

T.E. Civil Engineering Scheme

SEMESTER V

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2095111	Design of structures	3	--	--	3	--	--	3
2095112	Engineering Geology and Soil Mechanics	3	--	--	3	--	--	3
2095113	Transportation Engineering	3	--	--	3	--	--	3
20951XX	Program Elective Course- I	3	--	--	3	--	--	3
2095211	Multidisciplinary minor	3	--	--	3	--	--	3
2095119	Design of structures Lab	--	2	--	--	--	1	1
2095120	Engineering Geology and Soil Mechanics Lab	--	2	--	--	--	1	1
2095121	Transportation Engineering Lab	--	2	--	--	--	1	1
20951XX	Program Elective Lab - I	--	2	--	--	--	1	1
2095212	Multidisciplinary minor	--	2@	--	--	--	1	1
2095311	Open Elective	2#	--	--	2	--	--	2
2095511	Indian Knowledge System- II (Syllabus as per groups)	--	2*+2	--	--	--	2	2
Total		17	14	00	17	00	07	24

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Institute shall offer a course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

@ Institute shall offer a course for MDM from other Engineering Boards Group.

Course Code (PEC-1)	Course Name	Lab Code (PEL-1)	Lab Name
2095114	Modern Surveying Instruments and Techniques	2095122	Modern Surveying Instruments and Techniques Lab
2095115	Advanced Concrete Technology	2095123	Advanced Concrete Technology Lab
2095116	Applied Hydraulics	2095124	Applied Hydraulics Lab
2095117	Green Building	2095125	Green Building Lab
2095118	Advanced Structural Mechanics	2095126	Advanced Structural Mechanics Lab

SEMESTER V

course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2095111	Design of structures	20	20	40	60	2	--	--	100
2095112	Engineering Geology and Soil Mechanics	20	20	40	60	2	--	--	100
2095113	Transportation Engineering	20	20	40	60	2	--	--	100
20951XX	Program Elective Course- I	20	20	40	60	2	--	--	100
2095211	Multi-Disciplinary Minor	20	20	40	60	2	--	--	100
2095119	Design of structures Lab	--	--	--	--	--	25	--	25
2095120	Engineering Geology and Soil Mechanics Lab	--	--	--	--	--	25	25	50
2095121	Transportation Engineering Lab	--	--	--	--	--	25	25	50
20951XX	Program Elective Lab - I	--	--	--	--	--	25	25	50
2095212	Multi-Disciplinary Minor Lab	--	--	--	--	--	25	25	50
2095311	Open Elective	--	--	--	--	--	50	--	50
2095511	Indian Knowledge System-II (Syllabus as per groups)						50	--	50
Total		100	100	200	300	10	225	100	825

Course Code (PEC-1)	Course Name	Lab Code (PEL-1)	Lab Name
2095114	Modern Surveying Instruments and Techniques	2095122	Modern Surveying Instruments and Techniques Lab
2095115	Advanced Concrete Technology	2095123	Advanced Concrete Technology Lab
2095116	Applied Hydraulics	2095124	Applied Hydraulics Lab
2095117	Green Building	2095125	Green Building Lab
2095118	Advanced Structural Mechanics	2095126	Advanced Structural Mechanics Lab

SEMESTER VI

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2096111	Environmental Engineering	3	--	--	3	--	--	3
2096112	Geotechnical Engineering	3	--	--	3	--	--	3
20961XX	Program Elective Course - II	3	--	--	3	--	--	3
20961XX	Program Elective Course - III	3	--	--	3	--	--	3
2096211	Multi-Disciplinary Minor	3@	--	--	3	--	--	3
2096411	Computer Aided Structural Design and Drawing	--	2*+2	--	--	--	2	2
2096511	Professional Skill	--	2*+2	--	--	--	2	2
2096123	Environmental Engineering Lab	--	2	--	--	--	1	1
2096124	Geotechnical Engineering Lab	--	2	--	--	--	1	1
20961XX	Program Elective Lab - II	--	2	--	--	--	1	1
20961XX	Program Elective Lab - III	--	2	--	--	--	1	1
2096212	Multi-Disciplinary Minor Lab	--	2@	--	--	--	1	1
Total		15	18	00	15	00	09	24

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

@ Institute shall offer a course for MDM from other Engineering Boards.

Course Code (PEC-2)	Course Name	Lab Code (PEL-2)	Lab Name
2096113	Mass Transportation Engineering	2096125	Mass Transportation Engineering Lab
2096114	Advance Design of steel Structures	2096126	Advance Design of steel Structures Lab
2096115	Building Services & Repairs	2096127	Building Services & Repairs Lab
2096116	Ground Improvement Techniques	2096128	Ground Improvement Techniques Lab
2096117	Appraisal and Implementation of Infrastructure Projects	2096129	Appraisal and Implementation of Infrastructure Projects Lab

Course Code (PEC-3)	Course Name	Lab Code (PEL-3)	Lab Name
2096118	Sustainable and Smart Building Materials	2096130	Sustainable and Smart Building Materials Lab
2096119	Traffic Engineering and Transportation Planning	2096131	Traffic Engineering and Transportation Planning Lab
2096120	Earthquake Engineering	2096132	Earthquake Engineering Lab
2096121	Construction Equipment & Technology	2096133	Construction Equipment & Technology Lab
2096122	Smart Cities	2096134	Smart Cities Lab

SEMESTER VI

Course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2096111	Environmental Engineering	20	20	40	60	2	--	--	100
2096112	Geotechnical Engineering	20	20	40	60	2	--	--	100
20961XX	Program Elective Course- II	20	20	40	60	2	--	--	100
20961XX	Program Elective course - III	20	20	40	60	2	--	--	100
2096211	Multi-Disciplinary Minor	20	20	40	60	2	--	--	100
2096411	Computer Aided Structural Design and Drawing	--	--	--	--	--	50	--	50
2096511	Professional Skill	--	--	--	--	--	25	--	25
2096123	Environmental Engineering Lab	--	--	--	--	--	25	25	50
2096124	Geotechnical Engineering Lab	--	--	--	--	--	25	25	50
20961XX	Program Elective Lab - II	--	--	--	--	--	25	25	50
20961XX	Program Elective Lab - III	--	--	--	--	--	25	25	50
2096212	Multi-Disciplinary Minor Lab	--	--	--	--	--	25	25	50
Total		100	100	200	300	10	200	125	825

Course Code (PEC-2)	Course Name	Lab Code (PEL-2)	Lab Name
2096113	Mass Transportation Engineering	2096125	Mass Transportation Engineering Lab
2096114	Advance Design of steel Structures	2096126	Advance Design of steel Structures Lab
2096115	Building Services & Repairs	2096127	Building Services & Repairs Lab
2096116	Ground Improvement Techniques	2096128	Ground Improvement Techniques Lab
2096117	Appraisal and Implementation of Infrastructure Projects	2096129	Appraisal and Implementation of Infrastructure Projects Lab

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2096118	Sustainable and Smart Building Materials	2096130	Sustainable and Smart Building Materials Lab
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2096120	Earthquake Engineering	2096132	Earthquake Engineering Lab
2096121	Construction Equipment & Technology	2096133	Construction Equipment & Technology Lab
2096122	Smart Cities	2096134	Smart Cities Lab

Detailed Syllabus

SEM V

Vertical – 1 Major

Program Core Course Theory

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095111	Design of Structures	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095111	Design of Structures	20	20	40	60	2	--	--	100

Rationale:

Civil Engineers must have the basic knowledge of designing and detailing of structures. This course imparts a fundamental knowledge of design of basic structural elements using reinforced concrete and steel as materials. Reinforced concrete structures are widely used due to their strength, durability and versatility. Steel structures are preferred due to their light weight, higher strength and faster construction. This course is specifically aimed to create a knowledge of design philosophies, Indian Standard codal provisions and design aids in the design and detailing of RCC & Steel structural members.

Course Objectives:

1. To develop a clear understanding of the design of reinforced concrete structures using working stress method (WSM) and limit state method (LSM).
2. To design reinforced concrete beams and slabs as per the clauses of IS 456-2000.
3. To apply the concepts of limit state method in the design of columns and footings.
4. To learn the effective use of IS codes, design tables and aids in analyzing and designing the steel structures
5. To design tension members, compression members and column bases using standard steel sections.
6. To analyse and design steel flexural members.

Course Outcomes:

On completion of the course students will be able to:

1. Explain and compare the design philosophies of WSM and LSM.
2. Analyze and design reinforced concrete beams and slabs using Limit state method
3. Design reinforced concrete columns and footings using the concepts of Limit State Method.
4. Design bolted and welded connections and basic concepts of design of bracket connections.
5. Use limit state method to design tension members and compression members with battened and laced columns and base plates.
6. Design flexural members using structural steel sections.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction to Methods of Design of Structures:		05	CO1
	1.1	Concept of reinforced concrete, Methods for design of structures.		
	1.2	Working Stress Method (WSM) of design for reinforced concrete, permissible stresses, under reinforced, balanced and over reinforced sections, analysis of singly and doubly reinforced rectangular beams. Calculation of design constants.		
	1.3	Introduction to limit state method of design as per IS:456-2000. Characteristic load, characteristic strength, partial safety factors for loads and materials, limit states of collapse and serviceability.		
2	Limit State of Collapse: Flexure, Shear and Torsion		12	CO2
	2.1	Analysis and design of singly and doubly reinforced rectangular beam sections for flexure. Introduction to flanged beams.		
	2.2	Design of beams for shear, types of shear reinforcement.		
	2.3	Beams subjected to torsion: Design considerations as per IS 456-2000.		
	2.4	Design of Slabs Design of one-way slabs. Design of simply supported and restrained two-way slabs (no numerical examples based on restrained slabs in the examination)		
3	Limit State of Collapse – Compression:		05	CO3
	3.1	Limit state of collapse: short and slender columns, Minimum Eccentricity. Analysis and design of short columns.		
	3.2	Design of Isolated square and rectangular footings subjected to axial load.		
4	Introduction to Steel Structures		04	CO4
	4.1	Types of steel structures, Properties of Structural Steel, Indian Standard Sections. Types of joints.		
	4.2	Introduction to IS 800-2007. Section classification such as plastic, compact, semi-compact and slender.		
	4.3	Bolted and welded connections, Design strength of bolts and welds, bracket connections, introduction to framed and seat connections		

Module	Course Module / Contents	Hours	CO Mapping
5	Design of Axially Loaded Members	08	CO5
	5.1 Design of Tension Members: Introduction, types Design strength due to yielding, rupture and block shear (simple numerical examples using single angle sections)		
	5.2 Design of Compression Members: Introduction, effective length of columns, slenderness ratio, Design of struts using single angle sections. Design of laced and battened built-up columns.		
	5.3 Design of slab bases, introduction to gusseted bases.		
6	Design of Flexural Members	05	CO6
	6.1 Introduction, Types, laterally supported and unsupported beams, Plate girders.		
	6.2 Design strength of laterally supported beams in bending and shear, web buckling and web crippling		
	6.3 Design strength of laterally unsupported beams.		

Text Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Limit State Design of Reinforced Concrete: Jain A. K, Nemchand and Bros., Roorkee
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Design of Steel Structure by N. Subramanian, Oxford University Press, New Delhi.
5. Limit state design of steel structure by Dr. V.L. Shah and Gore, Structure publication Pvt. Pune.
6. Limit state design of steel structures by S. K. Duggal, McGraw Hill Education (India) Pvt. Limited, New Delhi.
7. Relevant Indian Specifications, Bureau of Indian Standards, New Delhi

References:

1. Fundamentals of Reinforced Concrete: Sinha & Roy, S. Chand and Co. Ltd.
2. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.
3. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.
4. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.
5. Design of Steel Structures by K. S. Sai Ram, Pearson Education, New Delhi.
6. Limit state design of steel structures as per IS 800/2007. by S. Kanthimathinathan. I.K. International Publishing House, New Delhi.
7. Structural design and drawing by D. Krishnamurthy, CBS Publishers, New Delhi

Online References:

Sr. No.	Website Name
1.	Design of Reinforced Concrete Structures: https://nptel.ac.in/courses/105105105
2.	Design of Steel Structures: https://nptel.ac.in/courses/105105162

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks** Q.1 will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095112	Engineering Geology and Soil Mechanics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095112	Engineering Geology and Soil Mechanics	20	20	40	60	2	--	--	100

Rationale:

Engineering Geology and Soil Mechanics form the foundation of civil engineering practice. Understanding the geological conditions of a site and the engineering behavior of soils is essential for the safe design and stability of structures. This course enables students to interpret geological features, assess soil properties, and analyze their impact on construction projects. It bridges the gap between natural earth materials and engineering applications, providing the knowledge required for foundation design, slope stability, and earthwork construction. Mastery of these concepts ensures effective decision-making in planning and executing civil engineering projects.

Course Objective:

Students will be able:

1. To acquire basic knowledge of Geology and to understand its significance in various civil engineering projects.
2. To study minerals and rocks in order to understand their fundamental characteristics and engineering properties.
3. To study structural geology for characterization of site, analysis and report geologic data using standards in engineering practice.
4. To understand physical and index properties of soil
5. To understand the techniques of soil exploration for assessing subsoil conditions and to classify the soil as per IS code.
6. To study permeability and seepage flow of water through soil.

Course Outcome:

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

- 1 Understand the importance of Geology to build safe and stable Civil Engineering structures.
- 2 Identify the minerals and rocks based on their physical properties, texture and structure to assess their engineering suitability.
- 3 Identify the geological structures for characterization of site for civil engineering structures.
- 4 Understand and determine physical and index properties of soil.

- 5 Understand the necessity and methods of exploration to assess the suitability of given soil in civil engineering by classifying it as per IS: 1498.
- 6 Determine the permeability of the soil and understand the concept flow net to understand the concept of piping failure.

Prerequisite: Basic knowledge of earth science and civil engineering and the fundamentals of mechanics and fluid mechanics.

Detailed Syllabus

Module	Course Module/Contents		Periods	CO Mapping
1	Introduction-Engineering Geology and Soil Mechanics		04	CO1
	1.1	Importance of geological studies in various civil engineering projects, rock mechanics, geotechnical engineering.		
	1.2	Internal Structure of Earth and Theory of Plate Tectonics.		
	1.3	Weathering types, erosion and denudation. Factors affecting weathering, soil, origin & mode of formation and types of soil obtained.		
2	Mineralogy and Petrology		06	CO2
	2.1	Identification of rock forming minerals with the help of physical properties. Explanation about clay minerals, e.g., Montmorillonite, Illite and Kaolinite; formation of clay minerals and their role in plastic behavior of soil.		
	2.2	Igneous Petrology - Mode of formation, Texture and structure, Classification of Igneous rocks, study of commonly occurring igneous rocks, Engineering aspect of Granite and Basalt		
	2.3	Sedimentary Petrology - Mode of formation, Textures, characteristics of shallow water deposits like lamination, bedding, classification, study of commonly occurring sedimentary rocks and their engineering application.		
	2.4	Metamorphic Petrology - Mode of formation, agents and types of metamorphism, structures and textures of metamorphic rocks, classification and study of commonly occurring metamorphic rocks and their engineering application.		
3	Structural Geology and Rock Quality Assessment		07	CO3
	3.1	Dip and Strike, Outcrop. Type of discontinuities in the rocks. Fold: Terminology, Classification on the basis of position of axial plane, and engineering consideration. Fault: Terminology, Classification on the basis of movement of faulted block, and Engineering consideration. Joints: Definition, types and engineering consideration		
	3.2	Determination of thickness of the strata with the help of given data.		
	3.3	Geological Maps and their application for civil engineering works.		
	3.4	Geo-mechanics classification (RMR) and its application in tunneling. RQD and its significance in determining subsurface geology of the area.		
	3.5	Factors controlling water bearing capacity of rocks, Pervious and Impervious rocks, different types of rocks as source of ground water, confined and unconfined aquifer.		

Module	Course Module/Contents		Periods	CO Mapping
4	Introduction – Basic Properties and Plastic Characteristics of Soil		08	CO4
	4.1	Definitions and scope of Geotechnical Engineering		
	4.2	Soil phase systems, volumetric ratios: void ratio, porosity, degree of saturation, air voids, air content.		
	4.3	Weight-volume relationship: different unit weights, water content, specific gravity of soil solids, mass and absolute specific gravity.		
	4.4	Functional relationships among different unit weights, volumetric ratios, water content, Relative Density.		
	4.5	Different methods to determine water content, specific gravity and unit weight of soil.		
	4.6	Definition of plasticity of soil, consistency of soil, importance of consistency limits. definition & determination of liquid limit, plastic limit, shrinkage limit.		
	4.7	Definitions of shrinkage parameters, plasticity index, liquidity index, consistency index, flow index, toughness index.		
	4.8	Activity, Sensitivity and Thixotropy of soil.		
5	Soil Exploration and Soil Classification		07	CO5
	5.1	Necessity of soil exploration, methods of soil investigation, methods of boring, disturbed and undisturbed soil samples, soil sampling and samplers, number and spacing of bore holes, depth of bore holes.		
	5.2	Penetrometer tests: SPT, SCPT and DCPT and Borelog representation of data		
	5.3	Necessity of soil classification, Indian standard particle size classification, Indian standard soil classification system as per IS: 1498 -1970, boundary classification.		
	5.4	Sieve analysis, Sedimentation analysis, Hydrometer method of analysis, Limitation of sedimentation analysis.		
	5.5	Particle size distribution curve/ gradation curve and its uses.		
6	Permeability of soil and Seepage flow through Soil		07	CO6
	6.1	Types of soil water, definition of hydraulic head, hydraulic gradient, Darcy's law, validity of Darcy's law, permeability of soil.		
	6.2	Determination of coefficient of permeability of soil in lab using constant head and variable head methods, factors affecting permeability of soil, effect of permeability on various properties of soil.		
	6.3	Permeability of stratified soil deposits.		
	6.4	Definition of seepage and its importance for the analysis & design of hydraulic structures.		
	6.5	Flow net diagram, definition of flow line, equipotential line, flow channel, flow field, characteristics of flow net, use of flow net, phreatic line, Quick Sand Condition.		

Text Books:

1. Engineering Geology: N. Chenna, Kesavulu, Macmillan India Limited, 1996.
2. Engineering Geology: Dr. R. B. Gupte, Pune Vidyarthi Griha Prakashan, Pune.
3. Principles of Engineering Geology', Rawat S., Bhattacharya M. and Joshi, P., 2020, Nirali Prakashan- Mumbai, ISBN 978-93-90506-36-1
4. Principles of Engineering Geology: K. M. Banger.

5. Soil Mechanics and Foundation: Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications
6. Soil Mechanics and Foundation Engineering: K.R. Arora; Standard publishers and Distributors
7. Soil Mechanics and Foundation Engineering: V.N.S Murthy; Saitech Publications
8. Geotechnical Engineering: C. Venkatramaiah; New age International
9. Basic and Applied Soil Mechanic: Gopal Ranjan and A.S. Rao; New Age International

References:

1. Geology for Civil Engineering: A. C. McLean, C.D. Gribble, George Allen & Unwin London.
2. Earth Revealed, Physical Geology: David McGeary and Charles C. Plummer, Diane H. Carlson, 2001, McGraw-Hill edition.
3. Theoretical Soil Mechanic: K. Terzaghi; John Wiley and Sons
4. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley and sons
5. Relevant Indian Standard Specification Code: BIS Publications, New Delhi
6. Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House
7. Geotechnical Engineering: Purushothama Raj; Tata McGraw Hill Publications

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/105105168
2.	https://nptel.ac.in/courses/105105106

Assessment:

Internal Continuous Assessment: 40

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, Presentation, Project, Assignment etc. (at least 3)

End Semester Theory Examination:

Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks** Q.1 will be compulsory and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095113	Transportation Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095113	Transportation Engineering	20	20	40	60	2	--	--	100

Rationale:

The course is structured to provide a holistic understanding of national development through multi-modal transport. It focuses on the core engineering skills of Highway Geometric Design to ensure safety and comfort, and Traffic Engineering to optimize flow and manage capacity. The latter modules cover Pavement Design and construction techniques (MoRTH/IRC standards) for structural durability. Finally, it integrates contemporary topics like Road Safety Audits and Intelligent Transportation Systems (ITS), along with modern design and simulation software, to equip students with practical, future-ready skills for designing, operating, and maintaining sustainable transportation infrastructure.

Course Objectives:

1. To introduce the role and scope of different transportation modes and enable students to perform preliminary design calculations for basic airport and railway elements.
2. To teach the principles of highway planning and to design safe and efficient highway geometric features.
3. To train students in the fundamental methods of conducting traffic studies and applying traffic flow theory for intersection signal design and highway capacity analysis.
4. To familiarize students with the material properties of bitumen and aggregates and to impart the knowledge required for the design of flexible and rigid pavements using IRC standards.
5. To explain the standard construction and maintenance procedures for pavements, the necessity of highway drainage, and the methods for diagnosing and evaluating pavement distresses and failures.
6. To introduce the concepts, benefits, and applications of Intelligent Transportation Systems (ITS) and the methodology and stages involved in conducting a Road Safety Audit (RSA).

Course Outcomes:

On completion of the course students will be able to:

1. compare various transportation modes and compute key design parameters for runway length and railway super-elevation.
2. design the geometric features of highways, including cross-section elements, sight distances, super-elevation, and curves, as per IRC guidelines.

3. analyze traffic flow data (speed, volume, density) and design isolated traffic signals.
4. evaluate the suitability of pavement materials (bitumen, aggregate) and apply IRC methods to design the structural layers of flexible and rigid pavements.
5. identify different types of pavement distress, evaluate pavement condition, and suggest appropriate construction and drainage solutions.
6. explain the role, benefits, and applications of ITS and outline the purpose and various stages of a Road Safety Audit (RSA).

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction to Transportation Engineering		06	CO1
	1.1	Role of Transportation in development of nation, Scope of Transportation Engineer.		
	1.2	Various modes of transportation Roadways, Railways, Airways and waterways. Comparison and suitability of each mode. Various public transport available in urban area.		
	1.3	Airport Engineering: Layout and component of airport with their purpose, Runway length, calculations and corrections. Design of Taxiway and Exit Taxiway.		
	1.4	Railway Engineering: Cross sectional elements of permanent way and purpose of each. Design of Super elevation and Negative Super elevation.		
2	Planning and Geometric design of Highways		09	CO2
	2.1	Classification of roads based on various criteria, Road development plans, agencies related to highway development, Highway alignment (basic requirement and factors governing), Surveys for Highway alignment.		
	2.2	Terrain Classification, Vehicular Characteristics, Cross section elements of highways (width of carriage way, shoulders, medians, width of road way, right of way, camber & its profile).		
	2.3	Design speed, sight distance, perception time, break reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance.		
	2.4	Horizontal Alignment: Horizontal curves, design of super elevation, its provisions, minimum radius of horizontal curves, widening of pavement, transition curves.		
	2.5	Vertical Alignment: Vertical curves, types, Sight distance at vertical curves, Gradient types, Grade compensation on curves.		
	2.6	Introduction to geometric design software's such as MXROAD etc.		

