Design of RCC beams, columns, and footing reactions using STAAD.Pro as per IS 456.
- Modeling, analysis, and design of steel building frames using STAAD.Pro as per IS 800.
- Modeling, analysis, and design of RCC–Steel hybrid (composite) building structures under gravity, wind, and seismic loads.
- Mini Project: Analysis and design of a residential multi-storey RCC building using STAAD.Pro.

Useful Video links:

Exp. No	Topics	Links
1	Introduction to STAAD.Pro interface, modeling, load assignment, and analysis	STAAD.Pro Introduction and Basics

2	Modeling and analysis of RCC beams and continuous beams	<u>STAAD.Pro RCC Beam Analysis Tutorial</u>
3	Modeling and analysis of RCC columns and beam-column frames	<u>STAAD.Pro Frame Analysis Tutorial</u>
4	Modeling and analysis of a G+1 RCC building	<u>STAAD.Pro RCC Building Design Part-1</u>
5	Modeling and analysis of a multi-storey RCC building	<u>STAAD.Pro RCC Building Design Part-2</u>
6	Analysis of multi-storey RCC buildings under wind loads	<u>STAAD.Pro Wind Load Analysis Tutorial</u>
7	Analysis of multi-storey RCC buildings under earthquake loads	<u>STAAD.Pro Seismic Analysis Tutorial</u>
8	Design of RCC beams, columns, and footing reactions	<u>STAAD.Pro RCC Design Tutorial</u>
9	Modeling, analysis, and design of steel building frames	<u>STAAD.Pro Steel Structure Design Tutorial</u>
10	Modeling, analysis, and design of RCC–Steel hybrid structures	<u>STAAD.Pro Composite Structure Design Tutorial</u>
11	Mini Project: Residential multi-storey RCC building design	<u>Complete RCC Building Design using STAAD.Pro</u>

Course Code	PEC-CE-318A				
Category	Professional Elective Course				
Course Title	Advanced Steel Structures				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are: ● To impart practical knowledge of advanced steel structures and their application. ● To teach the students advance level design of steel structures. ● To make the students familiar with the relevant IS codes to be used in construction industries. ● To teach the students modern design methods such as design of light gauge steel.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the concepts of eccentric connections, cold-formed sections, industrial steel structures, and design provisions.	Level 1: Remember
CO2	Explain the behavior and design principles of advanced steel structural components such as towers, water tanks, stacks, and plate girders.	Level 2: Understand
CO3	Apply codal provisions and design procedures for advanced steel structural systems and their connections.	Level 3: Apply
CO4	Analyze and design complex steel structures including gantry girders, industrial buildings, towers, and special steel components for engineering applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Eccentric and Moment Connections: Beams-Column Connections, Connections Subjected to Eccentric Shear, Bolted Framed Connections, Bolted Seat Connections, Bolted Bracket Connections. Bolted Moment Connections, Welded Framed Connections, Welded Bracket Connections and Moment Resistant Connections. Module 2: Cold Formed Sections: Brief description of various types of cold-formed sections, local buckling, concepts of effective width and effective sections, elements with stiffeners, Design of compression and bending elements.
Unit-II	Module 3: Industrial Buildings: Loads, general arrangement and stability, design considerations, design of Purlins, design of roof trusses, industrial building frames, bracings and stepped columns.

	Module 4: Towers: Transmission line towers, Microwave towers, Design loads, classification, Design and specification.
Unit-III	Module 5: Design of Water Tanks: Types of water tank, permissible stresses, design of circular, rectangular and pressed steel tanks including staging. Module 6: Design of Steel Stacks: Types of steel stack, various loads consideration of steel stacks, Design of steel stacks including foundation.
Unit-IV	Module 7: Plate Girder: Elements of plate girder, Design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices, Curtailment of flange plates, Design beam to column connections: Introduction, design of framed and seat connection. Module 8: Design of Gantry Girder: Loading Consideration, Selection Criteria of Gantry Girder, Specification, Design of Gantry girder

Suggested Readings

- 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.

Useful Video Links

Unit No.	Topic	Link
I	Beams-Column Connections	https://youtu.be/3oMMA5gwQ_o?si=b1BpWFBGDG9qCHjTi
	Cold Formed Sections	https://www.youtube.com/live/ntIY4ffnBo?si=bfoSItdJJoFtptXVY
II	Industrial Buildings	https://youtu.be/jcZ-mEUyBzQ?si=E2Ft3m5Qw9lutdQy
	Transmission line towers	https://youtu.be/XKNAhSCL7A4?si=J2jFggRKm-OJh5Ti
III	Types of water tank	https://youtu.be/Kds06g-_93Q?si=4o5COnURV-f6ekx4
	Types of steel stack	https://youtu.be/yuZ17yBbkj0?si=GSeZGtqL3O6Yslw5
IV	Elements of plate girder	https://youtu.be/xsgtuNXmmvc?si=3ZEaKYSkm2V9Vvq1
	Loading Consideration	https://youtu.be/ElKIibv9kE4?si=wVkRnFyxmsWhrMFu