Module	Course Module / Contents		Hours	CO Mapping
3	Traffic Engineering		08	CO3
	3.1	Introduction to various traffic studies. Speed study: methods to determine speed, types of speed (Spot speed, Design speed, Upper & lower limit speeds, Mean -Median and Modal speed); Traffic Volume study (flow): Definition, AADT, ADT. Design volume, methods of determining traffic volume. Traffic density: Definition, importance.		
	3.2	Theory of traffic flow, Microscopic and Macroscopic parameters of Traffic flow, fundamental relation between Speed-Flow-Density (Q-K-V curve), Passenger car Unit: Factors affecting and values, Highway capacity and Level of service.		
	3.3	Different types of Intersections-At-grade and Grade Separated, Types of conflicts, calculation of conflict, reduction of conflict, Signal design using Webster's method, Traffic signs.		
	3.4	Introduction to traffic simulation software's Such as VISSIM, VISSUM etc.		
4	Pavement Material and Design		09	CO4
	4.1	Types of pavements, comparison of flexible and rigid pavements, Requirements of pavement materials. Various test on bitumen and aggregate.		
	4.2	Flexible pavement design: Concepts related to flexible pavement design such as tyre pressure, contact pressure, ESWL, VDF and LDF. IRC approach for design of flexible pavement as per IRC standards.		
	4.3	Rigid pavement design: Modulus of subgrade reaction, equivalent radius of resisting section, radius of relative stiffness, stresses on rigid pavement, combine loading temperature stress.; Design of rigid pavements as per IRC standards. Types of joints in rigid pavement, sealer and filler materials.		
	4.4	Design of rigid and flexible pavement using IITPAVE and KENPAVE.		
5	Pavement Construction, Drainage and Failures		04	CO5
	5.1	Construction of bituminous pavements, cement concrete pavement. And joint (As per IRC, MORTH specifications).		
	5.2	Highway drainage: Necessity/ Significance, mode of ingress of water in highway structure, Different methods of drainage- surface and subsurface drainage.		
	5.3	Structural and functional evaluation, their methods. Distress / failure in Rigid and flexible pavement. Overlay and its types.		

Module	Course Module / Contents		Hours	CO Mapping
6	Highway Safety and Intelligent Systems		03	CO6
	6.1	Introduction to Road safety Audit, its purpose, Stages and activities in road safety audit. (IRC:SP:88)		
	6.2	Introduction to Intelligent transportation system, its benefit and applications.		

Text Books:

- 1 A Course of Railway Engineering: Saxena, S. C. and Arora, S. P.; Dhanpat Rai Sons, New Delhi.
- 2 Airport Planning Design: Khanna, S.K., Arora, M.G. and Jain, J.J.; Nemchand Bros., Roorkee.
- 3 Highway Engineering: Khanna, S.K. and Justo, C. E. G.; Nem Chand and Bros., Roorkee.
- 4 Principles, Practice and Design of Highway Engineering (Including Airport Engineering) Sharma, S.K.; S. Chand and Company Pvt. Ltd., New Delhi.

References:Books:

- 1 Indian Railway Track: Agarwal, M. M., Suchdeva Press New Delhi.
- 2 Planning Design of Airport: Horonjeff Mckelrey, Tata Mc-Graw Hill India Publishing House, New Delhi.
- 3 Transportation Engineering and Planning: C.S. Papacostas and P.D. Prevedouros; Prentice Hall India Learning Pvt. Ltd., New Delhi.
- 4 Principles of Transportation Engineering: Chakraborty, Partha and Das, Animesh; Prentice Hall India Learning Pvt. Ltd., New Delhi.
- 5 Transportation Engineering: Khisty, C.J. and Lall, Kent, B.; Prentice Hall India Learning Pvt. Ltd., New Delhi.
- 6 Traffic Engineering and Transport Planning: Kadiyali, L.R., Khanna Publishers, Delhi.
- 7 Principles and Practice of Highway Engineering: Kadiyali, L. R.; Khanna Publishers, Delhi.

IRC Codes

- 1 Indian Roads Congress. (2019). *Guidelines for the Design of Flexible Pavements (IRC:37-2018/2019)*. New Delhi: Indian Roads Congress.
- 2 Indian Roads Congress. (2015). *Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (IRC:58)*. New Delhi: Indian Roads Congress.
- 3 Indian Roads Congress. (2019). *Manual on Road Safety Audit (IRC:SP:88)*. New Delhi: Indian Roads Congress.
- 4 Ministry of Road Transport and Highways (MoRTH), Government of India. (2013). *Specifications for Road and Bridge Works* (5th Revision). Published by Indian Roads Congress (IRC).
- 5 Any other relevant IRC codes.

Online References:

Sr. No.	Website Name
1.	NPTEL: Transportation Engineering Course https://nptel.ac.in/courses/105105107
2.	Swayam: Traffic Engineering Course https://onlinecourses.nptel.ac.in/noc22_ce41/preview
3.	NPTEL: Pavement material course https://nptel.ac.in/courses/105107219
4.	Swayam: Analysis and Design of Bituminous Pavements https://onlinecourses.nptel.ac.in/noc24_ce42/preview
5.	NPTEL: Pavement Construction Technology course https://nptel.ac.in/courses/105103685

Assessment:**Internal Continuous Assessment: 40%****Internal Assessment Test (IAT) for 20 marks each:**

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Assignments covering all modules as per syllabus. Additionally, Open book test, Quizzes, Class Tests, and case study (any 1 or 2) to be planned.

End Semester Theory Examination:**➤ Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks** Q.1 will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Program Elective Course – 1 Theory

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095114	Modern Surveying Instruments and Techniques	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095114	Modern Surveying Instruments and Techniques	20	20	40	60	2	--	--	100

Rationale:

In recent years, surveying instruments and techniques have undergone revolutionary transformations in the measurement of level differences, distances, angles, areas, and volumes. These advancements have been made possible through the integration of electronics into surveying instruments. With rapid technological progress and the availability of cost-effective, innovative electronic components, modern instruments have become both affordable and user-friendly. This course highlights the latest developments in surveying instruments and methods, including digital levels, electronic distance measurement (EDM) devices, electronic theodolites, total stations, GPS, GIS, remote sensing, drone surveys, aerial photogrammetry, and hydrographic surveys. It aims to equip learners with practical industry-oriented skills in utilizing these modern tools for data acquisition and mapping through relevant software applications.

Course Objectives:

1. Understand the working principles and methodologies of modern surveying instruments and compare with conventional instruments
2. Exhibit the concepts of Global Positioning System, Geographical Information Systems and remote sensing techniques
3. Demonstrate the importance of Aerial Photogrammetry in surveying works
4. Study the art of delineating the levels underwater bodies
5. Understand the concepts of cartographic visualization using GIS tools
6. Highlight the modern techniques in the field of surveying and mapping various software

Course Outcomes:

On completion of the course students will be able to:

1. Compare modern surveying instruments with conventional instruments.
2. Elucidate the utility of geoinformatics in surveying data collection and analysis.
3. Explain the utility of Aerial photogrammetry in surveying works.
4. Describe the procedure of hydrographic surveying and mapping.

5. Design map layouts and cartographic visualisations using appropriate GIS tools, and develop a GIS-based project applying end-to-end workflows from data acquisition to spatial analysis and presentation.
6. Apply modern surveying tools to solve complex problems and demonstrate essential skills for working on surveying software.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction to Modern Surveying Instruments:		05	CO1
	1.1	Principles governing modern instruments and comparison with the conventional instruments.		
	1.2	E.D.M. Electromagnetic spectrum, Electromagnetic distance measurement, Instruments – Digital planimeter, Auto Level, Laser Level, Electronic Digital Theodolite, Total Station, Scan station, Smart Station (Total station with GPS), LIDAR		
2	Geoinformatics		12	CO2
	2.1	Global Positioning System- Global Positioning System – working principle and methods, Different Approaches to use GPS and their accuracies, Advantages of GPS in Navigation, Survey, Planning and Mapping.		
	2.2	Geographical Information System -Introduction, Definition, Objectives, Components (people, procedure, hardware, software & data) & functions (input, manipulation, management, query & analysis and visualization) of GIS. Coordinate systems and projections, Geo-referencing, GIS data – spatial (Raster & vector) & spatial data. Introduction to vector and raster data analysis such as network analysis, overlay analysis etc. for vector, DEM, Management of a spatial data.		
	2.3	Remote Sensing introduction, Definition, Necessity, Importance and use; Basic concepts in Remote Sensing, Basic Laws of electromagnetic radiation, Atmospheric effects on radiation, Interaction of EM energy with matter, Resolution in remote sensing, Satellite remote sensing, Problems confronting remote sensing system. Ideal and Real remote sensing systems.		
3	Aerial Photogrammetry		06	CO3
	3.1	Introduction, principle and uses of Aerial photographs, Definitions, of different terms, Scale of vertical and tilted photograph (simple problems), Ground Coordinates.		
	3.2	Relief Displacements, Ground control, Procedure of aerial survey, overlaps and mosaics, Stereoscopes		

Module	Course Module / Contents		Hours	CO Mapping
4	Hydrographic Surveying		04	CO4
	4.1	Hydrographic Surveying: Objects, Applications, establishing controls, Shore line survey, Sounding, sounding equipment, Methods of locating soundings – conventional and using GPS.		
	4.2	Reduction of soundings, Plotting of soundings, Nautical sextant and its use, Tides and tide gauges, determination of MSL.		
5	Cartographic Surveying		04	CO5
	5.1	Introduction, Map layout, Data presentation, Toposheet Indexing, Distribution Maps Web GIS;		
	5.2	Introduction to Web GIS, OGC Standards and services, Mobile GIS		
6	Applications of Modern Survey Techniques and Map Preparation Using Software		08	CO6
	6.1	Applications of Total Station, GPS, GIS, Remote sensing, Google Earth, LIDAR, Drones in Civil Engineering.		
	6.2	Introduction of GRAM++, Q-GIS, Map Info, etc.		

Text Books:

- 1 Agor R, Advanced Surveying, Khanna Publishers, New Delhi (ISBN9788174909053).
- 2 Kanetkar, T.P. and Kulkarni, S.V., Surveying and Levelling Vol. II, Pune Vidhyarthi Gruh Publication (ISBN9782508807185).
- 3 Arora, K.R., Surveying Vol. III, Standard Book House. New Delhi (ISBN9788189401276).
- 4 Basudeb Bhatta, Remote Sensing and GIS, Third Edition, Oxford University Press, New Delhi. ISBN: 9780199496648
- 5 B. C. Punmia, Ashok K Jain, Arun K Jain, Advance Surveying, Laxmi Publications (ISBN 9788170088530)
- 6 R. Subramanian, Surveying and levelling, Oxford University Press, New Delhi (ISBN9780198085423)
- 7 P. Dong , Q.Chen, Lidar Remote Sensing and applications ,CRC Press (ISBN 9781138747241)

Reference Books:

- 1 Basudeb Bhatta, Remote Sensing and GIS, Third Edition, Oxford University Press, New Delhi. ISBN: 9780199496648
- 2 T.M Lillesand, R.W Kiefer, and J.W Chipman, Remote sensing and Image interpretation, 5th edition, John Wiley and Sons, India; ISBN: 978-1-118-34328-9
- 3 Kaplan E.D and Hegarty C.J., Understanding GPS: principles and applications, Artech House (ISBN978-1-63081-058-0)

- 4 Wolf P.R. and Dewitt B.A., Elements of Photogrammetry, McGraw Hill,(ISBN 978-0072924541)
- 5 DeMers M.N., Fundamentals of GIS, John Wiley (ISBN978-0470129067)
- 6 Gibson P.J., Introductory Remote Sensing: Principles and Concepts, Routledge (ISBN0 415 18962 4).

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc20_ce16/preview
2.	https://onlinecourses.nptel.ac.in/noc25_ce31/preview
3.	https://onlinecourses.nptel.ac.in/noc25_ce13/preview

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095115	Advanced Concrete Technology	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095115	Advanced Concrete Technology	20	20	40	60	2	--	--	100

Rationale:

Concrete technology forms a critical foundation for civil engineering, serving as a cornerstone in the planning, execution, and quality control of infrastructure projects. With continuous advancements in materials science and construction methodologies, an in-depth understanding of concrete behavior, mix design, and performance characteristics is essential for modern civil engineers. This course is designed to equip students with comprehensive knowledge of concrete as a versatile and widely used construction material. It emphasizes the scientific principles governing the properties of constituent materials, mix proportioning techniques, and various stages of concrete production, including mixing, placing, compacting, curing, and finishing.

Students will also explore advanced topics such as high-performance concrete, durability parameters, non-destructive testing, and sustainability in concrete construction. Emphasis is placed on quality assurance and control practices, as well as compliance with evolving national and international standards. The practical part of the course enables students to gain in-depth exposure to advanced material characterization, mix design optimization, workability evaluation, and strength assessment through standard laboratory procedures. Students will perform various tests on fresh and hardened concrete, including non-destructive testing (NDT), durability assessment, and study of special concretes such as self-compacting concrete (SCC), fiber-reinforced concrete (FRC), and high-strength concrete.

Course Objectives:

1. To understand the various properties and tests of materials used in concrete along with the rheology of fresh concrete.
2. To study the different procedures for testing hardened concrete, its compositions and quality of in place concrete.
3. To understand the concept of durability, permeability and cracking in concrete. Also to study the constituents and properties of High Performance Concrete(HPC).
4. To understand the concepts and optimization of the mix design of concrete by various codes./methods
5. To study the various constituents, properties, significance and applications of special concrete.
6. To study the quality of concrete and check the acceptance criteria.

Course Outcomes:

On completion of the course students will be able to:

1. To understand the various concrete materials and demonstrate the properties of fresh concrete.
2. To study and understand different testing methods of concrete.
3. To describe the durability of concrete and apply the knowledge of durability in extreme weather concreting.
4. To design the concrete mix for field applications by different codes/methods.
5. To explain the various properties of special concrete and understand its applications.
6. To discuss the quality of concrete and explain the acceptance criteria.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Constituents and Properties Of Concrete		08	CO1
	1.1	Introduction of cement and water: Chemistry of Bogue's compounds and its importance. Structure of hydrated cement.		
	1.2	Aggregates: Types of aggregate (natural, synthetic, recycled) and its engineering properties. Introduction to gradation of aggregates, standard grading curve and gap grading.		
	1.3	Chemical admixture: Introduction to accelerators, retarders, plasticizers, super plasticizers, viscosity modifying admixtures, water proofers, miscellaneous admixtures.		
	1.4	Mineral admixture: Introduction, composition of mineral admixture, fly ash and its type, silica fume, ground granulated blast furnace slag and others. Effects of mineral admixture on fresh and hardened concrete properties.		
	1.5	Properties of fresh concrete: Introduction to properties of fresh concrete, w/c ratio, w/b ratio, gel space ratio, maturity concept, aggregate cement bond strength, pumping of concrete.		
	1.6	Rheological models of fresh concrete: Introduction, simple flow test, rheological models and test methods, factors affecting rheological properties of concrete and effect of rheological properties on different types of concrete.		
2	Testing of Concrete		03	CO2
	2.1	Test of hardened concrete - compression, tension, and flexure. Methods of testing (destructive, semi destructive, non-destructive).		

Module	Course Module / Contents		Hours	CO Mapping
	2.2	Advanced non-destructive evaluation: Ground penetration radar, probe test penetration, pull out/off, break off method, stress wave propagation method, electrical / magnetic methods, infrared thermography and core test.		
3	Durability and Permeability of Concrete		10	CO3
	3.1	Introduction to durability and permeability: Transport mechanism of fluids and gases in concrete, role of w/c and admixture on durability. Design of durability using performance specification.		
	3.2	Corrosion and carbonation: Introduction to corrosion of reinforcement in concrete, factors influencing corrosion, damages preventive measures of corrosion, tests for existing structures and remedial measures of corrosion, introduction and measurement of depth of carbonation.		
	3.3	Concrete structures in special environment: Frost action, fire or high temperature, chemical attack and aggressive environment (sulphate attack, chloride attack, acid attack in sewers, sea water attack), alkali aggregate reaction (alkali silica and carbonate reaction).		
	3.4	High performance concrete: Methods for achieving high performance concrete, requirements for high performance characteristics, material selection, advantages and applications.		
4	Concrete Mixture Design		10	CO4
	4.1	Design of concrete mixes by IS 10262 (latest edition) Method – with and without fly ash, super plasticizer, effect of pumping of concrete on mixture design.		
	4.2	Design of concrete mixes by American Concrete Institute (ACI) Method – Air and non-air entrained concrete. Design of high strength concrete mixes using ACI 211.4R - 93 Method.		
	4.3	Design of concrete mixes by Department of Environment (DoE) Method.		
	4.4	Design of concrete mixes by Road note 4 Method.		
	4.5	Design of light weight aggregate concrete mixes.		
5	Special Concretes		06	CO5
	5.1	Light weight concrete and ultra-light weight concrete: Types and properties of light weight aggregates, factors influencing the strength and density of light weight aggregate concrete, properties of light weight aggregate concrete. Introduction to other light weight concrete – Cellular and foamed concrete.		

Module	Course Module / Contents		Hours	CO Mapping
	5.2	Self-compacting concrete (SCC): Materials for SCC, comparison of traditional and SCC constituents, requirements for SCC, initial mix compositions, production and placing of SCC, fresh concrete tests for SCC.		
	5.3	Fiber Reinforced Concrete (FRC): Fiber types (metallic fiber, polymeric fibers, carbon fibers, glass fibers and naturally occurring fibers), properties and applications. Interaction between fibers and matrix (un-cracked and cracked matrix), basic concepts and mechanical properties: tension and bending.		
	5.4	Introduction to other special concrete – Vacuum concrete, waste material-based concrete, shotcrete, roller compacted concrete, mass concrete, underwater concrete and ferrocement.		
6	Quality Control (QC)		02	CO6
	6.1	Introduction: Statistical QC, quality factors, control charts.		
	6.2	Acceptance criteria according to Indian standards: Strength of concrete (site and laboratory)		

Recommended Books:

1. Concrete Technology Theory and Practice: Shetty M.S., S. Chand.
2. Concrete Technology: A. R. Shanthakumar, Oxford University Press, New Delhi, 2007.
3. Properties of concrete: Neville, Isaac Pitman, London.
4. Concrete Technology: Gambhir M.L., Tata McGraw Hill, New Delhi.
5. Concrete Technology: Neville A.M. & Brooks. J. J., ELBS-Longman, Pearson Education Ltd.
6. Design of concrete mixes by N Krishna Raju (Latest Edition), CBS Publishers and Distributors Pvt. Ltd.

Reference Books:

1. Fibre Reinforced Cementitious Composites: Arnon Bentur and Sidney Mindess, Modern Concrete Technology Series, Tylor and Francis.
2. Concrete- Microstructures, Properties and Materials: P. Kumar Mehta and Paulo J. M. Monteiro, Indian Edition, Indian Concrete Institute, Chennai, 1999 .
3. Special Publication of ACI on Polymer concrete and FRC.
4. Concrete Technology: D.F. Orchard, Wiley, 1962.
5. Relevant I.S. codes: Bureau of Indian standard and ACI code.
6. IS 10262 : 2009: Concrete Mix Proportioning – Guidelines
7. IS 456-2000: Plain And Reinforced Concrete - Code Of Practice (Fourth Revision)
8. IS 383-1970: Specification For Coarse And Fine Aggregates From Natural Sources For Concrete (Second Revision).
9. IS 9103-1999: Indian Standard Concrete Admixtures - Specification (First Revision.
10. IS.9012-1978: Recommended Practices for shotcreting.

11. IS 3812 (Part 1) :2003 Indian Standard Pulverized Fuel Ash — Specification Part 1 for use as Pozzolana in Cement, Cement Mortar and Concrete
12. IS 16714:2018: Ground Granulated Blast Furnace Slag For Use In Cement, Mortar, And Concrete-Specifications.
13. ACI 211.4R - 93 Method: Guide for Selecting Proportions for High-Strength Concrete with Portland Cement and Fly Ash Reported by ACI Committee 211 .

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc25_ce93/preview (swayam)
2.	https://onlinecourses.nptel.ac.in/noc25_ce10/preview (swayam)
3.	https://onlinecourses.nptel.ac.in/noc25_ce73/preview (swayam)
4.	Sachan, A. K., and C. V. S. Kameswara Rao. "A cone penetration test for workability of fibre reinforced concrete." <i>Materials and Structures</i> 21.6 (1988): 448-452.

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes and presentation on case study of project associate with specialized concrete.

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095116	Applied Hydraulics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095116	Applied Hydraulics	20	20	40	60	2	--	--	100

Rationale:

The knowledge of this course is essential to understand facts, concepts of impact of jets and dimensional analysis. It also helps to study the concept of uniform flow through open channels, non-uniform flow through open channels.

Course Objectives:

The students will be able to learn:

1. To carry out the dimensional analysis
2. To introduce the concept of impact of jets.
3. To study the working principles of turbines.
4. To study the working principles of centrifugal pumps.
5. To study the uniform flow through open channels and design of most economical section.
6. To study the non-uniform flow through open channels.

Course Outcomes:

On completion of the course students will be able to:

1. Illustrate the importance of dimensionless numbers, dimensional analysis and similarity behavior of model and prototype
2. Describe impact of jet on stationary, moving, hinged and series of plates also solve the numerical based on forces acting on it.
3. Distinguish various types of turbines, Characteristic curves and its components.
4. Analyze Centrifugal pumps by incorporating velocity triangle diagrams.
5. Identify the hydraulic behaviour of open channel flow and design the most economical section of channels.
6. Explain mathematical relationships for hydraulic jumps, surges, and critical, uniform, and gradually-varying flows.

Detailed Syllabus

Module	Course Module / Contents	Hours	CO Mapping
1	Dimensional Analysis	05	CO1
	1.1 Dimensional homogeneity, Buckingham's π theorem, Reyleigh's method		
	1.2 Dimensionless numbers and their significance		
	1.3 Model (or similarity) laws, application of model laws: Reynold's model law, Froude's model law, scale effect in models		
2	Impact of Jets	08	CO2
	2.1 Impulse momentum principle		
	2.2 Jet striking flat plates, stationary and moving vertical, inclined plates,		
	2.3 Jet striking hinged plates, curved vanes, series of plates and vanes mounted on wheel, concept of velocity triangles.		
3	Hydraulic Turbines	08	CO3
	3.1 General layout of hydro-electric plant, heads, efficiencies of turbine, classification		
	3.2 Working of Impulse Turbine (Pelton Wheel), Reaction Turbine, Francis Turbine, Kaplan Turbine, Velocity triangles for turbines		
	3.3 Draft tube theory, specific speed, unit quantities, Characteristic curves, Cavitation.		
4	Centrifugal Pumps	04	CO4
	4.1 Work done, heads, efficiencies, Minimum speed, priming, characteristic curves, NPSH, cavitation		
	4.2 Series parallel operation, Multistage pumps		
	4.3 Velocity triangles for pumps, specific speed, model testing		
5	Uniform Flow Through Open Channels	06	CO5
	5.1 Uniform Flow: Flow through open channel: Definition, types of channels, Prismatic, non-prismatic channels, Types of flows in channels		
	5.2 Uniform flow: steady flow and unsteady flow, laminar and turbulent flow, critical flow, subcritical flow, supercritical flow		
	5.3 Chezy's formula, Manning's formula, hydraulically efficient channel cross-sections (most economical sections).		
6	Non-Uniform Flow Through Open Channels	08	CO6
	6.1 Concept of Specific energy and specific energy curve, applications of specific energy and Momentum principle to open channel flow, specific force		
	6.2 Gradually varied flow, dynamic equation for gradually varied flow, back water curve and afflux, Introduction to surface profiles, RVF, Hydraulic jump and standing wave.		

Text Books:

1. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi.
2. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
3. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
4. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538.
5. Fluid Mechanics and fluid pressure engineering: Dr. D.S.Kumar, F.K. Kataria and sons.
6. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.
7. Flow through open channels, K.G.Ranga Raju (1993): New Delhi: Tata McGrawHill, c1993.
8. Flow Through Open Channels. Rajesh Srivastava (2007): Oxford University Press, 2007, pbk, 432 p, ISBN: 0195690385.

References:

1. Fluid Mechanics: Frank M. White, Tata Mc-Graw Hill International Edition.
2. Fluid Mechanics: Streeter White Bedford, Tata Mc-Graw International Edition.
3. Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Franzini, E.J. Finnemore, Tata Mc-Graw Hill, New Delhi.
4. Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGE Learning India (Pvt.) Ltd.
5. Introduction to Fluid Mechanics: Edward J. Shaughnessy, Jr, Ira M. Katz, James P. Schaffer. Oxford Higher Education.
6. Open channel Hydraulics: Chow, V.T., McGraw Hill International, New York.
7. Open Channel Flow: Henderson F.M., McGraw Hill International, New York.

Online References:

Sr. No.	Website Name
1.	NPTEL (relevant courses)

Assessment:**Internal Continuous Assessment: 40%****Internal Assessment Test (IAT) for 20 marks each:**

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.

End Semester Theory Examination:**➤ Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095117	Green Building	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095117	Green Building	20	20	40	60	2	--	--	100

Rationale:

The rationale of this course is to introduce students to the concepts and principles of green building design and sustainable construction. It aims to develop an understanding of energy-efficient, water-conserving, and environmentally responsible building practices. Students will learn to evaluate materials, systems, and site planning strategies that minimize environmental impact and promote sustainability. The course encourages the application of green rating systems and innovative techniques to create eco-friendly and cost-effective building solutions.

Course Objectives:

1. To understand the fundamental principles of sustainable and green building design.
2. To evaluate the environmental impact of building materials and construction methods.
3. To learn techniques for energy, water, and material efficiency in buildings.
4. To apply green building rating systems and assessment tools.
5. To promote eco-friendly and cost-effective construction practices.
6. To develop awareness of sustainable site planning and resource conservation.

Course Outcomes:

On completion of the course students will be able to:

1. Explain the core principles and components of sustainable and green building design.
2. Utilize green building rating systems and analytical tools for performance evaluation.
3. Integrate concepts of sustainable site planning and resource management in design decisions.
4. Demonstrate methods to achieve energy, water, and material efficiency in building projects
5. Assess the environmental impacts of various building materials.
6. Propose eco-friendly and economically viable solutions for green buildings.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction to Green Building		04	CO1
	1.1	Fundamentals of Green Building and sustainable development		
	1.2	Overview of features of green building: Design and Construction Efficiency, Water Efficiency, Energy Efficiency, Material Efficiency, Indoor Environmental Quality, Waste Reduction, Operations and Maintenance.		
	1.3	Case Studies and Examples of Green Buildings.		
2	Introduction to Green Building Rating Systems		06	CO2
	2.1	LEED (Leadership in Energy and Environmental Design), IGBC (Indian Green Building Council), TERI-GRIHA / SWAGRIHA (Green Rating for Integrated Habitat Assessment), BREEAM (Building Research Establishment Environmental Assessment Method), EDGE (Excellence in Design for Greater Efficiencies), The Indian Bureau of Energy Efficiency (BEE), The Energy Conservation and Sustainable Building Code (ECSBC)		
	2.2	Indian Green Building Council (IGBC) rating system		
3	Site Selection, Planning and Design		08	CO3
	3.1	Site preservation		
	3.2	Passive architecture		
	3.3	Soil erosion control		
	3.4.	Natural topography and on-site vegetation		
	3.5	Preservation of transportation of trees on-site		
	3.6	Heat island reduction		
	3.7	Optimization in structural design		
	3.8	Innovation in design process		
4	Water Conservation		09	CO4
	4.1	Rainwater Harvesting (RWH): design. Methods for various types of building, Current technologies used in RWH		
	4.2	Water-Efficient Plumbing Fixtures		
	4.3	Irrigation Systems		
	4.4	Wastewater Treatment and Reuse, on-site wastewater treatment, Regulatory standards and quality requirements for treated water reuse, Wastewater Reuse During Construction.		
	4.5	Water Metering		

Module	Course Module / Contents		Hours	CO Mapping
	Energy Efficiency			
	4.7	Minimum and Enhanced Energy Efficiency		
	4.8	Commissioning Plan for Building Equipment and Systems (Pre- and Post-Installation)		
	4.9	On-site and Off-site Renewable Energy		
	4.10	Energy Metering and Management		
5	Green building materials and indoor environmental quality		09	CO5
	5.1	Sustainable building materials, e.g., FSC, ISO, IGBC-approved products, Life Cycle Assessment (LCA), numerical on Life Cycle Costing (LCC).		
	5.2.	Waste Management in Buildings		
	5.3.	Indoor Environmental Quality (IEQ) and Air Management, Fresh Air Ventilation, CO ₂ Monitoring and Carbon Management, E-factor, numerical on carbon footprint		
	5.4.	Day lighting and Pollution Control, Minimizing Indoor and Outdoor Pollutants, Low-Emitting Materials		
	5.5.	Occupant Health and Well-Being, Designing spaces		
	5.6.	Indoor Air Quality (IAQ) Testing and Management, testing after construction and before occupancy.		
6	Green Audit and Performance Assessment		03	CO6
	6.1	Introduction to Green Audit, Phases of a Green Audit		
	6.2	Green Audit for Existing and Heritage Buildings, Methodologies and strategies, retrofitting, operational efficiency, and sustainable management practices.		
	6.3	Case Study of a Green Audit		

Text Books:

1. Green Building: Principles and Practices, Dr. Adv. Harshul Savla (Notion Press)
2. The Idea of Green Building by A. K. Jain (Khanna Publishers)
3. Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination by Karthik Karuppu (Notion Press)
4. Green Building Materials & Implementation Dr. V. Muruges (Notion Press)
5. Green Building Fundamentals G. Harihara Iyer (Notion Press)

References:

1. Indian Green Building Council (IGBC) web-site: <https://igbc.in/igbc/>
2. Swagriha manual: https://www.grihaindia.org/files/SVAGRIHA_Manual_Ver-2013.pdf
3. Leadership in Energy & Environmental Design (LEED) web-site: <https://www.usgbc.org/leed>

4. Green Building: Principles & Practices in Residential Construction by Abe Kruger and Carl Seville (Delmar Cengage Learning)
5. Green Building through Integrated Design by Jerry Yudelson (McGraw Hill)
6. Green Building Handbook: Volume 1: A Guide to Building Products and their Impact on the Environment by Tom Wooley, Sam Kimmins, Rob Harrison and Paul Harrison (Routledge Publishers)

Online References:

Sr. No.	Website Name
1.	Indian Green Building Council (IGBC) https://igbc.in/igbc
2.	Swagriha manual: https://www.grihaindia.org/files/SVAGRIHA_Manual_Ver-2013.pdf
3.	Leadership in Energy & Environmental Design (LEED) https://www.usgbc.org/leed
4.	NPTEL courses: https://nptel.ac.in/aboutus
5.	Energy Conservation and Sustainable Building code: https://beeindia.gov.in/sites/default/files/ECSBC%202024_Building%20Code%20for%20Commercial%20Buildings.pdf

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Site visit, Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095118	Advanced Structural Mechanics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095118	Advanced Structural Mechanics	20	20	40	60	2	--	--	100

Rationale:

Advanced Structural Mechanics enhances students' understanding of structural behaviour beyond basic strength of materials. It introduces concepts such as unsymmetrical bending, shear centre, curved beams, torsion, elastic stability, and deep-beam action, which are essential for analysing complex real-world structures. The course develops analytical skills needed for safe and efficient structural design and prepares learners for advanced subjects such as earthquake engineering, FEM, and structural dynamics.

Course Objectives:

1. Understand unsymmetrical bending, locate the shear centre, and find stresses for symmetrical and unsymmetrical thin-walled open sections; understand the basics of springs.
2. Explain and compute stresses in beams curved in elevation (hooks, rings, chain links).
3. Analyse beams curved in plan under different loadings and support conditions.
4. Model and evaluate the response of beams on elastic foundation (infinite/semi-infinite; various loads).
5. Apply appropriate theories of failure to materials under multiaxial stress states and justify the choice.
6. Determine deflections and shear-correction factors for deep beams of common sections (rectangular, circular, I-section).

Course Outcomes: On completion of the course students will be able to:

1. Select an appropriate failure theory for a given stress state; compute the factor of safety with justification.
2. Compute stresses in unsymmetrical bending and locate the shear centre for thin-walled open sections
3. Analyse curved beams to determine neutral axis location and extreme fibre stresses for typical cases (hooks, rings, links).
4. Analyse shafts/bars in torsion to obtain maximum shear stress, angle of twist, and power capacity.
5. Determine Euler buckling loads (with energy methods) and estimate effects of composite member properties using effective modulus.
6. Determine deep-beam deflection using Timoshenko theory and evaluate the shear-correction factor k for common sections.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Theories of Failure		07	CO1
	1.1	Maximum principal stress theory, Maximum principal strain theory		
	1.2	Maximum Shear Stress Theory		
	1.3	Distortion (Von mises) theory for ductile materials		
	1.4	Maximum total strain energy theory.		
2	Unsymmetrical Bending, Shear Centre and Springs		07	CO2
	2.1	Product of inertia, principal moment of inertia		
	2.2	Flexural stresses due to bending in two planes for symmetrical sections, bending of unsymmetrical sections.		
	2.3	Shear Centre for symmetrical & unsymmetrical (about both axes) thin-walled open sections.		
	2.4	Helical springs, flat spiral springs, laminated springs.		
3	Beams Curved in Elevation and Plan		07	CO3
	3.1	Beams Curved in Elevation -Bending of beams with large initial curvature, -Behaviour when loaded in their plane of curvature.		
	3.2	Applications to Curved Members -Analysis of hooks -Circular closed rings -Chain links with straight lengths and semi-circular ends		
	3.3	Beams Curved in Plan – General Analysis -Behaviour of beams curved in plan under different loading and support conditions		
	3.4	Specific Cases of Beams Curved in Plan -Cantilever circular arc beams fixed at two ends and subjected to central concentrated load -Simply supported semicircular beams subjected to UDL -Beams supported on three equally spaced columns -Analysis of circular ring beams		
4	Torsion of Circular Members and Prismatic Bars		06	CO4
	4.1	Torsion of Circular Members -Torsion of solid and hollow circular shafts -Shear stress, angle of twist, design using τ & θ -Power transmission capacity of shafts		

Module	Course Module / Contents		Hours	CO Mapping
	4.2	Strain Energy and Combined Shaft Systems -Strain energy in torsion -Castigliano's Theorem I applied to torsion -Shafts in series and parallel		
	4.3	Torsion of Prismatic and Thin-Walled Sections -Torsion of non-circular prismatic bars (rectangular sections): key results and limitations -Example of thin-walled closed sections under torsion		
5	Elastic Stability		06	CO5
	5.1	Introduction to Elastic Stability -Concept of elastic stability in structural members -Behaviour of slender members under axial loading		
	5.2	Euler's Buckling Load & Energy Methods -Euler's buckling load for columns -Use of energy methods for buckling analysis		
	5.3	Composite Members & Effective Modulus -Terminology related to composite members -Rule of mixtures (basics) -Determination of effective modulus for Euler buckling -Brief comparison of torsion behaviour in thin-walled tubes		
6	Analysis of Deep Beams		06	CO6
	6.1	Deflection of Deep Beams -Determination of deflection in deep beams -Behavioural differences between deep beams and slender beams		
	6.2	Shear Correction Factor (k) -Evaluation of shear-correction factor for: -Rectangular solid and hollow sections -Circular solid and hollow sections -I-sections		
	6.3	Relation to Timoshenko Beam Theory -Importance of shear correction factor in Timoshenko beam theory -Applicability and limitations for deep-beam analysis		

Text Books:

1. Agarwal, P., & Shrikhande, M. *Earthquake-Resistant Design of Structures*. Prentice Hall India, New Delhi, 4th Edition, 2007.
2. Duggal, S. K. *Earthquake-Resistant Design of Structures*. Oxford University Press, New Delhi.

References:

1. Clough, R. W., & Penzien, J. *Dynamics of Structures*. McGraw-Hill Publications.
2. Chopra, A. K. *Dynamics of Structures: Theory and Applications to Earthquake Engineering*. Prentice Hall.
3. Key, David. *Earthquake Design Practice for Buildings*. Thomas Telford Publishers.
4. Kelly, James M. *Earthquake-Resistant Design with Rubber*. Springer-Verlag Publications.
5. Dowrick, D. J. *Earthquake-Resistant Design for Engineers and Architects*. John Wiley & Sons.
6. Robinson, D. *Passive Vibration Control*.

Online References:

Sr. No.	Website Name
2.	https://onlinecourses.nptel.ac.in/noc25_ce110/preview

Assessment:**Internal Continuous Assessment: 40%****Internal Assessment Test (IAT) for 20 marks each:**

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)

End Semester Theory Examination:**➤ Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Program Core Course Lab

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095119	Design of Structures Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095119	Design of Structures Lab	--	--	--	--	--	25	--	25

Lab Objectives:

1. To develop a clear understanding of design philosophy for the design of reinforced concrete structures using working stress method (WSM) and limit state method (LSM).
2. To describe various clauses of IS: 456-2000 and their significance in the RCC design.
3. To apply various concepts of LSM in the analysis and design of beams, slabs, columns and footings.
4. To explain the concepts of design of structural steel members as per the provisions of IS 800-2007.
5. To illustrate structural steel connections.
6. To analyse and design the structural steel members for axial, bending and shear loads.

Lab Outcomes: Student will be able to

1. Explain the concepts of WSM in the analysis of singly and doubly reinforced rectangular beams.
2. Apply the principles, procedures and current Indian code requirements to the analysis and design of beams and slabs, using the design concepts of LSM.
3. Use the principles of LSM in the design of columns and footings.
4. Illustrate the structural steel sections, types of joints and various structural connections.
5. Analyse and design tension, compression and flexural members using structural steel.
6. Demonstrate the use of relevant codes and standards in the design of a structural member.

Online Resources:

Sr. No.	Website Name
1.	Design of Reinforced Concrete Structures: https://nptel.ac.in/courses/105105105
2.	Design of Steel Structures: https://nptel.ac.in/courses/105105162
3.	Design of Connections in Steel Structures: https://nptel.ac.in/courses/105106216

List of Tutorials.

Sr. No.	List of Tutorials	Hrs	LO
1.	Analysis of singly and doubly reinforced RC beams using WSM.	02	LO1
2.	Analysis and design of singly and doubly reinforced rectangular RC beams using LSM.	02	LO2

3.	Design of beams for bending and shear using LSM, with reinforcement detailing	02	LO2
4.	Design of one-way slabs with reinforcement detailing.	02	LO2
5.	Design of simply supported two-way slabs with reinforcement detailing.	02	LO2
6.	Design of short columns and isolated square or rectangular footings with reinforcement detailing.	02	LO3
7.	Introduction to structural steel sections and Indian standard steel tables: simple sketches of commonly used sections, lap and butt joints.	02	LO4
8.	Design of bolted and welded connections, bracket connections.	02	LO4
9.	Sketching of framed and different types of seat connections.	02	LO4
10.	Design of built-up columns connected with lacing or battens with neat sketches.	02	LO5
11.	Design of slab bases with neat sketches. Gusseted bases (only sketching)	02	LO5
12.	Design of flexural members.	02	LO5
13.	Report and Presentation on design of any structural member as per the provisions of IS 456-2000 or IS 800-2007, as a group activity (suggested topics: Flanged beams, beams subjected to torsion, restrained slabs, combined footings, beam to beam connection and beam to column connections, gusseted bases etc.)	02	LO6

Text Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Limit State Design of Reinforced Concrete: Jain A. K, Nemchand and Bros., Roorkee
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.
5. Design of Steel Structure by N. Subramanian, Oxford University Press, New Delhi.
6. Limit state design of steel structures by S. K. Duggal, McGraw Hill Education (India) Pvt. Limited, New Delhi.
7. Relevant Indian Specifications, Bureau of Indian Standards, New Delhi.

References:

1. Design of Steel Structure by Allen Williams
2. Practical Design of Steel Structure by Karuna Moy Ghosh, Whittles Publishing
3. Structural design and drawing by D. Krishnamurthy, CBS Publishers, New Delhi.
4. Teaching Resources Material for steel structures by INSDAG Kolkata

Assessment:

Term Work shall consist of

1. Detailed neatly written design reports and structural drawings of tutorials based on the above list. Structural drawings to be prepared on A3 sized drawing sheets or sketch books.
2. A site visit report related to this course.

Distribution of marks for Term Work shall be as follows:

Design reports, drawings and Site visit report:	15 marks
Report & Presentation:	05 marks
Attendance:	05 marks

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095120	Engineering Geology & Soil Mechanics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095120	Engineering Geology & Soil Mechanics Lab	--	--	--	--	--	25	25	50

Laboratory Objectives

Students will be able:

1. Identify various rock forming minerals on the basis of physical properties.
2. Identify Igneous, Sedimentary and Metamorphic rocks and assess their suitability as construction and foundation material.
3. Interpret the geological map and assess the suitability of the site for Civil Engineering works.
4. To determine physical and index properties of soil and perform grain size distribution of soils.
5. To determine coefficient of permeability in the laboratory.
6. To determine the density index (relative density) of cohesionless soil

Laboratory Outcomes

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

1. Identify various rock forming minerals and rocks on the basis of physical properties. Identify the suitability of various rocks based on their physical properties, structure, and texture
2. Study the given geological map by plotting the section to analyze structural features and assess site suitability for civil structures.
3. Determine the physical and engineering properties of soil
4. Determine the plasticity characteristics of soil
5. Carry out sieve analysis of soil, plot grain size distribution curve and classify the soil as per IS: 1498.
6. Determine coefficient of permeability of soils

Text Books:

1. Engineering Geology: N. Chenna, Kesavulu, Macmillan India Limited, 1996.

2. Engineering Geology: Dr. R. B. Gupte, Pune Vidyarthi Griha Prakashan, Pune.
3. Principles of Engineering Geology', Rawat S., Bhattacharya M. and **Joshi, P.**, 2020, Nirali Prakashan-Mumbai, ISBN 978-93-90506-36-1
4. Principles of Engineering Geology: K. M. Banger.
5. Soil Mechanics and Foundation: Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications
6. Soil Mechanics and Foundation Engineering: K.R. Arora; Standard publishers and Distributors
7. Soil Mechanics and Foundation Engineering: V.N.S Murthy; Saitech Publications
8. Geotechnical Engineering: C. Venkatramaiah; New age International
9. Basic and Applied Soil Mechanic: Gopal Ranjan and A.S. Rao; New Age International

References:

1. Geology for Civil Engineering: A. C. McLean, C.D. Gribble, George Allen & Unwin London.
2. Earth Revealed, Physical Geology: David McGeary and Charles C. Plummer, Diane H. Carlson, 2001, McGraw-Hill edition.
3. Theoretical Soil Mechanic: K. Terzaghi; John Wiley and Sons
4. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley and sons
5. Relevant Indian Standard Specification Code: BIS Publications, New Delhi
6. Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House
7. Geotechnical Engineering: Purushothama Raj; Tata McGraw Hill Publications

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/105105168
2.	https://nptel.ac.in/courses/105105106

Module	Detailed Contents	Lab Sessions/ Hr	LO Mapping
Part A: Perform Any Four:			
1	Study of Physical Properties of Minerals: Rock forming minerals Identification of common Rock forming minerals on the basis of physical Properties- Quartz, Orthoclase, Plagioclase, Micas, Hornblende, Asbestos.	02	LO1
2	Identification of Non-Silicate Minerals: Carbonate Group: Calcite and Economic Minerals	02	LO1
3	Identification of Rocks: Identification on the basis of texture and structures of the following rocks: Igneous Rocks -Granite and its varieties, Basalt and its varieties Sedimentary Rocks - Conglomerate, Breccia, Sandstone, Shales, Limestones and Laterites.	02	LO1
4	Metamorphic Rocks - Marbles, Quartzite, Slate, Schist and Gneiss	02	LO1
5	Geological Maps: (i) Horizontal strata: Drawing the cross section and assessment of	02	LO2

Module	Detailed Contents	Lab Sessions/ Hr	LO Mapping
	geological history of the area. (ii) Inclined Strata: Calculation of dip and strike in an inclined strata and assessment of geological history of the area.		
6	Assessment of the geological conditions for a proposed dam site in the given map	02	LO2
7	Assessment of the geological conditions for groundwater reserve in the given map	02	LO2
Part B: Perform Any Six:			
1	Determination of natural moisture content of soil using oven drying method Following other methods to find moisture content shall be explained briefly: a) Pycnometer method b) Sand bath method c) Alcohol method d) Torsional balance method e) Moisture meter f) Radio activity method	02	LO3
2	Specific gravity of soil grains by density bottle method or Pycnometer method	02	LO3
3	Field density using core cutter method	02	LO3
4	Field density using sand replacement method	02	LO3
5	Determination of liquid (Casagrande's Method), and plastic limit.	02	LO4
6	Determination of liquid limit by cone penetrometer method	02	LO4
7	Field identification of fine-grained soils	02	LO5
8	Grain size distribution of coarse-grained portions (gravel and sand) of soil by sieve analysis	02	LO5
9	Grain size distribution of fine portions (silt and clay) of the soil by Hydrometer analysis.	02	LO5
10	Determination of co-efficient of permeability using constant head method	02	LO6
11	Determination of co-efficient of permeability using falling head method	02	LO6

Assessment:

Term Work: Term Work shall consist of at least 10 practicals (combined Part A and Part B) based on the Experiment list and 05 questions per module as an Assignment.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 05 Marks (Assignments) + 5 Marks (Attendance)

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Oral Exam: An oral exam will be held based on the above syllabus

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095121	Transportation Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095121	Transportation Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To determine the strength properties of coarse aggregates, specifically their resistance to sudden shock (impact) and gradual loading (crushing).
2. To evaluate the durability and geometrical properties of road aggregates by measuring their resistance to wear (abrasion) and assessing their shape characteristics.
3. To experimentally determine the consistency and temperature susceptibility of a given bitumen sample using the Penetration and Softening Point tests.
4. To assess the flow characteristics (viscosity) and elastic properties (ductility) of bitumen to evaluate its suitability for various road applications.
5. To familiarize students with modern computational tools for the design of flexible and rigid pavements based on specified traffic loads and material properties.
6. To conduct a basic classified traffic volume count and speed study to gather essential data for traffic engineering analysis and planning.