Course Code	PEC-CE-320A				
Category	Professional Elective Course				
Course Title	Pre-Stressed Concrete				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are: • To introduce the need for prestressing as well as the methods, types and advantages of prestressing to the students. • 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.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the fundamental concepts of prestressing systems, material properties, and losses of prestress in concrete members.	Level 1: Remember
CO2	Explain the behavior of prestressed concrete members under shear, torsion, deflection, cracking, and serviceability conditions.	Level 2: Understand
CO3	Apply analytical and design principles for prestressed concrete members subjected to axial load, flexure, shear, and torsion.	Level 3: Apply
CO4	Analyze and design advanced prestressed concrete systems including composite beams, continuous beams, and miscellaneous prestressed structures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
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: Introduction, Types of Cracks, Components of Shear Resistance and Pure Torsion, Modes of Failure, Effect of Prestressing Force, Stress in an Uncracked Beam, Design and Detailing Requirement for Shear, 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, Poles, Partial prestressing – definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

Suggested Readings

- Rajagopalan. N, “Prestressed Concrete”, Narosa Publishing House, 2002.
- Dayaratnam. P., “Prestressed Concrete Structures”, Oxford and IBH, 2013
- Lin T.Y. and Ned.H.Burns, “Design of prestressed Concrete Structures”, Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
- IS1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards,

Useful Video Links

Unit No.	Topic	Link
I	Material Properties	https://youtu.be/63-XoZ68jBo?si=YmlYPhbajlrQWrn5
	Losses in Prestress	https://youtu.be/AZoSeBRdEbg?si=gEuBd4rSlnftaSI1
II	Types of Cracks	https://youtu.be/gz1oEgECS9Q?si=xq8RtQ8cy_PmR_b9
	Factors Influencing Deflections	https://youtu.be/_nCKshanJN4?si=bPVEOy13QSmnbrg
III	Analysis of Members	https://youtu.be/LMH8aDqKJrE?si=b0eZF9_I8oPvzRZ2
	Design of Members	https://youtu.be/0ASvSbMgLP0?si=MnFOgAaVNfC-QQ9D
IV	Composite and Continuous Beams	https://youtu.be/Up4wUjuGvpo?si=UyQYJwfrjmXGP4_L
	Miscellaneous Structures	https://youtu.be/16P51olKuzk?si=6YXNPJjk_7L_EhyP

Course Code	PEC-CE-322A				
Category	Professional Elective Course				
Course Title	Contracts Management				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are: • To introduce the fundamentals, principles, and importance of contract management in construction projects. • To develop understanding of contract formation, administration, legal provisions, and contractual obligations. • To study contract execution, monitoring, risk management, and dispute resolution mechanisms.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the basic concepts, types, clauses, and legal framework of contract management.	Level 1: Remember
CO2	Explain contract formation, administration, performance monitoring, and contractual obligations in construction projects.	Level 2: Understand
CO3	Apply contract management principles for handling payments, variations, risk management, and contract execution in different project situations.	Level 3: Apply
CO4	Analyze contractual disputes, legal issues, risk factors, and closure procedures for effective contract management in engineering projects.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Introduction & Basics: Contract Management – Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management, Parties to a Contract, Types of Contracts. Module 2: Contract Formation & Start-Up: Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships, Planning and People-Resource Management.
Unit-II	Module 3: Contract Clauses & Conditions: Common Contract Clauses, Notice to Proceed, Rights and Duties of Various Parties, Notices to be Given, Contract Duration and Price, Performance Parameters. Module 4: Time, Risk & Legal Conditions: Delays, Penalties and Liquidated Damages, Force Majeure, Suspension and Termination, Changes & Variations, Notices under Contracts.
Unit-III	Module 5: Contract Administration & Payments : Contract Administration, Payments, Managing Performance, Monitoring and Measurement

	Module 6: Contract Management in Different Situations : Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods, Design, Supply and Installation Contracts, Contract Management in Consultancy
Unit-IV	Module 7: Legal Framework & Dispute Resolution: Various Acts Governing Contracts, Legal Aspects in Contract Management, Contract Management Legal View, Dispute Resolution, Conventional Dispute Resolution Methods, Alternative Dispute Resolution Methods, Integrity in Contract Management. Module 8: Risk, Change & Closure: Managing Risks, Managing Change, Contract Closure and Review, Ending a Contract, Post-Implementation Review.

Suggested Readings

- Construction Law – Informa Law.
- Project Procurement Management – Wiley.
- Managing and Administering the FIDIC Forms of Contract – Wiley Blackwell.
- The Indian Contract Act, 1872 – LexisNexis.
- Construction Claims and Responses – Wiley Blackwell.
- Indian Contract Act, 1872
- Arbitration and Conciliation Act, 1996
- FIDIC Contract Conditions Manuals.
- CPWD Works Manual and General Conditions of Contract.
- World Bank Procurement and Contract Guidelines for ICB/NCB Works.