Lab Outcomes: Student will be able to

1. Calculate the Aggregate Impact Value and Crushing Value and compare them to standard specifications to judge the aggregate's suitability for road base or surface courses.
2. Successfully perform the Abrasion and Shape tests and use the data to comment on the expected service life and workability of the aggregate mixture.
3. Evaluate the grade and temperature performance of bitumen by correctly performing and analyzing Penetration and Softening Point test results.
4. Demonstrate proficiency in conducting the Viscosity and Ductility tests, and use the results to determine the bitumen's handling and crack resistance properties.
5. Utilize pavement design software to input relevant data and produce a standardized pavement layer structure and thickness for a given design life.
6. collect and correctly process raw field data to calculate Average Daily Traffic (ADT) and various measures of speed necessary for geometric design.

Text Books:

- 1 Chandra, Satish, Rajat Rastogi, and Manoj K. Shukla. Manual for Testing of Highway Materials. New Delhi: Narosa Publishing House, 2022.
- 2 Bureau of Indian Standards (BIS). IS:2386 Part I & II (latest revision). New Delhi: BIS.

References:

- 1 Traffic Engineering and Transport Planning: Kadiyali, L.R., Khanna Publishers, Delhi.
- 2 Principles and Practice of Highway Engineering: Kadiyali, L. R.; Khanna Publishers, Delhi.
- 3 Ministry of Road Transport & Highways (MoRTH). *Specifications for Road and Bridge Works*. 6th Revision (or latest). New Delhi: Indian Roads Congress.

Online Resources:

Sr. No.	Website Name
1.	IITPAVE Software use https://www.youtube.com/watch?v=uOkVUk0-i9k
2.	KENPAVE Tutorial https://www.youtube.com/watch?v=M-8YmKJiihE

List of Experiments.

Sr. No.	List of Activities	Hrs	LO
01	Experiment 1: Determination of Aggregate Impact Value	2	1
02	Experiment 2: Determination of Aggregate Crushing Value	2	1
03	Experiment 3: Determination of Abrasion Value of Road Aggregate	2	2
04	Experiment 4: Shape Test of Aggregate	2	2
05	Experiment 5: Penetration Test on Bitumen.	2	3
06	Experiment 6: Softening Point Test on Bitumen	2	3
07	Experiment 7: Viscosity Test on Bitumen.	2	4
08	Experiment 8: Ductility Test on Bitumen	2	4
09	Software based design: Design of flexible and Rigid pavement using software	4	5
10	Traffic Survey: Classified Volume Count and Speed Study at Mid-block section.	2	6

Assessment:

Term Work: Term Work shall consist of practical's based on the above list along with assignments, quizzes etc. as mentioned in theory course.

Term Work Marks: 25 Marks (Total marks) = 08 Marks (Experiments) + 06 Marks (Assignments, Open book test, Class test, Quizzes etc.) + 03 Marks (Software based design) + 03 Marks (Traffic Survey) + 05 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the Theory syllabus and Lab work.

Program Elective Course - 1

Lab

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095122	Modern Surveying Instruments and Techniques Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095122	Modern Surveying Instruments and Techniques Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the working principle and temporary adjustments of the Total Station
2. To operate the Total Station and generate its output in terms of plans, elevations.
3. To enable the learner to Transfer data collected through TS on a convenient computer aided drafting (CAD) software
4. To understand the fundamental features of Global Navigation Satellite System (GNSS)
5. To enable the learners, to operate the Global Navigation Satellite System (GNSS) receivers and retrieve the information
6. To enable the learners work on a Geographical Information System (GIS) platform for assimilating geographical data

Lab Outcomes: Student will be able to:

1. Operate a Total Station and traverse the field.
2. Perform various operations like computing height of a structure, computing area of plot, subdividing area, demarcating boundaries, etc. using Total Station.
3. Set out foundation plan using Total Station.
4. Compute the point, line and area features using Global Navigation Satellite System.
5. Plot various existing features in a geographic area on a GIS platform
6. Add attribute and perform various statistical operations in GIS.

Text Books:

1. Agor R, Advanced Surveying, Khanna Publishers, New Delhi (ISBN9788174909053).
2. Kanetkar, T.P. and Kulkarni, S.V., Surveying and Levelling Vol. II, Pune Vidhyarthi Gruh Publication (ISBN9782508807185).
3. Arora, K.R., Surveying Vol. III, Standard Book House, New Delhi (ISBN9788189401276).
4. Basudeb Bhatta, Remote Sensing and GIS, Third Edition, Oxford University Press, New Delhi. ISBN: 9780199496648

Reference:

1. B. C. Punmia, Ashok K Jain, Arun K Jain, Advance Surveying, Laxmi Publications (ISBN 9788170088530)
2. R. Subramanian, Surveying and levelling, Oxford University Press, New Delhi (ISBN9780198085423)
3. Basic Concept of Remote Sensing, GPS and GIS Paperback – 1 January 2020
4. Textbook of Remote Sensing and Geographical Information Systems Paperback – 29 July 2022 by Kali Charan Sahu
5. P.Dong , Q.Chen, Lidar Remote Sensing and applications ,CRC Press (ISBN 9781138747241)

Online Resources:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc20_ce16/preview
2.	https://onlinecourses.nptel.ac.in/noc25_ce31/preview
3.	https://onlinecourses.nptel.ac.in/noc25_ce13/preview

List of Experiments.

Sr. No.	List of Experiments (Any Eight)	Hrs	LO
1	Introduction to concepts, fundamental features and working principle of Total Station (TS)	02	LO1
2	Temporary settings of a TS in field and perform basic functions on total station like traversing, area of open plot, height calculations, etc.	02	LO1
3	Collect detailed features of a plot (comprising features such as 2-3 buildings, courtyards, security cabins, playgrounds, trees, gates, poles, roads, drainage lines, etc.) using TS	02	LO2
4	Transfer data collected through TS on a convenient computer aided drafting (CAD) software	02	LO2
5	Feeding a CAD plan in TS and setting out a foundation plan using TS	02	LO3
6	Introduction to fundamental features of Global Navigation Satellite System (GNSS) and collect point, line and polygon features through a GNSS receiver	02	LO4
7	Computing latitudes, longitudes, altitudes of points, length of roads,	02	LO4

	area of plots, etc. using a GNSS system		
8	Basic introduction to compatibilities, utilities and attributes of peculiar Geographical Information System (GIS) softwares available in market w.r.t their various commands, features, capabilities and functions.	02	LO5
9	Collecting ground points through GNSS and TS for integrating it with spatial data obtained from a GIS platform like google earth, Open street network, etc. and developing a model on a GIS software	02	LO5
10	Add various layers in term of attributes and perform various statistical operations and queries in GIS	02	LO6

Assessment:

Term Work: Term Work shall consist of practicals and project based on the above list. Also, Term work Journal must include at least 6 assignments (covering all lab outcomes).

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095123	Advanced Concrete Technology Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095123	Advanced Concrete Technology Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the effect of admixture in concrete.
2. To observe the failure effect of hardened concrete in flexure and tension.
3. To study the performance characteristics of hardened concrete.
4. To design high strength concrete with ACI/ Road Note 4 method.
5. To study the effect of addition of polymer/fiber in concrete.
6. To perform Non Destructive Test on hardened concrete.

Lab Outcomes: Student will be able to

1. To study the effect of admixture on fresh and hardened concrete.
2. To analyze the tension & flexure of concrete.
3. To report the permeability of water in hardened concrete.
4. To optimize the constituent materials for high grade concrete and publish the result.
5. To discuss the effect on strength due to addition of polymer/fiber in concrete.
6. To interpret data of Non Destructive Test for the strength and performance of the concrete.

Text Books:

1. Concrete Technology Theory and Practice: Shetty M.S., S. Chand.
2. Concrete Technology: A. R. Shanthakumar, Oxford University Press, New Delhi, 2007.
3. Properties of concrete: Neville, Isaac Pitman, London.
4. Concrete Technology: Gambhir M.L., Tata McGraw Hill, New Delhi.
5. Concrete Technology: Neville A.M. & Brooks. J. J., ELBS-Longman, Pearson Education Ltd.
6. Concrete Manual : Gambhir M.L., Dhanpat Rai and Co. (Latest Edition)

References:

1. IS 516 (Part 1/Sec1): 2021: Hardened Concrete- Methods of Test
2. IS 9103-1999: Indian Standard Concrete Admixtures - Specification (First Revision).
3. IS 3085-1965 (Reaffirmed 2002): Method of test for permeability of cement mortar and concrete
4. IS 456-2000: Plain And Reinforced Concrete - Code Of Practice (Fourth Revision)

5. IS 383-1970: Specification For Coarse And Fine Aggregates From Natural Sources For Concrete (Second Revision).
6. IS 516 : Part 5 : Sec 1 : 2018: Hardened Concrete —Methods of Test Part 5 Non-destructive Testing of Concrete Section 1 Ultrasonic Pulse Velocity Testing (First Revision)
7. IS 516 : Part 5 : Sec 4 : 2020: Hardened Concrete — Methods of Test Part 5 Non-Destructive Testing of Concrete Section 4 Rebound Hammer Test (First Revision)
8. IS 516: Part 5 : Sec 3 : 2021: Hardened Concrete - Methods of Test Part 5 Non-Destructive Testing of Concrete Section 3 Carbonation Depth Test (First Revision)
9. ACI 211.4R - 93 Method: Guide for Selecting Proportions for High-Strength Concrete with Portland Cement and Fly Ash Reported by ACI Committee 211.
10. Road Research, "Road note no 4 " (Second edition) , Design of concrete mixes. Department of Scientific and Industrial Research Road Research Laboratory
11. Fibre Reinforced Cementitious Composites: Arnon Bentur and Sidney Mindess, Modern Concrete Technology Series, Tylor and Francis.
12. Sachan, A. K., and C. V. S. Kameswara Rao. "A cone penetration test for workability of fibre reinforced concrete." *Materials and Structures* 21.6 (1988): 448-452.

Online Resources:

Sr. No.	Website Name
1.	https://www.trl.co.uk/uploads/trl/documents/Road-Note-04-(2nd-Edition)---Design-of-Concrete-Mixes.pdf
2.	https://onlinecourses.nptel.ac.in/noc25_ce93/preview (swayam)
3.	https://onlinecourses.nptel.ac.in/noc25_ce10/preview (swayam)
4.	https://onlinecourses.nptel.ac.in/noc25_ce73/preview (swayam)

List of Experiments.

Sr. No.	List of Experiments	Hrs	LO
01	Performance study of any one admixture in concrete.	2	1
02	Test on Split Tensile strength	2	2
03	Test on Modulus of Rupture of Concrete.	2	2
04	Permeability Test on concrete.	2	3
05	Mix design in laboratory by ACI method.	2	4
06	Mix design in laboratory by Road Note 4 method	2	4
07	Test on polymer modified concrete/mortar.	2	5
08	Test on fiber reinforced concrete.	2	5
09	Nondestructive testing of concrete- some applications (rebound hammer, ultrasonic pulse velocity etc.).	2	6
10	Nondestructive testing of concrete- Carbonation Test on concrete.	2	6

Assessment:

Term Work: Term Work shall consist of performance and report on results of any six practical's selected such that all laboratory outcome (LO1 to LO 6) are achieved from the above list of experiments. The interpretation of the data acquired from the results shall be described clearly at the end of the report.

Term work must include: 1) A review report on any recent research article from standard peer review journal related to advanced concrete technology. (Preferable related to advanced material in concrete technology). 2) A Site Visit Report to a Precast Factory or Recycled aggregate Plant.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (6 Experiment) + 5 Marks (Review report on research article) + 5 Marks (Site Visit Report) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095124	Applied Hydraulics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095124	Applied Hydraulics Lab	--	--	--	--	25	---	25	--

Lab Objectives:

1. To describe the concepts of fluid dynamics and its applications.
2. To exemplify the fundamentals of impulse momentum principle and explain the working of various hydraulic machines.
3. To classify the uniform and non-uniform flow in open channel.

Lab Outcomes: Student will be able to

1. Analyze the force exerted by a fluid jet on various stationary vanes.
2. Evaluate the performance characteristics of impulse and reaction turbines under varying operating conditions.
3. Determine the operational efficiency and performance parameters of centrifugal pumping systems.
4. Investigate flow resistance and roughness coefficients in open channel flow.
5. Analyze steady flow phenomena in open channels, including specific energy transitions and hydraulic jumps.
6. Calibrate flow measurement devices used in open channels to determine discharge coefficients.

References:

1. Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company.
2. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi.
3. Hydraulics Fluid Mechanics and Fluid Machines: S. Ramamrutham, Dhanpat Rai Publishing Company (P) Ltd-New Delhi.
4. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
5. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538.
6. Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons.
7. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

List of Experiments.

Sr. No.	List of Experiments (Any six)	Hrs	LO
01	Impact of jet, flat plate, inclined plate, curved vanes.	02	1
02	Performance of Pelton turbine.	02	2
03	Performance of Francis turbine.	02	2
04	Performance of Kaplan turbine.	02	2
05	Performance of Centrifugal pumps	02	3
06	Chezy's roughness factor	02	4
07	Specific energy.	02	5
08	Hydraulic Jump.	02	5
09	Calibration of Broad crested weir/Venturi flume	02	6

Assessment:

Term Work: Term Work shall consist of practicals from the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 12 Marks (Experiment) + 8 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus, conducted by an internal and an external examiner.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095125	Green Building Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095125	Green Building Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the basic principles and concepts of green building and sustainable development.
2. To study eco-friendly building materials and technologies used in sustainable construction.
3. To analyze energy and water efficiency techniques applied in building design.
4. To evaluate indoor environmental quality and its impact on occupant comfort.
5. To explore methods of waste management and resource conservation in buildings.
6. To examine real-life examples and case studies of green buildings and their performance.

Lab Outcomes: Student will be able to

1. Explain the fundamental concepts and importance of green buildings.
2. Identify and evaluate sustainable building materials and technologies.
3. Apply energy and water conservation techniques used in building design.
4. Assess indoor environmental and air quality parameters for occupant comfort.
5. Apply waste management and resource optimization practices in building projects.
6. Examine and interpret real-world green building case studies and rating systems.

Text Books:

1. Green Building: Principles and Practices, Dr. Adv. Harshul Savla (Notion Press)
2. The Idea of Green Building by A. K. Jain (Khanna Publishers)
3. Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination by Karthik Karuppu (Notion Press)
4. Green Building Materials & Implementation Dr. V. Muruges (Notion Press)
5. Green Building Fundamentals G. Harihara Iyer (Notion Press)

References:

1. Indian Green Building Council (IGBC) web-site: <https://igbc.in/igbc/>
2. Swagriha manual: https://www.grihaindia.org/files/SVAGRIHA_Manual_Ver-2013.pdf

Online Resources:

Sr. No.	Website Name
1.	Indian Green Building Council (IGBC) https://igbc.in/igbc
2.	Swagriha manual: https://www.grihaindia.org/files/SVAGRIHA_Manual_Ver-2013.pdf
3.	Leadership in Energy & Environmental Design (LEED) https://www.usgbc.org/leed
4.	Energy Conservation and Sustainable Building code: https://beeindia.gov.in/sites/default/files/ECSBC%202024_Building%20Code%20for%20Commercial%20Buildings.pdf

List of Experiments.

Sr. No.	List of Experiments (Any Eight)	Hrs	LO
Select any one project, under which 8 experiments have to be conducted Project 1: Critical analysis of rating system and codes Project 2: Approach to Green Building Design and Optimization.			
01	Site Selection and Passive Design Analysis	2	LO1
02	Water Efficiency and Rainwater Harvesting.	2	LO3
03	Energy Efficiency in Buildings	2	LO3
04	Indoor Environmental Quality Assessment (IEQ) & Indoor Air Quality (IAQ) of a building.	2	LO1
05	Sustainable and Local Building Materials	2	LO2
06	Waste Management and Resource Recycling	2	LO5
07	Roof Garden and Heat Island Reduction Techniques	2	LO5
08	Building Performance Simulation	2	LO4
09	Innovation and Future Trends in Green Buildings	2	LO6

Assessment:

Term Work: Term Work shall consist of practicals and site visit report based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095126	Advanced Structural Mechanics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2095126	Advanced Structural Mechanics Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. Experimentally investigate the unsymmetrical bending and shear centre of thin-walled open sections.
2. Measure stresses/strains in curved beams (hooks/rings/links) and compare with theory.
3. Determine torsional response of circular and prismatic bars ($\tau_{\max}$, angle of twist, power).
4. Evaluate elastic stability (Euler buckling) using experimental rigs and energy-method cross-checks.
5. Determine deflection and shear-correction factor (k) for deep beams; relate to Timoshenko theory.
6. Characterise spring behaviour (helical/leaf) under load and validate stiffness models.

Lab Outcomes: Student will be able to

1. Locate shear centre and compute flexural stresses for thin-walled open sections.
2. Determine stress distribution in curved members and identify neutral axis shift.
3. Measure torsion parameters (τ , θ) for circular/prismatic bars; estimate power capacity.
4. Estimate Euler buckling load and discuss effects of composite/effective modulus.
5. Measure deep-beam deflection and back-calculate k (rectangular, circular, I-section).
6. Extract spring constants and compare with theoretical expressions

Text Books:

1. Advanced Structural Mechanics (course modules — internal notes).
2. Timoshenko & Goodier, Theory of Elasticity; Timoshenko, Strength of Materials.
3. Cook et al., Concepts and Applications of Finite Element Analysis.

References:

1. Gere & Timoshenko, Mechanics of Materials.
2. Megson, Aircraft Structures (for shear centre / thin-walled sections).
3. Boresi & Schmidt – Advanced Mechanics of Materials

Online Resources:

Sr. No.	Website Name
1.	NPTEL: Advanced Mechanics of Solids
2.	MIT OCW: Mechanics of Materials Lab handouts
3.	Roark's Formulas (publisher resources)

List of Experiments.

Sr. No.	List of Experiments (Any Eight)	Hrs	LO
01	Unsymmetrical bending of an angle/channel section: measure tip deflection in two planes; compute flexural stresses using principal MOI.	2	LO1
02	Shear centre of thin-walled open section (C-channel/Z-section): asymmetric loading to find load line with zero twist.	2	LO1
03	Curved beam (hook/ring) using strain gauges: evaluate fibre stresses; compare with curved-beam theory.	2	LO2
04	Torsion test on circular shaft: τ - θ curve, modulus of rigidity, power capacity; Castigliano I check.	2	LO3
05	Non-circular prismatic bar (rectangular) in torsion: key results, warping observations, limitations vs circular.	2	LO3
06	Buckling of slender columns (pinned-pinned): determine Euler load; energy-method back-check; imperfections discussion.	2	LO4
07	Deep beam deflection (rectangular/I): dial-gauge deflections, back-calculate k ; compare with Euler-Bernoulli vs Timoshenko.	2	LO5
08	Beam on elastic foundation (Winkler) using spring bed / FE demo: deflection bowl under point/UDL; compare with analytics.	2	LO5
09	Helical spring testing : load-deflection curve, stiffness, energy storage; verification with theory.	2	LO6
10	Laminated (leaf) spring : eye-end testing, equivalent stiffness; compare with design formulae.	2	LO6

Assessment:

Term Work: Term Work shall consist of practicals and project based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Vertical – 5

IKS

**Detail Syllabus
(Common Syllabus as per BoS Groups)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2095511	Indian Knowledge System-II	--	2*+2	-	--	2	--	2

* Two hours of practical class to be conducted for full class as demo/discussion.

Two hours of practical class to be conducted for full class as demonstrated below.									
		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
2095511	Indian Knowledge System-II	--	--	--	--	--	50	--	50

Rationale: India has ancient Indian knowledge systems (IKS) that have significantly contributed to mathematics, science and engineering etc. NEP 2020 visualizes a framework where students can apply traditional knowledge with contemporary approaches to suggest sustainable solutions and innovative practices. This subject aims to integrate the IKS into present-day engineering education, research, and practice to cultivate well-rounded individuals grounded in India's great intellectual traditions

Course Objectives: To impart necessary knowledge and skills so as to enable students to

1. Understand the premise of Indian Knowledge System (IKS) in the domain of town planning and governance
2. Appreciate the ancient technologies used in Irrigation planning and transport systems, astronomy and Vastu shastra (The science of architecture) for fulfilling basic human needs.
3. To introduce students to traditional Indian chemical engineering knowledge and chemical processes related to metallurgy, pharmaceuticals.
4. To understand traditional chemical engineering practices, rasashastra apparatus, and to compare traditional processes with modern chemical engineering processes.
5. To enable students to understand India's rich Indigenous Knowledge Systems (IKS) in metals and metal processing.
6. To introduce the early development of transmission systems in India.

Course Outcomes:

After completion of this course, learner will be able to

CO1: Compare the ancient knowledge in the domain of town planning, governance, and traditional principles in residential (Vastu) construction.

CO2: Evaluate the developments in irrigations systems, transport systems and astronomy.

CO3: Explain traditional Indian chemical engineering knowledge and their scientific principles.

CO4: Describe classical chemical processes, rasashastra apparatus, and indigenous material processing techniques and compare traditional chemical engineering processes with modern chemical engineering processes.

CO5: Evaluate India's indigenous metal and metal-processing heritage.

CO6: Analyze early Indian transmission technologies

Prerequisite: Basic concepts of Science and Technology

Detailed Syllabus:

Module No.	Unit no	Detailed Content	Hours	CO Mapping
1	Title: Town Planning and Governance, Vastu shastra – The science of Architecture		5	CO1
	1.1	Development of ancient text, principles, Terminologies, Indic languages, various typologies, social infrastructure- places for gathering, worship, entertainment, cremation etc. Perspective of Arthaśāstra on town planning.		
	1.2	Governance systems and Principles of Town Planning: Principles of land management, local and global trade routes and trade centres; the establishment and decay of urban settlements. Ancient India urbanization, layouts in terms of geometry, population, geography, and various communities. Evolution of the cities, planning principles in urban centres. interconnection between ancient knowledge of town planning and present planning practices.		
	1.3	Eight limbs of Vastu, Ancient literature and archaeological evidence of building and building materials, Fortification and Forts.		
	1.4	Structural Principles in worship places Architecture. marvelous stone architecture for eternity, Iconography Use of bricks or dressed stone based on logical principals of structural engineering.		
2	Irrigation planning, transport systems and Astronomy		4	CO2
	2.1	Irrigation and water management. Ancient irrigation systems, dams, reservoirs, sluices, canals, embankments, wells, water-lifting devices, etc. from a historical point of view. Irrigation systems and practices in South India		
	2.2	Ancient transport systems during various periods : Indus valley, Buddhist period, Mauryan period, Gupta period, etc. Shipbuilding: Indigenous shipbuilding, materials and methods-Use of local materials: teak, bamboo, coir, and lac- Construction techniques: -Innovations in hull design, masts, and rigging.		
	2.3	Indian Astronomy: Planetary System. Motion of the Planets; Velocity of Light; Eclipse. Astronomy. Navagrahas. Important works in Indian Astronomy. Aryabhata and Nilakantha: Contribution to Astronomical Studies		

Module No.	Unit no	Detailed Content	Hours	CO Mapping
3		Traditional Chemical Processes and Industrial Advancements	4	CO3
	3.1	Overview of ancient Indian scientific texts related to chemicals, Arthashastra – mining techniques and metallurgy,		
	3.2	Charaka Samhita – pharmaceutical preparations and fermentation, Sushruta Samhita – preparation of alkali and mineral medicines, traditional chemical operations and processes such as manual metal extraction methods and herbal extraction techniques, small-scale batch production methods,		
	3.3	production of natural alkali from plant ash, comparison of traditional metallurgy with modern metallurgical processes, herbal extraction with solvent extraction and chromatography, natural alkali production with chlor-alkali industry, batch processing with continuous processing.		
4		Rasashastra – Ancient Indian Chemical Science and Classical Apparatus	4	CO4
	4.1	Introduction, scope of rasashastra in traditional Indian alchemy and medicine, development of rasashastra, contributions of Nagarjuna in metallurgical and alchemical practices, role of mercury (Parada) and metals in classical medicinal formulations,		
	4.2	Various apparatus used in rasashastra such as Dolayantra (boiling and heating setup), Patana Yantra (distillation apparatus), Puta (system for controlled heating), Musha (crucible) used for melting and calcination, Khalva Yantra (grinding and mixing of materials), rasashastra processes such as Shodhana (purification), Marana (calcination), Jarana (roasting) and Bhavana (levigation).		
	4.3	Comparison of Dolayantra with modern jacketed reactors, Patana Yantra with distillation columns, Marana process with rotary kiln or muffle furnace, mercury purification methods with modern hydrometallurgical refining techniques.		
5		Indigenous Metal and Metal Processing Techniques	5	CO5
	5.1	Early Metals in India Use of copper, bronze, gold, silver, tin, and lead in Harappan and Vedic periods. Indigenous mining, ore beneficiation, furnace designs, and smelting practices.		
	5.2	Landmark Indian Metallurgical Achievements Wootz Steel: crucible steelmaking, carbon control, carbide banding, global influence as Damascus steel. Zawar Zinc Distillation: world's earliest large-scale zinc		

Module No.	Unit no	Detailed Content	Hours	CO Mapping
		production; downward distillation furnaces. Chola Bronze Metallurgy: alloy design (Cu–Sn–Pb), precision lost-wax casting for sculptures. Aranmula Metal Mirror: high-tin bronze polishing technology with mirror-grade reflectivity. Konark Temple Iron Beams & Clamps: structural iron demonstrating marine corrosion resistance.		
	5.3	Scientific Insights Behind Traditional Metallurgy Delhi Iron Pillar: natural formation of a passive protective layer; high-phosphorus wrought iron. Microstructure evolution through traditional forming and heat-treatment cycles. Traditional Indian blacksmiths (Lohar, Vishwakarma, Asari, Kammalar communities)		
6		Development of Transmission in India	4	CO6
	6.1	Transmission in Early Indian Civilizations Indus Valley Civilization: evidence of wheel technology, carts, pottery wheels, and early bearing surfaces. Use of pulleys, levers, and inclined planes in construction and material handling.		
	6.2	Traditional gear and motion Conversion systems Sugarcane crushers, oil ghanis, temple clocks, and granaries		

Textbooks

1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.
3. Kak, S.C. (1987). "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), pp. 205–221.
4. Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.
5. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
6. Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
7. Gagan Bansal, Indian Knowledge System: Integrating Heritage with Engineering
8. Prafulla Chandra Ray, A History of Hindu Chemistry –
9. R. Balasubramaniam – Wootz Steel: An Advanced Material of the Ancient World
10. K.T.M. Hegde – Indian Archaeometallurgy
11. T.R. Anantharaman – The Rustless Wonder: The Iron Pillar of Delhi
12. AICTE – IKS Division Publications

References

1. Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.
2. Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.
3. R.T.V. Ramachandra – History of Indian Metallurgy
4. A. Ghosh - Encyclopedia of Indian Archaeology

5. Research papers on Zawar zinc distillation, Chola bronzes, and Aranmula mirror metallurgy.

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.swayam2.ac.in/e-learning/preview/imb23_mg54
2.	https://iksindia.org
3.	https://iks.iitk.ac.in

The experiential learning sessions may include:

- Field Visits to historical sites, museums.
- Arranging students' discussions with experts in various fields of IKS.
- Providing the students with online lectures by distinguished experts in the field.
- Students' participation in activities related to understand the practical aspects of Indian knowledge systems.

Traditional practices of arts, crafts, agriculture, Vastu Shastra etc.,

Herbal extraction using decoction or distillation methods.

Preparation of lime mortar (calcination, slaking, carbonation).

Natural dye extraction and mordanting process.

Herbal soap preparation through saponification.

Comparative study of batch vs continuous processing.

Sr No	Details of Activities
01	Project-based activities
02	Presentation
03	Case studies
04	Visit Museum/historical places and write a report
05	Flip class mode
06	Quiz with MCQ
07	Comparative Study of IKS & other scientific systems around the world
08	Group Discussions
09	Roleplay
10	Self-study activities

The faculty can choose any of these activities for continuous assessment

Assessment:

Term work Assessment for 50 marks:

- Suggested Pedagogy and assessment criteria:

1. Assignment as per the modules. 06
2. Project-based activities.
3. Presentation, Group Discussions, and Case studies.
4. Visit historical places.
5. Flip class mode/ Roleplay
6. Quiz MCQ
7. Assessment through flipped class and PowerPoint presentation along with documentation

Term Work:

Assignments	10 Marks
Presentation	20 Marks
Quiz /MCQ	15 Marks
Attendance	05 Marks

Sem VI

Vertical – 1

Major

Program Core Course Theory

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096111	Environmental Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096111	Environmental Engineering	20	20	40	60	2	--	--	100

Rationale:

The course introduces the fundamental concepts of Environmental Engineering related to water supply, treatment, sewerage systems, and sewage treatment. It promotes experiential and multidisciplinary learning through case studies, field visits, and design-based problem-solving, enabling students to develop analytical, technical, and ethical competence relevant to environmental protection and community development.

Course Objectives:

1. To impart fundamental knowledge of water supply systems, water demand estimation, and water quality standards for safe and sustainable use.
2. To develop an understanding of various water treatment processes and their design principles for ensuring potable water supply.
3. To introduce students to building-level water supply and drainage systems as per standard practices.
4. To explain the concepts of sewage characteristics, collection, conveyance, and design of sewerage systems.
5. To provide insights into sewage treatment processes, biological treatment mechanisms, and sludge management.
6. To create awareness about advanced treatment methods, environmental norms, and the importance of decentralized wastewater treatment.

Course Outcomes:

On completion of the course students will be able to:

1. Apply the principles of water supply systems to estimate water demand and evaluate water quality as per drinking water standards.
2. Analyse and design of conventional units of water treatment plants.
3. Demonstrate the layout and functioning of building water supply and drainage systems as per plumbing codes
4. Determine the characteristics of domestic sewage and design the layout of sewerage systems considering self-cleaning criteria.
5. Illustrate different biological treatment processes for sewage treatment.
6. Explain sludge treatment and disposal methods with respect to sustainability and environmental standards.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Water Supply and Quality of Water		03	CO1
	1.1	Water supply: Water supply systems, Intake structures (Reservoir intake and canal intake), distribution systems of water and distribution layouts. Introduction to Population forecasting methods and water demand		
	1.2	Quality of water: Drinking water standards and characteristics of water, water borne diseases.		
2	Water Treatment		13	CO2
	2.1	WTP: Typical layout of WTP, Aeration, Types of Aeration systems, sedimentation, types of settling, tube settlers, design of sedimentation tank.		
	2.2	Coagulation and flocculation: Principle of coagulation, flocculation, Clari flocculator, coagulants aids.		
	2.3	Filtration: rapid sand filters, operation, cleaning and back-washing, Entire design of rapid gravity filter with under drainage system. Pressure filter: Construction and operation		
	2.4	Disinfection: Different methods of disinfection, chlorination and chemistry of chlorination, chlorine demand, free and combined chlorine, various forms of chlorine, types of chlorination. Numerical to calculate quantity of required chlorine doses.		
	2.5	Advanced and Miscellaneous Treatments: Desalination, Water softening by lime soda process and by base exchange method, Reverse Osmosis, Activated carbon, Membrane filtration.		
3	Building Water Supply and Drainage System		03	CO3
	3.1	Building water supply: Service connection from main, Water meter.		
	3.2	Building drainage: basic principles, traps-types, location and function, Systems of Plumbing, anti siphonic and vent pipes.		
4	Domestic Sewage and Sewerage System		07	CO4
	4.1	Sewage: Introduction to domestic sewage, and storm water, System of sanitation, Physical and chemical characteristics, decomposition of sewage, BOD, COD, numerical on BOD. MPCB norms for disposal of sewage effluent.		

Module	Course Module / Contents		Hours	CO Mapping
	4.2	Sewerage system: Systems of sewerage: Separate, Combined and partially combined system, merits and demerits, self-cleaning velocity and non-scouring velocity, Sewer- Shape, hydraulic design of sewers, Laying and testing of sewers, manhole-location, necessity, types and drop manhole, ventilation		
5	Sewage Treatment		10	CO5
	5.1	Treatment processes: Objective, methods of treatment, flow sheets showing Preliminary, Primary, and Secondary. Primary treatment: Screening, Grit removal, Oil and Grease removal, settling tank.		
	5.2	Secondary Treatment Methods: Trickling filter- Principle, Process description and Design of trickling filter. Activated sludge process (ASP) - Principle, Process description, Recirculation of sludge, (numerical), Sludge volume index.		
	5.3	Introduction to Biological Treatment: Aerated lagoons, Membrane Batch Reactor (MBR)		
	5.4	Self-purification of natural water bodies: DO sag curve, Disposal of Raw and treated sewage on land and water.		
	5.5	Introduction to Centralised and Decentralised sewage treatment- Resue and recyle		
6	Sludge treatment and disposal		03	CO6
	6.1	Basic concept & mechanism of sludge digestion tank (no numericals), sludge drying beds		

Text Books:

- 1 Water Supply Engineering: Vol I: S. K. Garg, Khanna Publication.
- 2 Water Supply Engineering: P.N. Modi, Rajsons Publication.
- 3 Water Supply and Sanitary Engineering: S.K. Hussain, Oxford & IBH Publication, New Delhi
- 4 Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
- 5 Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan
- 6 Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers New Delhi
- 7 Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian
- 8 Integrated solid waste management, Tchobanoglous. Theissen and Vigil, McGraw Hill Publication.

References:

- 1 Manual on Wastewater Treatment 3rd Ed. Pub: CPH and Env. Engg. Organization, Ministry of Urban Development, Govt. of India, New Delhi, 1991.
- 2 Plumbing Engineering, Theory and Practice: *Patil S. M.*, Seema Publication, Mumbai.
- 3 Water Supply and Sewerage: *E.W. Steel*.
- 4 Manual on Water Supply and Treatment, (latest Ed.): Ministry of Urban Development, New Delhi.
- 5 Water supply and pollution control: J.W. Clark, W. Veisman, M.J. Hammer, International textbook company.
- 6 CPHEEO Manual on Water Supply and Treatment.
- 7 CPHEEO Manual on Sewage and Treatment.
- 8 Environmental Engineering: Peavy, H.S., Rowe D.R., Tchobanoglous G.; 1991, Tata- McGraw Hill.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/105104102
2.	https://cpcb.nic.in/wgstandards/

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Site Visit:

The students will visit to sewage treatment plant/ water treatment plant in the nearby vicinity or in the city and prepare detailed report thereof. This report will form a part of the term work

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks** Q.1 will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096112	Geotechnical Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096112	Geotechnical Engineering	20	20	40	60	2	--	--	100

Rational

Basic knowledge of analysis and design of foundations is very important for all civil engineers, more so for geotechnical and structural engineers. Soil testing (both field and lab tests) and its analysis are not only compulsory prerequisites for the analysis, design and construction of any major structure but also holds lucrative consultancy work and job opportunities in the field of civil engineering. Immense research opportunities are also available in this field.

Course Objectives

1. Students will gain knowledge of effective stress principle, compaction and consolidation theory.
2. Students will evaluate the shear strength characteristics of the soil. Moreover, they would apply the knowledge for solving the related problems.
3. Students will analyze stability of slopes.
4. Students will analyze and evaluate lateral earth pressure.
5. Students will analyze and design shallow foundation.
6. Students will analyze and design deep foundation.

Course outcomes

On completion of this course, the students will be able to:

1. Evaluate the compaction and consolidation parameters for the soil.
2. Calculate the shear strength parameters for the soil.
3. Calculate the factors of safety of different types of slopes under various soil conditions, analyze the stability of slopes.
4. Calculate the lateral earth pressure under various soil conditions.
5. Calculate bearing capacity of shallow foundations using theoretical and field methods.
6. Calculate load carrying capacity of individual as well as group of pile foundation using theoretical and field methods and pile settlement.

Pre Requisite:

Knowledge of basic Geology and Soil Mechanics

DETAILED SYLLABUS

Module	Course Module / Contents		Hours	CO Mapping
1	Compaction and consolidation of soil		10	CO1
	1.1	Theory of compaction; determination of optimum moisture content (OMC) and maximum dry density (MDD) by conducting light and heavy compaction tests; factors affecting compaction, placement water content, relative compaction, and the Proctor needle method for compaction.		
	1.2	Compressibility and settlement; comparison between compaction and consolidation; concept of excess pore water pressure; initial, primary, and secondary consolidation; spring analogy for primary consolidation; consolidation test results – coefficient of compressibility, coefficient of volume change, compression, expansion, and recompression indices; normally and over-consolidated soils.		
	1.3	Terzaghi's theory of consolidation (no proof) – assumptions; coefficient of vertical consolidation; distribution of hydrostatic and excess pore water pressure with depth and time; time factor; relationship between time factor and degree of consolidation; determination of the coefficient of vertical consolidation; pre-consolidation pressure.		
	1.4	Definition of geostatic stresses, total stress, neutral stress/ pore water pressure, effective stress with water table variation and capillary rise.		
	1.5	Final settlement of a soil deposit in the field; time–settlement curve; and field consolidation curve.		
2	Shear Strength of soil		05	CO2
	2.1	Introduction; frictional and cohesive strength; important characteristics of Mohr's circle.		
	2.2	Coulomb's theory; Mohr–Coulomb theory – shear strength parameters; Mohr–Coulomb failure envelope – relationship between major and minor principal stresses, and total and effective stress analysis.		
	2.3	Different types of drainage conditions - UU, CU and CD; Direct shear test, Triaxial shear test, Unconfined compression test, Vane shear test; comparison between direct & triaxial shear tests, interpretation of test results of direct shear & triaxial shear tests; stress-strain curves		
3	Stability of Slopes		05	CO3
	3.1	Introduction: Types of slopes, types of slope failures, factor of safety.		
	3.2	Stability analysis of infinite slopes in i) cohesionless soil and ii) cohesive soil under a) dry condition, b) submerged condition and c) steady seepage condition along the slope. <i>[Derivation only for cohesionless soil in dry condition]</i>		
	3.3	Stability analysis of finite slopes: i) Taylor's stability number ii) friction circle method iii) Swedish circle. (No numerical on Swedish circle)		

Module	Course Module / Contents		Hours	CO Mapping
4.	Lateral Earth Pressure Theories		06	CO4
	4.1	Introduction to Lateral Earth Pressure Theories: Concept of lateral earth pressure based on vertical and horizontal stresses, different types of lateral earth pressures.		
	4.2	Rankine's earth pressure theory: i) assumptions, ii) active and passive states in cohesionless soil: effect of submergence, effect of uniform surcharge, effect of inclined surcharge iii) active and passive states in cohesive soil		
	4.3	Coulomb's wedge theory: i) assumptions, ii) active and passive states in cohesionless soil.		
	4.4	Culmann's Graphical Method (no proof)		
5	Shallow Foundations		07	CO5
	5.1	Introduction: Types of shallow foundations, definitions of different bearing Capacities		
	5.2	Theoretical methods of determining bearing capacity of shallow foundations: i) Terzaghi's theory: assumptions, zones of failure, modes of failure, ultimate bearing capacity equations for general and local shear failure, factors influencing bearing capacity: shape of footing and water table, limitations of Terzaghi's theory. ii) I.S. Code Method: bearing capacity equation		
	5.3	Field methods of determining bearing capacity of shallow foundations: i) standard penetration test and ii) plate load test		
6	Pile Foundations		06	CO6
	6.1	Introduction to pile foundations: necessity of pile foundations, types of pile foundation		
	6.2	Theoretical methods of determining load carrying capacity of pile foundations: i) static formulae and ii) dynamic formulae		
	6.3	Field method of determining load carrying capacity of pile foundations: pile load test		
	6.4	Group action of piles, settlement of pile groups, negative skin friction		

Text Books:

1 Soil Mechanics and Foundation: Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications

2 Soil Mechanics and Foundation Engineering: K.R. Arora; Standard publishers and Distributors

3 Soil Mechanics and Foundation Engineering: V.N.S Murthy; Saitech Publications

4 Geotechnical Engineering: C. Venkat Ramaiah; New Age International

5 Basic and Applied Soil Mechanics: Gopal Ranjan and A.S. Rao; New Age International

References:

- 1 Theoretical Soil Mechanics: K. Terzaghi; John Wiley and Sons
- 2 Fundamentals of Soil Engineering: D. W. Taylor; John Wiley & Sons
- 3 Relevant Indian Standard Specification Code: BIS Publications, New Delhi
- 4 Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House
- 5 Geotechnical Engineering: Purushothama Raj; Tata McGraw Hill Publications

Online References: <http://nptel.ac.in/noc>

Assessment

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination**Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks** Q.1 will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered.

Program Elective Course - 2

Theory

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096113	Mass Transportation Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096113	Mass Transportation Engineering	20	20	40	60	2	--	--	100

Rationale:

This course provides a holistic understanding of the diverse facets of transportation engineering, covering fundamental principles across land, air, and water modes. It's designed to equip future engineers with the knowledge to design, plan, and operate efficient, sustainable, and safe transportation systems. By integrating modern concepts like sustainable transportation, urban transit planning, and specialized structures, the curriculum addresses current infrastructural challenges and prepares students to meet the demands of rapid urbanization and the need for environmentally conscious development. The knowledge gained is essential for contributing to regional and national economic growth through improved connectivity.

Course Objectives:

1. To introduce students to the fundamental concepts of mass and sustainable transportation systems and the environmental considerations mandated by national and urban transport policies.
2. To provide a comprehensive understanding of aircraft characteristics, airport planning principles and associated operational aspects of airport.
3. To familiarize students with the detailed components of the permanent way, track geometrics, railway yards, and the operational characteristics of modern rail systems like MAGLEV and high-speed trains.
4. To explain the principles of water transportation, including the requirements, site selection, and functional components of harbours and ports and docks.
5. To analyze the relationship between urbanization and transport demand, explore various urban transit and paratransit modes, and detail the planning and operational parameters for effective transit service design.
6. To describe the classification, key components, and functional design considerations for various transportation structures, including bridges, skywalks, and foot over bridges (FOBs).

Course Outcomes:

On completion of the course students will be able to:

1. analyze the suitability of different mass transportation modes and apply basic principles of Environmental sustainability to transportation infrastructure projects.
2. design a basic airport layout while ensuring compliance with airport obstruction zoning laws and appropriate marking/lighting standards.
3. identify the functions and specifications of permanent way components and calculate geometric parameters required for safe rail operations on curves.
4. classify different types of harbours and docks, describe the function and layout of key harbour infrastructure components and understand port facility requirements.
5. evaluate the suitability and operational characteristics of diverse urban transit modes and perform calculations for service design parameters for a given transit route.
6. differentiate between various bridge classifications and components and explain the design and accessibility requirements for contemporary urban mobility structures.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction		02	CO1
	1.1	Introduction to Mass transportation System, modes, their suitability. National Urban Transport Policy,		
	1.2	Sustainable Transportation, Environmental Guidelines for Transportation Infrastructure Projects: Environmental Impact Assessment, Identification of Impacts, Measures for offsetting adverse impacts		
2	Air Transportation System		10	CO2
	2.1	Aircraft components part its function, aircraft characteristics, their influence on airport planning.		
	2.2	Airport obstruction: zoning laws, classification of obstructions, imaginary surfaces, approach zones, turning zones.		
	2.3	Airport layout: runway orientation, wind rose diagrams, basic runway length, corrections for runway length, airport classification, taxiway design, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers parking, size of gate position, number of gate position, blast considerations.		
	2.4	Airport marking, lighting of runways, taxiways, approach other areas.		
	2.5	Planning of Heliports: Characteristics of Helicopter, Selection of site, Size of landing area, Obstruction clearance requirements, Marking and Lighting of Heliports.		