Useful Video Links

Unit No.	Topic	Link
I	Contract Management	https://youtu.be/wDaltiUARU4?si=L98vzzZPSfTapjtN
	Contract Formation	https://youtu.be/t96A1DrsZTw?si=1cqvpQ5PbTkKrVD6
II	Common Contract Clauses	https://youtu.be/zHPm2MQlTHM?si=3Kb5OizJOPHCIRmv
	Penalties and Liquidated Damages	https://youtu.be/E4KfgtglmP8?si=PLMUSxcjqVhlFby
III	Contract Administration	https://youtu.be/YsQu_WUw7Y0?si=Us3StzlcZ9-XIz9n
	Contract of Supply of Goods	https://youtu.be/UoZ8VmTr1eY?si=0ukMc8cw0nHahxry
IV	Various Acts Governing Contracts	https://youtu.be/t96A1DrsZTw?si=twwap530gofVDipn
	Managing Risks	https://youtu.be/zyet9fPS24k?si=d7KBj2E8e4pohcyr

Course Code	PEC-CE-324A				
Category	Professional Elective Course				
Course Title	Hydro Power Engineering				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are: • To introduce energy systems and renewable energy resources • To explore society’s present needs and future energy demands and then focus on alternatives, renewable energy sources. • To introduce basics of turbine and powerhouse.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the fundamentals of energy sources, hydropower systems, and the basic components of hydropower plants.	Level 1: Remember
CO2	Explain the operating principles of hydropower stations, pump storage plants, intake structures, and water conveyance systems.	Level 2: Understand
CO3	Apply engineering principles for the analysis and design of penstocks, turbines, surge tanks, and hydropower plant components.	Level 3: Apply
CO4	Analyze hydropower plant layouts, operational performance, and system requirements for efficient power generation.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 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.

Unit No.	Contents
Unit-I	Module 1: Introduction to Energy Sources: Sources of energy, Status of hydropower, thermal vs. hydropower, advantages of hydropower, Energy contribution of hydropower in power system. Module 2: Basics of Hydropower: Electrical load on hydropower, load curves, load factor, capacity factors, utility factors and diversity factors, load on hydropower stations, load curves, load duration curves, firm power, secondary power, Prediction of loads.
Unit-II	Module 3: Types of Hydropower Stations: Elements of Hydro power, classification of hydropower stations, run of river plants, General layout of run of river plants, Valley dam plants, storage and pondage. Module 4: Basic features of Pump Storage Plants: Advantages of pump storage plants, types of pump storage plants, efficiency of pump storage plants, Reversible Turbines.
Unit-III	Module 5: Intakes: Intake structures: functions and their types, Components of intakes: forebay, trash racks, gates and valves, Force required to operate Gates. Module 6: Water Conveyance System: Classifications of Penstocks, Design criteria of penstocks, anchor blocks, types of valves, water hammer effects, instantaneous closure of power canal, Surge tank and its classification.

Unit-IV	Module 7: Turbines: Type of turbines, criteria for selection, specific speed of turbines, unit power, unit discharge, cavitations in turbines, Design of the draft tube. Module 8: Power Houses: General layout and arrangements of hydro-power units, number and size of units, substructure, spacing of units, super-structure, underground power stations.
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Suggested Readings

- Water power Engineering by Dandekar and Sharma.
- Hydropower structures Volume III-By R S Varshney.
- Hydro Power Engineering by Dr Darde P N, Vayu Education, Delhi.
- Hydro-Electric Engineering Practice Vol.I, II& III Brown J.G.
- Water Power Engineering, Borrows, H.K.
- Water Power Development, Vol.I& II, Mosonyi, E.
- Water Power Engineering, M.M.Deshmukh.

Useful Video Links

Unit No.	Topic	Link
I	Sources of energy	https://youtu.be/583QHO5X1jo?si=inQMoDflbsR49U28
	Electrical load on hydropower	https://youtu.be/HSC-2gLtJX0?si=GW7UQxtRYUzEV1Ae
II	Elements of Hydro power	https://youtu.be/MSR7Acw_Q6U?si=ycnJKDjbK2g9a8j
	Reversible Turbines	https://youtu.be/3BCiFeykRzo?si=KGI7kwlPCG0xk8Ml
III	Intake structures	https://youtu.be/RrtbXAqmylo?si=MC00gqcAuPrgn1uF
	Classifications of Penstocks	https://youtu.be/CYJZbdzkofY?si=3LciS0cw6Osx4Seg
IV	Type of turbines	https://youtu.be/gOgKaCBlwX0?si=1Wr1pXWjg9XNTO0N
	underground power stations	https://youtu.be/x3oG5nbR6TM?si=GXnKs_ihIeckw_gK