Module	Course Module / Contents		Hours	CO Mapping
3	Rail Transportation System		10	CO3
	3.1	Permanent way-track components, cross section in cutting and filling. Sleeper: functions, types, sleeper density. ballast: functions, types. Rails: rail cross sections, wear, creep of rails, coning of wheels and tilting of rails Fixtures and fastenings in rails.		
	3.2	Geometrics: Widening on curves, cant and cant deficiency, Negative superelevation Turnout: Components and design, Gradient and its types		
	3.3	Yards: details of different types of railway yards their functions.		
	3.4	Construction and Maintenance of rails		
	3.5	Modern Rails: Characteristics of MAGLEV, Metro rails and mono rails, modernization of track and railway station, high speed trains (Bullet trains) and high-speed tracks		
4	Water Transportation System		05	CO4
	4.1	Introduction of water transportation system, limitations Harbour: Requirements, classification based on different types and condition, Site selection, layout and function of its components Harbour Infrastructures: Types of breakwaters, jetty, dock fenders, piers, wharves, dolphin, mooring accessories		
	4.2	Docks: Repair facilities, wet docks, lift docks, dry docks, gates for graving docks, floating docks		
	4.3	Port facility: requirements, classification Transit shed, warehouses, cargo handling, container handling		
5	Urban Transit System		06	CO5
	5.1	Urbanisation trends and transport demand. Mode Share analysis (Private vs. Public Transport). Evolution of urban transit system, Transit Oriented Development. Role of Urban Metropolitan Transport Authorities (UMTAs).		
	5.2	Modes of urban transit system: operational Characteristics and suitability of their modes. Para Transit system: Auto-Rickshaws (shared/contract), E-Rickshaws, Shared Taxis, Bike Taxis. Street Transit system: City Bus System / Conventional Bus Systems, Bus Rapid Transit (BRTS) Rapid Transit System: Metro Rail, Suburban Rail, Monorail, Regional Rapid Transit System.		
	5.3	Transit operations: Assessment of Demand, Service Design Parameters, Fleet Size Calculation, Transit route, Route Planning, route location, Stop location Designing seamless transfer hubs (Metro-Bus-IPT)		

Module	Course Module / Contents	Hours	CO Mapping
6	Transportation Structures	06	CO6
6.1	Bridge: classification of bridge, Components of bridge, Bridge superstructure and its types, Bearings and Joints on Bridges, Piers, abutments, Wing walls and approaches, Types of bridge foundations		
6.2	Skywalk: Function in Urban Mobility, Design and Accessibility Considerations		
6.3	Foot Over bridge (FOB): Key components / Structure, Materials used, Dimensions, Geometric Considerations		
6.4	Low-cost Bridges: Introduction to Causeways, Culverts, Floating bridges etc.		

Text Books:

- 1 Khanna S.K., Arora M.G., Jain S.S., Airport Planning & Design, Nemchand Bros., Roorkee
- 2 Saxena S.C., Railway Engineering, Dhanpat Rai & Sons, 1995
- 3 Srinivasan R., Harbours, Docks & Tunnel Engineering, Charotar Publishing House, Anand
- 4 Partha Chakroborty, Animesh Das, Principles of Transportation Engineering
- 5 Bindra S.P., Bridge Engineering, Dhanpat Rai & Sons
- 6 Ponnuswamy, S. Urban Transportation: Planning, Operation and Management. McGraw Hill Education (India) Private Limited.

References:

- 1 Horenjeff Robert, The planning & Design of Airports, McGraw Hill Book Co.
- 2 Indian Railway Track: Agarwal, M. M., Suchdeva Press New Delhi.
- 3 Planning Design of Airport: Horonjeff Mckelrey, Tata Mc-Graw Hill India Publishing House, New Delhi.
- 4 Docks & Harbour Engineering, Bindra S.P., Dhanpat Rai Publications,
- 5 Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House
- 6 Kadiyali, L. R. (2018). Transportation Engineering (9th ed.). Khanna Publishers.
- 7 Public Transit Planning and Operation: Modeling, Practice and Behavior by Avishai (Avi) Ceder

Online References:

Sr. No.	Website Name
1.	Introduction to Multimodal Urban Transportation Systems (MUTS) https://onlinecourses.nptel.ac.in/noc21_ce72/preview
2.	Urban Transportation Planning https://ocw.mit.edu/courses/1-252j-urban-transportation-planning-fall-2016/pages/lecture-slides/

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ **Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks** **Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096114	Advanced Design of Steel Structures	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096114	Advanced Design of Steel Structures	20	20	40	60	2	--	--	100

Rationale:

Steel is a widely used construction material in civil engineering due to its strength and versatility. Structures such as girders, tanks, towers and chimney etc are subjected to various loads including wind forces. This course introduces the design of these structures using **Limit State Method (LSM)**, ensuring both safety and serviceability. It equips students with the knowledge to analyze and design different steel structures as per latest Indian code provisions.

Course Objectives:

1. To learn the design concept of moment resistance beam end connections.
2. To learn the design of welded plate girder.
3. To learn the design of welded gantry girder.
4. To learn the design principles of different types of steel water tanks.
5. To learn the analysis and design of steel truss and round tubular structures.
6. To learn the fundamentals of PEB structures.

Course Outcomes:

On completion of the course, the learner will be able to:

1. Explain the design concept of moment resistance beam connections.
2. Explain the behaviour of welded plate girders (with and without stiffeners)
3. Explain the analyze & design the gantry girder.
4. Identify the loads acting on elevated steel tanks and stacks, and to understand their analysis and design including staging and foundation.
5. Understand the design of different types of truss members and design of tubular structures using round tubular members
6. Understand the fundamental concepts and stresses on PEB sections.

Detailed Syllabus

Module	Course Module / Contents	Hours	CO Mapping
1	Moment Resistant Beam End Connections:	07	CO1
	1.1 Design of moment resistant bolted and welded beam end connections, Framed, stiffened and unstiffened seat connections.		
	1.2 Design of column with eccentric load and gusseted base.		
2	Welded Plate Girder	06	CO2
	2.1 Design of plate girder, With & without load bearing and non-load bearing stiffeners.		
3	Gantry Girder:	07	CO3
	3.1 Loads acting on gantry girder, Analysis and Design of gantry girder.		
	3.2 Fundamental concepts of analysis and design.		
4	Elevated Steel Tanks and Stacks:	07	CO4
	4.1 Loads acting on tanks including wind, design of circular tanks with hemispherical and conical bottom with supporting ring beam		
	4.2 Design of staging for design of circular tanks with hemispherical and conical bottom including design of columns and gusseted base foundation		
5	Steel Trusses and Tubular Members:	08	CO5
	5.1 Analysis and design of determinate truss using angle sections, Support detailing, Design of angle section purlin		
	5.2 Classification of Tubular Structures, Analysis and design of tension and compressive member using round tubular sections		
6	PEB Structures:	04	CO6
	6.1 Introduction to PEB, different structural forms of PEB sections.		
	6.2 Fundamental concepts of analysis and design.		

Text Books:

1. Design of Steel Structures: N Subramanian, Oxford University Press
2. Design of Steel Structures: Punmia, A. K. Jain & Arun Kumar Jain. Laxmi Publication
3. Design of Steel Structures: Dayaratnam, Wheeler Publication, New Delhi.
4. Design of steel structures: Krishnamachar B.S, & Ajitha Sinha D.
5. Design of steel structures: S. K. Duggal, McGraw-Hill.

Reference Books:

1. Design of Steel Structures: Mac. Ginely T.
2. Design of Steel Structures: Kazimi S. M. & Jindal R. S., Prentice Hall of India.
3. Design of Steel Structures: Breslar, Lin and Scalzi, John Willey, New York.
4. Design of Steel Structures: Arya and Ajmani, New Chand & Bros.
5. Relevant IS codes, BIS Publication, New Delhi
6. Steel structures, Controlling behavior through design: R. Englekirk, Wiley
7. LRFD Steel Design: William T. Segui, PWS Publishing
8. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord and James. Stallmeyer, McGraw-Hill

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing.

End Semester Theory Examination:

- **Question Paper Format:**

- Question paper will comprise of six question; each carrying 15 marks.
- The first question will be compulsory.
- The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096115	Building Services & Repairs	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096115	Building Services & Repairs	20	20	40	60	2	--	--	100

Rationale:

The "Building Services & Repairs" course is designed to provide students with a comprehensive understanding of the essential mechanical, electrical, and plumbing systems in modern buildings, alongside the critical knowledge required for the condition assessment and repair of reinforced concrete (RCC) structures.

Course Objectives:

1. To understand the concepts of mechanical systems in buildings such as lifts, escalators, HVAC systems, pumps & their applications.
2. To understand design concepts of electrical system, safety and illumination fundamentals.
3. To get familiar with the plumbing system and services in buildings related to water supply, drainage, gas supply and firefighting installations.
4. To learn about causes of distress of concrete structures and learn various instrumental testing methods for Condition assessment & evaluation of structure and assess the extent of repairs.
5. To acquire the knowledge of repair materials and repair methodologies for rehabilitation of RCC structures.
6. To learn implementing repair process and to follow safety during construction work.

Course Outcomes:

On completion of the course students will be able to:

1. Apply the knowledge of working & installation of mechanical utility services in buildings.
2. Understand the electrical supply lines, materials, safety devices and illumination systems used in buildings.
3. Investigate and learn operations and adopt appropriate materials in plumbing systems & integrate the same into the building projects.
4. Assess the structural health of the buildings & adopt repair strategy to the damaged structures.
5. Implement the right methods and materials for repairing the concrete structures and also decide the sequence of operations.
6. Create and understand proper documentation process and adopt practices for safety for protection of men and materials on the repair site

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction		06	CO1
	1.1	Mechanical systems: Lifts/elevators, escalators, conveyors: their components, capacity and principles of working, common problems. Motors, Generators, Pumps, HVAC Systems - Heating systems, Cooling Systems, Packaged HVAC, types, capacity, components and their principles of working, common problems.		
2	Electrical systems & Illumination in Buildings		06	CO2
	2.1	Electrical grids and supply system: Layout of substations Transformers & switch gears, Main & distribution boards, electrical systems in buildings, Single / Three phase supply, ISI specifications, electrical load, electrical layout plan in a building, Types of wires, wiring system & their choice, Solar energy, CCTV, LAN. Protective devices in electrical installation: Earthing for safety, Types of Earthing, fuses, circuit breakers, lightening arrester.		
	2.2	Principles of Illumination Design: Visual task, Factors affecting visual task, Luminous flux, candela, solid angle illumination, utilization factor. Modern theory of light & color: Synthesis of Light, Additive & Subtractive synthesis of colour, classification of lighting, artificial lights sources, spectral energy distribution, luminous efficiency, color temperature, colour rendering. Level of illumination: Lighting for stores, offices, school, hospitals and house lighting, elementary idea of special features required and minimum level of illumination required in buildings.		
3	Plumbing Systems in Building		06	CO3
	3.1	Water Distribution system: Material for service pipes, service connection, size of service pipe, Water meter, valves and storage tanks, water requirement for domestic use and firefighting.		
	3.2	Drainage system: Pipe and traps, system of plumbing, house drainage plans, Chambers- gradient and spacing, manholes, septic tanks and soak pit, Introduction to rain water harvesting system.		
	3.3	Other plumbing systems: Fire safety, fire-fighting installations, types and purpose, piped gas supply systems, AC ducting.		
4	Deterioration of Concrete Structures & Condition assessment		06	CO4
	4.1	Durability & Causes of deterioration of concrete structures: effects of climate, moisture, temperature, chemical, wear, erosion & loading on serviceability & durability. Design errors & construction errors, causes of seepage & leakage in concrete structures, formation of cracks including those due to corrosion.		

Module	Course Module / Contents		Hours	CO Mapping
	4.2	Condition Survey, Evaluation & Damage Assessment: Structural audit and bye laws. Diagnostic methods & analysis. Destructive, semi-destructive and non-destructive methods: core test, carbonation test, chloride test, petrography, corrosion analysis, cover meter test, rebound hammer test, ultrasonic pulse velocity test, and crack measurement techniques, Concrete endoscopy & thermal imaging, pull- off test & pullout test.		
5	Repair Materials & Methodologies for Repairs		06	CO5
	5.1	Repair analysis, Repair materials: and their desired properties, Polymer modified mortar/ concrete, micro concrete, bonding chemicals, protective materials and their properties for moisture barrier systems, water-proofing of concrete structures, Systems like integral, crystalline, coatings, membranes, joints sealants, crack repair fillers, corrosion resistant steels, Pre-packed zinc sacrificial anode, Snap-On zinc mesh anode CP system, corrosion inhibitors, rust solvents.		
	5.2	Repair methodologies: Crack and patch repair, Injection grouting, surface coatings, column jacketing, guniting, shotcrete, Ferroconcrete, FRP, Carbon fiber wrapping, methods of rebar corrosion protection, cathodic protection.		
6	Repair Process Implementation and Safety During Repairs		06	CO6
	6.1	Legal Documentation and Records		
	6.2	Estimates of repair work, procedure and flow chart for repairs, Bill of quantities, Tendering, Work order, Agreement and Contract, Measurement book, bills, security deposits, Role of PMC. Safety during Repairs: Causes of accidents, safety signs, barricading, insurance, Temporary Support structures such as, formwork, shuttering, centering, staging and scaffolding.(3L)		

Text Books:

1. A text book on Building Services R. Udaykumar Eswar Press, Chennai.
2. Building Services S. M. Patil Seema Publication, Mumbai Revised edition.
3. Heat Pumps and Electric Heating: E. R. Ambrose, John and Wiley and Sons, Inc., New York, 1968
4. Handbook for Building Engineers in Metric Systems, NBC, New Delhi, 1968.
5. Philips Lighting in Architectural Design, McGraw-Hill, New York, 1964.
6. The Lighting of Buildings: R. G. Hopkinson and J. D. Kay, Faber and Faber, London, 1969.
7. Building Construction: Dr. B. C. Punmia, Ashok K Jain, A.K Jain
8. Construction Engineering and Management: S. Seetharaman, Umesh Publications, Delhi.
9. Water supply and Sanitary Installations: A. C. Panchdhari, New Age International Publication, Delhi

10. Concrete Repair and Maintenance: Peter H. Emmons and Gajanan M. Sabnis, Galgotia Publication
11. Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.
12. National Building Code of India -2005 Bureau of Indian Standards

References:

- 1 Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
- 2 CPWD hand book on Repairs and Rehabilitation of RCC buildings published by DG (Works), CPWD, Government of India (Nirman Bhawan),
- 3 Guide to Concrete Repair, *Glenn Smoak*, US Department of the Interior Bureau of Reclamation, Technical Service Center.
- 4 Management of Deteriorating Concrete Structures: *George Somerville*, Taylor and Francis publication
- 5 Concrete Building Pathology: *Susan Macdonald*, Blackwell Publishing.
- 6 Testing of Concrete in Structures: *John H. Bungey, Stephen G. Millard and Michael G. Grantham*, Taylor and Francis Publication.
- 7 Fire Safety in Building: V. K. Jain, New Age International Publication, Delhi
- 8 MEP systems & Repairs of Buildings: A.S. Radke, Lambert Academic Publishing.

Online References:

Sr. No.	Website Name
1.	http://www.cpwd.gov.in/handbook.pdf .
2.	https://www.usbr.gov/tsc/techreferences/mands/mands-pdfs/Guide2ConcreteRepair2015_Final.pdf
3.	http://kmcenter.rid.go.th/kcresearch/MANUAL_OUT/MAEN0011.pdf

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096116	Ground Improvement Techniques	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096116	Ground Improvement Techniques	20	20	40	60	2	--	--	100

Rational

A geotechnical engineer often needs to design new structures or repair the structures on or in problematic soils in engineering practices. The types of soil at construction sites are not always totally favorable for supporting civil engineering structure such as buildings, bridges, highways, tunnels, retaining walls, dams, offshore structures and many more. Soil needs to be treated using ground improvement techniques to enhance the soil strength. This course will deal with different ground improvement techniques, their principles, effectiveness, design issues and areas of applications.

Course Objectives

1. To enable students to identify problematic soils, associated issues and need for ground improvement.
2. To make the students understand shallow and deep compaction techniques, importance of pre-compression and vertical drains.
3. To make the students understand different soil stabilization techniques and study the phenomena like liquefaction and their effects.
4. To make the students learn the concepts, purpose and effects of grouting.
5. To make the students understand application of stone column technique.
6. To provide students the concept of reinforced earth, soil nailing and ground anchors.

Course outcomes

On completion of this course, the students will be able to:

1. Identify the problems associated with the existing ground conditions and recognize the need for ground improvement.
2. Explain shallow and deep compaction techniques, pre-compression and vertical drains as well as estimate maximum dry density and consolidation settlement.
3. Evaluate soil stabilization and select the effective soil stabilization technique and to explain the concept of Liquefaction Potential of different types of soil
4. Apply knowledge of grouting as per IS 14343:1996.
5. Design of stone column as per IS 15284-1 (2003).
6. Describe reinforced earth mechanism, multiple functions of Geosynthetics and evaluate capacity of anchors.

DETAILED SYLLABUS

Pre Requisite: Knowledge of basic Geology, Soil Mechanics and Geotechnical Engineering

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction		06	CO1
	1.1	Different types of problematic soils and concerns: Inadequate mechanical properties, swelling and shrinkage - expansive soils, collapsible soils, marshy and soft soils, organic/ peaty soils, loose sandy or gravelly deposits, liquefiable soils, karst deposits, foundation on dumps and sanitary landfills, old mine pits, etc		
	1.2	Ground improvement techniques for different soil types – (Principles, applicability to various soil conditions, material requirements, equipments required, results likely to be achieved and limitations); Need for ground improvement; Control of ground improvement works; Grain size ranges for different treatment methods; Classification of ground modification techniques; Factors affecting the selection of ground improvement techniques; Benefits/objectives of ground improvement techniques.		
	1.3	Emerging trends in ground improvement techniques – (Types and brief discussion on constructive use of waste materials, low cost technologies with soil and additives, Geosynthetics, biotechnical stabilization, microbial geotechnology and nano-technology in ground improvements, Sustainable development and Energy Geotechnology etc.)		
		Note: Refer IS 13094 (1992): “Selection of ground improvement techniques for foundation in weak soils – Guidelines”		
2	Compaction and Consolidation		06	CO2
	2.1	Shallow compaction – laboratory and field methods of compaction, compaction curve, advantages of compaction, effect of compaction		
	2.2	Deep compaction – objectives, brief discussion on dynamic compaction (types of dynamic compaction, evaluation of improvement), dynamic consolidation, dynamic replacement, Vibro-compaction or, Vibro-floatation, Vibro replacement, blasting.		
	2.3	Precompression and vertical drains – Precompression or preloading (principle, settlement without and with Precompression), accelerated consolidation by sand drains, free strain and equal strain cases, design of sand drain layout; Brief discussion on prefabricated vertical drains (PVDs), advantages of PVDs over sand drains		
3	Stabilization & Liquefaction of Soil		06	CO3
	3.1	Methods of stabilization – Mechanical stabilization; lime, cement, fly-ash, bitumen, chemicals and polymer stabilization; Electrokinetic stabilization.		

Module	Course Module / Contents		Hours	CO Mapping
	3.2	Liquefaction of Soil – Introduction to liquefaction of soils and its basic terminologies, criterion and factors affecting liquefaction of soil; Mitigation measures		
4.		Grouting	06	CO4
	4.1	Grouting – Grouting technology, grout materials, choice of a grout material, classification, general relationship between permeability and groutability.		
	4.2	Particulate grouts – characteristics of grout materials, characteristics of grout slurries.		
	4.3	Non-particulate grouts – types of chemical grouts, salient features of chemical grouts, grout properties (mechanical properties, chemical properties, economic factors), penetrability and performance aspect of coarse and fine grouts, limits of groutability based on grain size distribution, Various applications of grouting.		
5		Stone Columns	07	CO5
	5.1	Some important features of stone column treatment – Influence of soil type, influence of construction methodology, treatment depth, area of treatment		
	5.2	Basic design parameters – stone column diameter, pattern, spacing, equivalent diameter, replacement ratio, stress concentration factor; Failure mechanisms; Design considerations; Estimation of load capacity of a stone column (unit cell concept); Settlement analysis by the reduced stress method; Granular blanket; Field loading tests.		
	5.3	Installation techniques of stone columns – non-displacement method, displacement method, vibro-replacement method; Vibrofloat and rammed stone columns; Methods of improving the effectiveness of stone column.		
		Note: Refer IS 15284-1 (2003): “Design and construction for ground improvement - Guidelines, Part 1: Stone columns”		
6		Reinforced Earth and Anchors	08	CO6
	6.1	Reinforced Earth – Theory of reinforced earth concept, Design principles of reinforced earth through Mohr circle analysis, Necessity of reinforced earth and Materials		
	6.2	Introduction to Geosynthetics – scope and definitions, multiple functions of Geosynthetics (Separation, Filtration, Drainage, Reinforcement, Protection(Cushion), Barrier/ Containment/ Waterproofin, Erosion Control), Areas of applications.		
	6.3	Soil nailing and ground anchors – Introduction to soil nailing and ground anchors, Capacity of shallow horizontal strip anchor by using Mononobe-Okabe method.		

Text Books:

1. P. P. Raj (2016). "Ground Improvement Techniques", Second edition, Laxmi Publications (P) LTD.
2. M. R. Hausmann (1990). "Engineering Principles of Ground Modification", McGraw-Hill Inc.,US.
3. Nihar Ranjan Patra (2012). "Ground Improvement Techniques", Vikas Publishing.
4. S. L. Kramer (2013). "Geotechnical Earthquake Engineering", Pearson.
5. B. M. Das (1990). "Earth Anchors", Elsevier.

References:

1. IS15284 (Part 1): Design and Construction for Ground Improvement–Guidelines: (Stone Column), Bureau of Indian Standards, New Delhi, (2003).
2. IS 13094 (1992): "Selection of ground improvement techniques for foundation in weak soils – Guidelines"
3. IS 14343:1996 "Choice of Grouting Materials for Alluvial Grouting – Guidelines"
4. IS 15284-1 (2003): "Design and construction for ground improvement - Guidelines, Part 1: Stone columns"
5. R.M. Koerner (1984). "Constructional and Geotechnical Methods in Foundation Engineering (McGraw-Hill series in construction engineering and project management), McGraw-Hill Inc.,US.
6. FHWA Report No. Rd 83/026, (1983) Design and Construction of Stone Columns, Vol I.
7. B. M. Das (2011). "Principles of Foundation Engineering", 7th edition, Cengage Learning.
8. R.M.Koerner (1999). "Designing with Geosynthetics", 4th Edition, Prentice Hall, Jersey.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/105108075
2	https://nptel.ac.in/courses/105106052
3	https://nptel.ac.in/courses/105105210

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

➤ **Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096117	Appraisal and Implementation of Infrastructure Project	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096117	Appraisal and Implementation of Infrastructure Project	20	20	40	60	2	--	--	100

Rationale:

For any Civil Engineering project, a range of alternative schemes meeting project goals are feasible. Thus, to identify the most suitable out of it, project evaluation has to be carried out in terms of financial viability, environmental impact, utility to the society, engineering feasibility, profitability, etc. This course is intended to make students aware of this evaluation (appraisal) criterion for any Civil engineering project. Students will understand the importance of feasibility studies and get acquainted to the process of preparing a project report, both being crucial role players while deciding the viability of a project. The professional construction engineering practice will be rendered meaningful if students learn about ways to raise project funds, their effective planning and optimum utilization. This course is devised to help students in understanding financial and economic aspects of a project.

Course Objectives:

1. To know the procedure of feasibility studies for any infrastructure project.
2. To learn the procedure of appraisals required for deciding the worthiness of any project.
3. To learn the procedure of forecasting demand and know the uncertainties involved.
4. To know the components and importance of technical & managerial appraisal.
5. To get acquainted with decision making criteria such as Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio etc.
6. To get acquainted with different methods of project finance and implementation.

Course Outcomes:

On completion of the course students will be able to:

1. Classify the infrastructure projects and describe the phases involved in project formulation
2. Prepare detailed project report on the basis of various feasibility studies and SWOT analysis.
3. Devise a project's development cycle and get acquainted with the different appraisals in the process of deciding the worthiness of the project
4. Exhibit and apply the managerial skills and knowledge of financial aspects required during the implementation of the project.
5. Determine the financial & economic feasibility of infrastructure project
6. Know the various agencies involved in project implementation as well as select the method of project implementation which is best suited for a particular project.

Detailed Syllabus:

Module	Course Module / Contents		Hours	CO Mapping
1	Infrastructure Projects and Report Preparation:		04	CO1
	1.1	Meaning of infrastructure project, Role of Infrastructure in Economic Development.		
	1.2	Classification of infrastructure projects.		
	1.3	Project Formulation and phases involved in it.		
	1.4	Feasibility studies, SWOT analysis. Preparation of Detailed Project Report (DPR).		
2	Project Appraisal:		06	CO2
	2.1	Introduction to Project Appraisal, Need of appraisal, steps of appraisal.		
	2.2	Project development cycle for infrastructure projects.		
	2.3	Importance and phases in a project development cycle for major infrastructure projects.		
3	Market Appraisal:		09	CO3
	3.1	Importance and methods of carrying out demand analysis		
	3.2	Sources to gather project related information and ways to carry out market survey.		
	3.3	Methods of forecasting the demand. Uncertainties involved in demand forecasting.		
4	Technical and Managerial Appraisal:		05	CO4
	4.1	Method to study the technical appraisal/viability of a project in terms of its location, type of land and intended use of building, technology requirements of the project, Size and complexity of tools and plants, raw materials to be used and their impact on the vicinity, energy requirements, water supply and disposal of effluents if any.		

Module	Course Module / Contents	Hours	CO Mapping
	4.2 Study of managerial requirements of a project, Desirable organizational structure and hierarchy to manage as well as implement the project.		
5	Financial appraisal and Economic Appraisal:	09	CO5
	5.1 Various costs related to a project, Methods to determine the profitability of a project, Break even analysis. Meaning and purpose of financial appraisal.		
	5.2 Time value of money concept, Methods of financial appraisal as Urgency, Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.		
	5.3 Economic appraisal: meaning of economic appraisal, common techniques in economic appraisal as Economic Rate of return, Effective Rate of Protection, Domestic Resource Cost.		
6	Project Financing and Implementation:	06	CO6
	6.1 Meaning of project financing, Types and Sources of finance in local, National and International context. Issues related to project financing.		
	6.2 Main features of project finance as special purpose vehicle, high capital intensity, multiple stakeholders, Public Private Partnership (PPP)		
	6.3 Agencies involved in the implementation of a project. Methods of implementation like Built, operate and Transfer (B.O.T) and its other variants like B.O.O, B.O.O.T, B.L.T, etc.		

Recommended Books:

1. Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
2. Infrastructure Development & Financing in India - N. Mani (New Century Publications).
3. Infrastructure & economic development - Anu Kapil (Deep & Deep Publications).
4. Construction Management: Planning and finance - Cormican D. (Construction press, London).

Reference Books:

1. Real Estate, Finance and investment - Bruggeman.Fishr (McGraw Hill).
2. The cost management toolbox; A Managers guide to controlling costs and boosting profits. - Oliver, Lianabel (Tata McGraw Hill).
3. Reference Guide for PPP project appraisal prepared by Infrastructure Finance Secretariat, Department of Economic Affairs, Ministry of Finance Govt. of India.
4. NPTEL: Civil Engineering-Name of Course:
Principles of Construction Management. <https://nptel.ac.in/courses/105104161>

Online References:

Sr. No.	Website Name
1.	https://www.pppinindia.gov.in
2.	NPTEL: Civil Engineering-NOC: Principles of Construction Management. https://nptel.ac.in/courses/105104161

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, presentation and project on Case study of infrastructure project

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Program Elective Course - 3 Theory

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096118	Sustainable and Smart Building Materials	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096118	Sustainable and Smart Building Materials	20	20	40	60	2	--	--	100

Rationale:

Sustainable development means meeting present needs without compromising future generations. Major threats include population growth, urbanization, energy use, global warming, waste generation, and resource depletion. The construction industry, consuming about 40% of total energy and half of global resources, heavily impacts the environment—mainly through cement production, a major source of greenhouse gas emissions. Reducing cement use by incorporating industrial by-products like fly ash, silica fume etc. can significantly cut CO₂ emissions and resource consumption. Smart materials, which respond to external stimuli such as temperature, stress, or light by changing shape, color, or other properties, enhance the comfort, durability, and safety of structures. Materials like alloys, composites, gels, and polymers are increasingly used from aerospace and medical fields to modern buildings. Understanding their principles and applications is essential for sustainable, intelligent construction. This course provides comprehensive knowledge of sustainable and smart building materials for eco-efficient construction.

Course Objectives:

1. To inculcate more awareness among students about sustainability
2. To learn the concepts of Life Cycle Assessment, Life Cycle Costing
3. To know the importance of cement reduction and replacements for a sustainable development.
4. To demonstrate alternative building materials and roofing systems in practice.
5. To understand the significance of smart materials, their types and properties, and to learn how to select appropriate materials for specific applications
6. To develop smart technology using smart materials

Course Outcomes:

On completion of the course students will be able to:

1. Demonstrate sustainability concept for sustainable development.
2. Apply the concepts of Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) for sustainable construction.
3. Describe Cementitious and Supplementary Cementitious Materials and their Characterization
4. Explain different roofing systems and use of waste materials in construction industry.
5. Classify the smart building materials
6. Explain energy efficient materials, durability and technology

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction to Sustainability		05	CO1
	1.1	Introduction: Need and concept of sustainability, Social, Environmental and economic sustainability concepts.		
	1.2	Sustainable development, Nexus between technology and development, Challenges for sustainable development, Fundamentals of sustainability.		
	1.3	Global Environmental issues: Resource degradation, Ozone pollution and Ozone layer depletion, Climate change, Carbon cycle, Factors affecting Carbon credits and carbon trading, carbon footprint, Carbon sequestration-carbon capture and storage (CCS).		
	1.4	Environmental Legislation in India – water act and air act		
2	Life Cycle Analysis and Life Cycle Cost Analysis		05	CO2
	2.1	Introduction of LCA and LCC, Service life, Life cycle concept for structures and selection of materials for durability and sustainability.		
	2.2	Embodied energy of materials, material life cycle, process of calculation and relevance in sustainable building material selection and construction techniques , Eco Labeling of Materials		
3	Cementitious and Supplementary Cementitious Materials and their Characterization		08	CO3
	3.1	Lime, Lime pozzolana cements, Pozzolana: Surkhi, Fly ash, IS (3812) (Type C and F), GGBFS, Silica Fumes, Metakaolin, RHA Composite cements and its types, IS (16415:2015), Magnesia based cements, Calcium sulfo- cement, Alkali activated, cement (Type 1 and Type II), Geopolymers. Composition, Properties and uses.		

Module	Course Module / Contents		Hours	CO Mapping
	3.2	Membrane curing: wax and resin based, self-curing compound: Polymer and polyethylene glycol, Water reducing admixtures, use of treated domestic effluent (TDE) for mixing and curing.		
4	Alternate Building Materials and Roofing Systems		06	CO4
	4.1	Building materials from Agro and Industrial Waste: Typical agro- waste and biomass resources, Bamboo, recycled timber		
	4.2	Use of Industrial Waste: Fly ash, Blast furnace slag, Iron ore tailings, Gold mine tailings Granite and marble polishing fines, demolished building waste		
	4.3	Concepts in Roofing Alternatives, Types of roof, Roof as a structural system, Cost reduction through construction process efficiency		
	4.4	Filler Slab Roofs, Composite beam and panel roofs, construction Details and roof assembly		
	4.5	Masonry Domes and Vaults: Relevance, analysis and design, Barrel vault.		
5	Introduction and fundamentals of Smart Building Materials		09	CO5
	5.1	History, importance and need, merits and demerits of smart building materials. Smart Structure system, Components, Importance of smart structures. Fundamentals of Smart Materials Types and characteristics of smart materials		
	5.2	Phase-changing materials: Thermo-chromics, Photochromics, Mechanochromics, Chemochromics, Electrochromics, Liquid crystals, Suspended particle, Electrorheological, Magnetorheological.		
	5.3	Energy-exchanging materials: Electroluminescents, Photoluminescents, Chemoluminescents, Thermoluminescents, Light-emitting diodes, Photovoltaics		
	5.4	Energy-exchanging (reversible) materials: Piezoelectric, Pyroelectric, Thermoelectric, Electrorestrictive, Magnetorestrictive		
	5.5	Miscellaneous Materials: Shape Memory alloy, optical fiber, Construction chemicals, Sealants etc. Review of material, effect, working principle, advantages and disadvantages, application in Smart Structures, Use of alternative materials for structural steels and rebars		
6	Energy Efficient Materials, Durability and Technology		06	CO6
	6.1	Use of solar energy, wind energy, Smart window, Smart paints, Smart Wall skin, Smart roof. FRP rebars and its properties, smart lighting. Different types of sensors their working and principles		
	6.2	Use of Thermal and Sound Insulation systems and materials		

Module	Course Module / Contents	Hours	CO Mapping
	6.3 Smart Concrete: Transparent concrete, Polymer modified concrete and mortars, self-healing concrete, self-compacting concrete, light weight concrete, pervious concrete, fiber reinforced concrete, temperature controlled concrete , Electrically conductive concrete, fire/ heat resistant concrete, acid resistant concrete		

Text Books:

1. *Alternative Building Materials and Technologies* by KS Jagadish, BV Venkatraman Reddy and KS Nanjunda Rao, New Age International publications.
2. *Sustainability Engineering: Concepts, Design and Case studies* by Allen D.T. and Shonnard D.R., Prentice Hall.
3. *Sustainability of Construction Materials* by Jamal M Khatib, Woodhead Publishing Limited
4. D. Michelle Addington, Daniel L. Schodek, "Smart Materials and New Technologies For the architecture and design professions", Harvard University. ISBN0750662255.
5. Nilesh Y. Jadhav, *Green and Smart Buildings Advanced Technology Options*, Springer Nature, ISBN 978-981-10-1002-6.
6. Mel Schwartz, *Encyclopaedia of Smart Materials*, Vol. 1 and Vol. 2, John Wiley & Sons, Inc.
7. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
8. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.
9. Vinod K. Wadhawan, "Smart Structures: Blurring the Distinction between the Living and the Nonliving", Oxford University place, ISBN 978-0-19-922917-8.
10. Venkatarama Reddy, B. V., and. Jagadish, K., S. "Embodied energy of common and alternative building materials and technologies". *Energy and Buildings*. 35, 129-137, 2003.
11. Carole Ryan, 2011, *Traditional Construction For A Sustainable Future*, Spon Press
12. David Rockwood , 2015 *Bamboo Gridshells*, Routledge Press

References:

1. *Sustainability Engineering: Concepts, Design and Case studies* by Bradley A.S.; Adebayo A.O, and Mario P., Cengage learning.
2. D. Patranabis – *Sensor and Transducers (2e)* Prentice Hall, New Delhi, 2003
3. SP-7 (National Building Code of India), Bureau of Indian Standards.

Online References:

Sr. No.	Website Name
1.	https://igbc.in/igbc
2.	https://link.springer.com/book/10.1007/978-981-10-1002-6
3.	https://www.elsevier.com/books/smart-buildings/casini/978-0-08-100635-1
4.	https://edgebuildings.com/
5.	https://beeindia.gov.in/sites/default/files/BEE_ECSBC_2024.pdf

6.	https://nptel.ac.in/courses/105105157
7.	https://nptel.ac.in/courses/105102195
8.	https://nptel.ac.in/courses/121104452

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)

End Semester Theory Examination:

➤ **Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks** **Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096119	Traffic Engineering and Transportation Planning	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096119	Traffic Engineering and Transportation Planning	20	20	40	60	2	--	--	100

Rationale:

Transportation is a vital component of a nation's infrastructure, influencing economic growth, urban development, and social integration. With rapid urbanization and increasing vehicle ownership, there is an urgent need for sustainable traffic management and integrated transportation planning. This course provides civil engineering students with the knowledge and analytical tools to plan, design, and manage efficient, safe, and sustainable transportation systems. It bridges theoretical principles with real-world applications, emphasizing modern technologies such as Intelligent Transportation Systems (ITS), data analytics, and Artificial Intelligence in traffic management.

Course Objectives:

1. Understand the fundamental principles of transportation systems and their role in national and regional development.
2. Learn the methods and techniques for transportation planning, surveys, and data analysis.
3. Develop an understanding of travel demand modeling and traffic assignment principles.
4. Analyze traffic flow characteristics and capacity in urban and highway networks.
5. Design and evaluate intersections, corridors, and traffic management systems as per IRC and Indo-HCM guidelines.
6. Explore emerging smart transportation technologies, including electric and connected vehicles, and AI-driven traffic management systems

Course Outcomes:

On completion of the course students will be able to:

1. Explain the role of transportation systems in urban and regional development and identify key issues in Indian transportation systems.
2. Conduct and analyze transportation planning surveys such as O-D, parking, speed-delay, and accident studies.
3. Develop and apply travel demand models (trip generation, distribution, mode choice, and assignment) using basic analytical techniques.

4. Evaluate traffic flow characteristics and determine roadway capacity and level of service using Indo-HCM standards.
5. Design signalized intersections and rotary intersections as per IRC standards and coordinate signals for corridors.
6. Assess the economic feasibility of transportation projects and integrate intelligent and sustainable transportation concepts in design.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Fundamentals of Transportation Systems and Planning		04	CO1
	1.1	Components of transport systems – vehicles, users, infrastructure, and environment		
	1.2	Transportation problems and influencing factors in India		
	1.3	Integration of Land Use and Transport Planning		
2	Transportation Planning Process and Surveys		06	CO2
	2.1	Transportation planning process and concept of sustainable mobility-Zoning and land use classification-Study area delineation, zoning, and planning surveys		
	2.2	Urban travel characteristics and demand concepts		
	2.3	Types and sources of data-Origin-destination, parking, speed-delay, and accident studies		
	2.4	Data analysis, sample size, accuracy checks, and interpretation		
	2.5	Travel demand management and congestion management techniques		
3	Travel Demand Modelling (Four-Stage Model)		10	CO3
	3.1	Trip Generation: Trip generation models: regression and category analysis Trip attractions and productions of different zone		
	3.2	Trip Distribution Gravity model, Fratar and Furness methods, and Introduction to opportunity models		
	3.3	Mode Choice (Modal Split): Factors influencing mode choice, split-curve, and probabilistic models		
	3.4	Traffic Assignment: Network elements: nodes, links, and minimum path trees, All-or-nothing, multipath, and capacity restraint assignment		
4	Traffic Flow and Capacity Analysis		07	CO4
	4.1	Traffic stream characteristics: speed, flow, density, headway, and gap acceptance		
	4.2	Speed-flow-density relationships and shockwave theory		
	4.3	Passenger Car Unit (PCU), capacity, and Level of Service (LOS) as per Indo-HCM 2017		

Module	Course Module / Contents		Hours	CO Mapping
5	Intersection and Corridor Design		06	CO5
	5.1	Types of intersections, conflict points, and control hierarchy		
	5.2	Design of rotaries and signalized intersections (IRC:93)		
	5.3	Signal coordination, area traffic control, and grade-separated intersections		
6	Traffic Management Design and Smart Transportation Systems		06	CO6
	6.1	Economic Analysis-Economic evaluation of highway schemes, need for economic evaluation, cost and benefits of transportation projects		
	6.2	Methods of traffic system management		
	6.3	Pedestrian and cyclist facilities (IRC:103-2022 and IRC:11-2015)		
	6.4	Electric and connected vehicles – trends, challenges, and infrastructure needs		
	6.5	AI and data analytics in traffic management and safety enhancement		

Text Books:

1. Khanna, S. K. and Justo, C. E. G., Highway Engineering, Nem Chand & Bros., Roorkee.
2. Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi.
3. Papacostas, C. S. and Prevedouros, P. D., Transportation Engineering and Planning, Prentice Hall of India.
4. Indian Roads Congress (IRC) publications — IRC:93, IRC:106, Indo-HCM 2017.

References

1. Hutchinson, B. G., Principles of Urban Transport Systems Planning, McGraw Hill.
2. O'Flaherty, C. A., Transport Planning and Traffic Engineering, Butterworth-Heinemann.
3. May, A. D., Traffic Flow Fundamentals, Prentice Hall.
4. Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice Hall.
5. IRC SP:55-2014 – Guidelines on Safety in Road Construction Zones.

Online References:

Sr. No.	Website Name
1.	Indian Roads Congress (IRC): https://www.irc.nic.in
2.	Ministry of Road Transport and Highways (MoRTH): https://morth.nic.in
3.	Transportation Research Board (TRB): https://www.trb.org
4.	Institute of Transportation Engineers (ITE): https://www.ite.org
5.	National Transportation Planning and Research Centre (NATPAC): https://natpac.kerala.gov.in
6.	NPTEL Courses – Transportation Engineering I & II, Traffic Engineering: https://nptel.ac.in

Assessment:**Internal Continuous Assessment: 40%****Internal Assessment Test (IAT) for 20 marks each:**

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)

End Semester Theory Examination:**➤ Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096120	Earthquake Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory				Term work	Pract / Oral	Total	
		Internal Assessment			End Sem Exam				Exam Duration (in Hrs)
		Test 1	Test 2	Total					
2096120	Earthquake Engineering	20	20	40	60	2	--	--	100

Rationale:

This syllabus, Earthquake Engineering, is meticulously structured to provide students with a comprehensive understanding of earthquake phenomena, their effects on the built environment, and the principles and methods required for designing earthquake-resistant structures. Given the seismic vulnerability of many regions, competence in this field is critical for modern civil and structural engineers.

Course Objectives:

1. To introduce students to fundamentals of earthquake engineering.
2. To learn parameters of measurement of earthquake.
3. To illustrate the earthquake characteristics.
4. To communicate the concept of seismic analysis.
5. To impart the basic principles for seismic design of structures confirming to Indian Standard Codes.
6. To study the various damping devices/method of reduction of seismic response.

Course Outcomes:

On completion of the course students will be able to:

1. Understand the fundamentals of earthquake engineering and seismicity.
2. Measure parameters of earthquakes and measurements
3. Analyze earthquake characteristics and associated effects on structures.
4. Understand the concepts of dynamic equations of motion and perform analysis for dynamic systems in civil engineering applications.
5. Apply the basic principles for seismic design and construction of structures in accordance with the provisions of Indian Standard Codes.
6. Design various design damping devices to mitigate seismic response.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	Engineering geology		06	CO1
	1.1	Structure of Earth, Origin of earthquakes, Plate tectonic, Ring of fire		
	1.2	Propagation of earthquake waves, Primary, Shear, Love, Rayleigh.		
	1.3	Characteristics of earthquakes		
	1.4	Indian Plate and Eurasian Plate, Indian earthquakes		
2	Measurement of earthquake		06	CO2
	2.1	Magnitude, energy, intensity of earthquake.		
	2.2	Instruments for measurements of earthquake Accelerograph, accelogram, recording		
	2.3	Epicentral distance, Focal depth		
3	Characteristics of ground motion		06	CO3
	3.1	Factors affecting ground motions		
	3.2	Concept of response spectra, Generation of site-specific spectra		
	3.3	Estimation of peak ground acceleration (PGA), Earthquake design spectra and inelastic spectra		
4	Methods of seismic analysis		07	CO4
	4.1	Seismic coefficient method		
	4.2	Response spectrum method		
	4.3	Time history method.		
5	Philosophy of earthquake resistant design		06	CO5
	5.1	Performance under minor, medium and major earthquakes.		
	5.2	Stiffness, Strength, Ductility, Configurations Use of IS codes 1893, IS 13920.		
6	Earthquake resistant building systems		05	CO6
	6.1	Vibration controlling devices, mass dampers, liquid dampers		
	6.2	Base isolation methods, bracings		

Text Books:

1. Duggal, S.K: 'Earthquake Resistant Design of Structures'; *Oxford University Press, New Delhi*
2. Agarwal, P. and Shrikhande, M.: 'Earthquake Resistant Design of Structures'; *Prentice Hall India, New Delhi, 4th Edition, 2007.*
3. A. K. Chopra: 'Dynamics of Structures- Theory and Application to Earthquake Engineering', *Prentice Hall Publication.*

References:

1. R. W. Clough and Joseph Penziene: 'Dynamics of Structures', *Mc. Graw Hill Publication.*
2. David Key: 'Earthquake Design Practice for Buildings'; *Thomas Telford Publishers.*
3. James M. Kelly: 'Earthquake Resistant Design with Rubber'; *Springer-Verlog Publication.*
4. D. J. Dowrick: 'Earthquake Resistant Design for Engineers and Architects'; *John Wiley and Sons.*
5. Robinson: 'Passive Vibration control'

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc25_ce101/course

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)

End Semester Theory Examination:

➤ **Question Paper Format:**

- Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules).
- A total of four questions needs to be answered

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096121	Construction Equipment and Technology	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096121	Construction Equipment and Technology	20	20	40	60	2	--	--	100

Rationale:

This course equips students with essential knowledge and skills to operate, maintain, and adapt to modern tools and systems used in the industry. As technology rapidly evolves, this subject ensures learners stay current with the latest advancements, enhancing their technical competence, efficiency, and employability. It bridges the gap between theory and practice, preparing students to meet industry standards and contribute effectively in a technology-driven workplace.

Course Objectives:

1. To enable students to understand the importance, selection, operation, and cost aspects of construction equipment, and to evaluate their performance for efficient construction management.
2. To familiarize students with various types of construction equipment used in civil engineering works, their working principles, applications, and selection based on site requirements, efficiency, and economy.
3. To develop students' understanding of tunneling techniques and underwater construction methods, emphasizing planning, execution, safety, and equipment selection for diverse soil and rock conditions.
4. To provide knowledge of various techniques and equipment used for substructure and superstructure construction in buildings, including foundation work, deep excavation, formwork, concreting, and construction of tall and large-span structures.
5. To develop an understanding of various construction methods, erection techniques, and safety considerations involved in the construction of special and tall structures, ensuring efficiency, stability, and safety during complex structural operations.
6. To introduce students to modern and sustainable construction methods and technological advancements in civil engineering that enhance performance, safety, energy efficiency, and durability of structures.

Course Outcomes:

On completion of the course, students will be able to:

1. Apply methods to estimate the economic life and performance of construction equipment.
2. Explain the functions, components, and working principles of earthmoving, drilling, and crushing equipment.
3. Apply suitable methods for dewatering, lining, and stabilisation in underground and underwater tunnels.
4. Illustrate techniques of continuous concreting and slip-form construction used in tall structures.
5. Apply the appropriate equipment and rigging techniques for safe erection of structural components.
6. Explain the working principles of earthquake-resistant and energy-efficient design techniques.

Detailed Syllabus

Module	Course Module / Contents	Hours	CO Mapping
1	Introduction	06	CO1
	1.1 Importance of construction equipment.		
	1.2 Cost of owning and operating equipment, Depreciation, investment, and operating cost.		
	1.3 Economic life, selection of equipment. Factors affecting selection of construction equipment.		
	1.4 Study of equipment operations and factors affecting their performance. Output of equipment, reference available types, and their capacities.		
2	Construction Equipment	09	CO2
	2.1 Earthmoving Equipment: Bulldozers, dozers and rippers, Scrapers, shovels, draglines, clamshells, hoes, Dumpers, dump trucks, wagons, Trenching machines, rollers, and compactors.		
	2.2 Drilling and Blasting Equipment: Jackhammers, drifters, drills, bits, blasting material handling, blasting caps, drilling patterns, safety.		
	2.3 Pile Driving Equipment: Types of pile driving hammers: single acting, double acting, differential acting, diesel hammers, hydraulic hammers.		
	2.4 Pumping Equipment: Reciprocating, diaphragm, and centrifugal pumps, Wellpoint system.		
	2.5 Stone Crushing Equipment: Jaw crushers, gyratory and cone crushers, hammer mills, Roll crushers, rod and ball mills, Aggregate screens and screening plants, Portable plants, and compressors.		

Module	Course Module / Contents		Hours	CO Mapping
3	Underground & Underwater Tunnelling		06	CO3
	3.1	Various purposes for which tunnelling may be carried out, Basic terms related to tunnelling. Conventional methods of carrying out tunnelling in different types of soils/rocks.		
	3.2	Methods for dewatering tunnels. Detailed Procedure for Underwater Tunnelling.		
	3.3	Use of drones, construction robots for aerial surveys. Use of GPS and remote sensing for setting out tunnel alignment.		
	3.4	Jumbo used for drilling and blasting, Blasting Techniques for quarrying stones for construction purposes. Diaphragm wall construction and other ground stabilisation methods.		
	3.5	Vertical shaft sinking machine (VSM). Tunnel Boring Machine (TBM), Micro tunnelling. New Austrian tunnelling method (NATM). Cut and cover method, top-to-bottom construction. Tunnel lining trolley.		
4	Sub-Structure & Super Structure Construction for building		06	CO4
	4.1	Box jacking, Pipe jacking, driving well and caisson, sinking cofferdam, cable anchoring, and grouting. Laying operations for a built-up offshore system, shoring for deep cutting.		
	4.2	Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections, Erection techniques of tall structures, large span structures, Launching techniques for heavy decks, in-situ prestressing in high-rise structures, post-tensioning of the slab		
5	Construction of Special Structures		06	CO5
	5.1	Erection of lattice towers - Rigging of transmission line structures, Construction sequence in cooling towers, Silos, chimneys, skyscrapers.		
	5.2	Construction sequence and methods in domes, Support structure for heavy equipment and machinery in heavy industries, Erection of articulated structures and space decks.		
	5.3	Roof truss: erection problems, Building / Industrial component, Equipment, and tackles used for erecting these. Plate girder: Launching a portion of bridge girder, large span lattice girder. Erection of chimney, Erection of overhead tank.		
6	Advancements in Construction Techniques		06	CO6
	6.1	Building construction techniques: Zero energy building, green building, pre-engineering building Solar Paints, Building Integrated Photovoltaic (BIPV)		

Module	Course Module / Contents		Hours	CO Mapping
	6.2	Earthquake Resisting Controls-Isolation and Dissipation.		
	6.3	Coastal construction techniques: Soundproofing walls, water-resistant roofs, high-performance doors and windows, air and moisture barriers.		
	6.4	Road construction techniques: 3D Printing, Road Printer, smart roads.		

Text Books:

1. Construction Equipment & Planning. Purifoy, R.L, & Ledbetter, McGraw-Hill
2. Construction Equipment & its Management. Sharma, S. C. Khanna Publishers
3. Tunnel Engineering Handbook Thomas R. Kuesel, Elwyn H. King, John O. Bickel Springer
4. Roy Chudley & Roger Greeno – Construction Technology, Prentice Hall.
5. S.C. Rangwala – Building Construction, Charotar Publishing.
6. erry Irvine – Advanced Construction Techniques, CA Rocketr

References:

1. IRC:43-2015 Recommended Practice for Plants, Tools and Equipment Required for Construction and Maintenance of Concrete Roads (First Revision).
2. IRC-2018 Pocket Book for Road Construction Equipment.
3. IRC: SP-97- 2013 Guidelines on Compaction Equipment for Road Works
4. Sankar, S.K. & Saraswati, S. – Construction Technology, Oxford University Press.
5. Peurifoy – Construction Planning, Equipment and Methods, Tata McGraw Hill.
6. Mahesh Varma – Construction Equipment Planning and Applications

Online References:

Sr. No.	Website Name
1.	NPTEL: Construction equipment - https://nptel.ac.in/courses/105103206
2.	NPTEL: Construction equipment - https://elearn.nptel.ac.in/shop/completed-courses/short-term-programscompleted/construction-technology-and-management/?v=c86ee0d9d7ed
3.	NPTEL: Construction Technology Courses – https://nptel.ac.in/
4.	MIT Open Courseware: Advanced Construction Techniques – https://ocw.mit.edu

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Quizzes, Class Tests, Presentation, and assignments, etc. (at least 3)

End Semester Theory Examination:

➤ Question Paper Format:

- The Question Paper will comprise a total of **six questions, each carrying 15 marks. Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3, then part (b) must be from any other Module randomly selected from all the modules.
- A total of four questions need to be answered

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Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096122	Smart cities	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096122	Smart cities	20	20	40	60	2	--	--	100

Rationale:

The syllabus is designed to equip students with the knowledge, skills, and competencies required to develop, manage, and maintain smart cities. The course covers various aspects of smart city development, including infrastructure, technologies, and applications.

The syllabus integrates concepts from urban planning, geography, computer science, and engineering to provide a comprehensive understanding of smart city development. The course includes case studies, projects, and hands-on exercises to help students apply theoretical concepts to real-world problems. The syllabus covers emerging technologies such as IoT, AI, GIS, and Remote Sensing, which are critical for smart city development and management. The course emphasizes the importance of sustainability and resilience in smart city development, including environmental management and disaster management.

The course aims to produce professionals who can contribute to the development of sustainable, resilient, and livable cities, improving the quality of life for citizens and promoting economic growth and development.

Course Objectives:

- ▲ On completion of the course students will be able to-
 1. To understand the concept of Smart Cities, their infrastructure, and applications of smart technologies in urban planning.
 2. To apply GIS and Remote Sensing approaches in smart city development, urban planning, and management.
 3. To explore the role of IoT in smart cities, including data collection, management, and applications.
 4. To investigate the applications of Artificial Intelligence in smart city management, including urban planning, transportation, and energy management.
 5. To examine smart technologies for environmental management, including water, waste, air quality, and energy management.
 6. To understand the role of smart technologies in disaster management, including the use of drones, ethical issues, and case studies.

Course Outcomes:

1. Smart City Development: Students will be able to design and develop smart city infrastructure, applying smart technologies in urban planning and management.
2. GIS and Remote Sensing Applications: Students will be able to apply GIS and Remote Sensing approaches in smart city development, urban planning, and management, analyzing data and making informed decisions.
3. IoT Applications in Smart Cities: Students will be able to design and implement IoT solutions for smart cities, collecting and managing data, and applying it in various applications.
4. AI in Smart City Management: Students will be able to apply Artificial Intelligence in smart city management, including urban planning, transportation, energy management, and public services.
5. Environmental Management: Students will be able to design and implement smart technologies for environmental management, including water, waste, air quality, and energy management.
6. Disaster Management: Students will be able to apply smart technologies in disaster management, including the use of drones, analyzing ethical issues, and learning from case studies of successful and unsuccessful technology implementations.

Prerequisite: Fundamentals of Transportation Engineering , Internet of Things , Artificial Intelligence

DETAILED SYLLABUS:

Module	Course Module / Contents		Hours	CO Mapping
1	Introduction to Smart cities		07	CO1
	1.1	Definition and concept of smart city, Challenges of Urbanization, Smart City Characteristics,		
	1.2	Government of India initiatives “100 Smart Cities” Policy and Mission, its Performance benchmarks, Smart City Standards		
	1.3	Important sectors of smart city, Concept of Digitalization, Smart Cities-E-Governance, Smart Citizen Services,		
	1.4	Concepts of Project Management in smart cities, Case Studies of Smart City Projects		
2	Smart Urban Planning Using GIS & Remote Sensing		06	CO2
	2.1	Fundamentals of GIS and Remote Sensing, Spatial Data Acquisition & Processing		
	2.2	Applications of GIS and Remote Sensing in Smart City Planning and Urban Monitoring		
	2.3	Geospatial Technologies for Smart City Services, Case Studies.		
3	IOT in Smart Cities		06	CO3
	3.1	Introduction to IoT, sensor networks, communication technologies, and IoT platforms		

Module	Course Module / Contents		Hours	CO Mapping
	3.2	Data management used to enable smart services like transportation, energy, water, wastewater & environmental monitoring,		
	3.3	Real- world case studies, implementation challenges		
4	AI in Smart City Management		06	CO4
	4.1	Overview of AI for Smart Cities, AI Techniques & Tools		
	4.2	Applications of AI in Urban Planning, in Urban Mobility, Traffic Management, Utilities & Public Services.		
	4.3	Case studies, Challenges and Future Directions.		
5	Smart Technologies for environment management		07	CO5
	5.1	Smart Technologies for - Water Management, Smart sanitation and storm water drainage system, Solid waste Management		
	5.2	Smart Pollution Control Technologies, Energy Management. Case Studies & Global Best Practices		
6	Smart Technologies for disaster management		07	CO6
	6.1	Introduction to Disaster Management, Phases of disaster management, Safety, Security and Disaster Management for Smart Citizen.		
	6.2	Role of technology in disaster management, Drones for Disaster Management, DRR Framework for Smart Cities,		
	6.3	Real-world examples of smart technologies in disaster management, Ethical issues related to the use of smart technologies in disasters		
	6.4	Case studies of successful and unsuccessful technology implementations.		

Text Books:

1. Jo Beall (1997); "A city for all: valuing differences and working with diversity"; Zed books limited, London (ISBN: 185649-477-2).
2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4).
3. Arup Mitra; "Insights into inclusive growth, employment and wellbeing in India"; Springer (2013), New Delhi (ISBN: 97881-322-0655-2
4. Mission statement & guidelines on Smart City Scheme". Government of India - Ministry of Urban Development [http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines\(1\).pdf](http://smartcities.gov.in/upload/uploadfiles/files/Smart%20City%20Guidelines(1).pdf)

References:

1. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony M. Townsend.
2. GIS for Urban and Regional Planning" by Peter O'Connell.
3. Artificial Intelligence in the 21st Century" by Stephen Lucci and Danny Kopec
4. Internet of Things for Smart Cities: Technologies, Big Data and Security by Zaigham Mahmood

Online References:

Sr. No.	Website Name
1.	NPTEL (National Program on Technology Enhanced Learning) 1. Integrated Waste Management for a Smart City https://nptel.ac.in/courses/105105160 or https://onlinecourses.nptel.ac.in/noc19_ce31/preview . 2. Smart Grid: Basics to Advanced Technologies https://onlinecourses.nptel.ac.in/noc24_ee148/preview . 3. Introduction To Internet Of Things By Prof. Sudip Misra IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs53/preview 4. Applied AI: Smart City https://srmuniv.digimat.in/nptel/courses/video/106106238/L55.html 5. Disaster Recovery And Build Back Better, IIT Roorkee https://nptel.ac.in/courses/124107010
2.	Coursera: 1. Management of Urban Infrastructures 2. https://www.coursera.org/learn/managing-urban-infrastructures-1 3. Smart Cities, Management of Smart Urban Infrastructures 4. https://www.classcentral.com/course/urban-planning-ecole-polytechnique-federale-de-la-8677
3.	Websites : 1. https://tomorrow.city/a/technology-for-smart-cities-the-pillars-of-urban-planning-of-the-future 2. https://www1.nyc.gov/assets/forward/documents/NYC-Smart-Equitable-City-Final.pdf 3. https://smartcity.go.kr/wp-content/uploads/2019/08/Smart-city-broschureENGLISH.pdf

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

Continuous Evaluation through:

Assignments, Class Tests, Quizzes, presentation, site visit

End Semester Theory Examination:

➤ Question Paper Format:

- Question Paper will comprise a total of **six questions each carrying 15 marks** Q.1 will be **compulsory** and should **cover the maximum contents of the syllabus**
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules). A total of four questions needs to be answered

Program Core Course Lab

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096123	Environmental Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096123	Environmental Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To provide hands-on experience in determining characteristics of water and wastewater.
2. To enable students to apply standard testing procedures for evaluating water and sewage quality parameters.
3. To develop analytical skills to assess the suitability of water for domestic and municipal use based on experimental results.
4. To familiarize students with various treatment processes through practical experiments.
5. To introduce the operation of plumbing systems and basic environmental engineering software tools.
6. To enhance students' ability to analyze, record, and validate experimental data, apply quality control measures, and ensure laboratory safety and precision in results.

Lab Outcomes:

Student will be able to

1. Interpret experimental data to assess the quality and suitability of water and wastewater for intended use.
2. Determine parameters such as pH, turbidity, hardness, chlorides and residual chlorine using laboratory techniques.
3. Determine parameters such as DO, BOD, COD, and total solids in wastewater samples.
4. Determine optimum dosage of coagulant.
5. Demonstrate plumbing system components.
6. Apply environmental software tools for water and wastewater analysis.

Text Books:

1. Water Supply Engineering: Vol I: S. K. Garg, Khanna Publication.
2. Environmental Engineering Vol II: Garg, S. K., Khanna Publishers New Delhi.
3. Water Supply Engineering: P.N. Modi, Rajsons Publication.
4. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.

References:

1. CPHEEO Manual on Water Supply and Treatment.
2. CPHEEO Manual on Sewage and Treatment.

Online Resources:

Sr. No.	Website Name
1.	https://www.upjn.co.in/pdf/Water_Supply/Part-A-Manual-Engineering-Planning-Design-and-Implementation.pdf
2.	http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php

List of Experiments.

Sr. No.	List of Experiments (Any Eight)	Hrs	LO
01	Determination of pH of water from various sources/ sewage sample	02	LO1, LO2
02	Determination of Turbidity in water sample.	02	LO1, LO2
03	Determination of Total Solids, suspended solids, dissolved solids, volatile solids.	02	LO1, LO3
04	Determination of total and temporary hardness	02	LO1, LO2
05	Determination of chlorides.	02	LO1, LO2
06	Determination of Optimum dose of coagulant by using Jar Test.	02	LO1, LO4
07	Determination of Dissolved Oxygen.	02	LO1, LO3
08	Determination of Residual chlorine	02	LO1, LO2
09	Determination of Bio Chemical Oxygen Demand of sewage Sample	02	LO1, LO3
10	Determination of Chemical Oxygen Demand of sewage sample.	02	LO1, LO3
11	Determination of sludge volume index	02	LO1, LO3
12	Demonstration of Plumbing System and report on it.	02	LO5
13	Introduction to various Environmental engineering software	02	LO6

Assessment:

Term Work: Term Work shall consist of practicals and theory assignments based syllabus. Theory assignment should not contain more than 5 questions on each module. The students shall visit to sewage treatment plant/ water treatment plant in the nearby vicinity or in the city and prepare detailed report thereof. This report will form a part of the term work.

Term Work Marks: Distribution of marks for Term Work shall be as follows:

Laboratory Work	:	08 Marks
Site Visit and Report	:	02 Marks
Assignments	:	06 Marks
Continuous Assessment (open book Test/ presentation/ class test/ quizzes Etc)	:	04 Marks
Attendance	:	05 Marks

Oral Exam: An Oral exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096124	Geotechnical Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096124	Geotechnical Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives

- 1 To study compaction and consolidation characteristics of soil.
- 2 To study and examine shear strength parameters of soil.
- 3 To Study and determine the strength of sub-grade soil.
- 4 To Study and determine swelling pressure of soil.
- 5 To gain the knowledge of stress distribution in soil.
- 6 To gain the knowledge of various geotechnical software

Lab outcomes

On completion of this course, the students will be able to:

- 1 Determine the consolidation parameters such as coefficient of compressibility, coefficient of volume change, coefficient of consolidation.
2. Plot the compaction curve and then determine the optimum moisture content and maximum dry density of soil.
- 3 Determine the cohesion and angle of shearing resistance for various types of soils.
- 4 Determine the CBR value of soil for pavement design.
- 5 Determine swelling pressure of soil.
- 6 Understand the concept of stress distribution in soils due to vertically applied load.

Text Books:

- 1 Soil Mechanics and Foundation: Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications
- 2 Soil Mechanics and Foundation Engineering: K.R. Arora; Standard publishers and Distributors
- 3 Soil Mechanics and Foundation Engineering: V.N.S Murthy; Saitech Publications
- 4 Geotechnical Engineering: C. Venkatramaiah; New age International
- 5 Basic and Applied Soil Mechanic: Gopal Ranjan and A.S. Rao; New Age International

References:

- 1 Theoretical Soil Mechanic: K. Terzaghi; John Wiley and Sons
- 2 Fundamentals of Soil Engineering: D. W. Taylor; John Wiley and sons
- 3 Relevant Indian Standard Specification Code: BIS Publications, New Delhi
- 4 Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House
- 5 Geotechnical Engineering: Purushothama Raj; Tata McGraw Hill Publications

Online References:

Sr. No.	Website Name
1	https://gte-nitk.vlabs.ac.in/List%20of%20experiments.html

DETAILED SYLLABUS

S. No.	List of Experiments (Any 6)	Hours	LO Mapping
1	Determination of pre-consolidation pressure and coefficient of consolidation from one dimensional consolidation test	06	LO1
2	Determination of optimum moisture content and maximum dry density using light compaction test	02	LO2
3	Determination of optimum moisture content and maximum dry density using heavy compaction test	02	LO2
4	Determination of shear strength parameters using direct shear test	02	LO3
5	Determination of shear strength parameters using unconsolidated undrained tri-axial compression test	02	LO3
6	Determination of undrained cohesion using unconfined compression test	02	LO3
7	Determination of shear strength of soft clays by vane shear test	02	LO3
8	Determination of CBR value using CBR test	02	LO4
9	Determination of swelling pressure of clays	02	LO1

Assignment

(a) Assignments should contain 5 - 7 numerical problems on each module

(b) One assignment shall be given on either vertical stress distribution in soils or a design problem using geotechnical engineering software. The teacher is expected to impart the knowledge to the students about the concept of stress distribution of soils or design problem using software. The questions related to stress distribution in soils or design problem using software shall **NOT** be asked in the theory examination. However, it shall be treated as a part of term work submission. It shall preferably cover the following points:

- Vertical stress distribution in soils: Estimation of vertical stress in soil due to surface load using Boussinesq equation.

OR

- Design problem using software: Introduction to any geotechnical software like Geo 5, PLAXIS, FLAC, MIDAS GTS-NX etc.

Oral Exam: An Oral exam will be held based on the above syllabus

Assessment:

Term Work: Term Work shall consist of at least 06 experiments based on the experiment list. Also, Term work Journal must include 06 assignments.

Distribution of Term Work Marks

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory Work	: 15 Marks
Assignments	: 05 Marks
Attendance	: 05 Marks

Oral Exam: An Oral exam will be held based on the above syllabus

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

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Program Elective Course – 2 Lab

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096125	Mass Transportation Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096125	Mass Transportation Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To analyze the interdependencies between a nation's mass transportation systems and its socio-economic development, focusing on concepts like the National Urban Transport Policy (NUTP) and sustainability.
2. To evaluate the operational and infrastructural requirements of the Air Transportation System, including air traffic control and airport planning considerations.
3. To evaluate the operational and infrastructural requirements of the railway Transportation System.
4. To determine the logistical and environmental constraints inherent in the Water Transportation System.
5. To design a preliminary layout or operational plan for an Urban Transit System for a hypothetical city, addressing passenger flow and system integration.
6. To investigate the structural and material requirements for key Transportation Structures and assess their maintenance and lifecycle performance through a case study analysis.

Lab Outcomes: Student will be able to

1. Justify the selection of sustainable transportation modes for urban planning scenarios, referencing principles derived from the NUTP.
2. Understand basic elements and calculate key performance indicators (KPIs) for air transportation network.
3. Understand basic elements and calculate key performance indicators (KPIs) for railway transportation network.
4. Understand water transport system and evaluate multi-modal transportation and urban transit systems.
5. Differentiate between the design specifications and construction methods used for various Transportation Structures.
6. Present a comprehensive technical report on a transportation system case study (related to objectives 1-5), synthesizing theoretical knowledge with practical evidence and communicating findings effectively as a group.

Text Books:

- 1 Khanna S.K., Arora M.G., Jain S.S., Airport Planning & Design, Nemchand Bros., Roorkee
- 2 Saxena S.C., Railway Engineering, Dhanpat Rai & Sons, 1995
- 3 Srinivasan R., Harbours, Docks & Tunnel Engineering, Charotar Publishing House, Anand
- 4 Partha Chakroborty, Animesh Das, Principles of Transportation Engineering
- 5 Bindra S.P., Bridge Engineering, Dhanpat Rai & Sons
- 6 Ponnuswamy, S. Urban Transportation: Planning, Operation and Management. McGraw Hill Education (India) Private Limited.

References:

- 1 Horenjeff Robert, The planning & Design of Airports, McGraw Hill Book Co.
- 2 Indian Railway Track: Agarwal, M. M., Suchdeva Press New Delhi.
- 3 Planning Design of Airport: Horonjeff Mckelrey, Tata Mc-Graw Hill India Publishing House, New Delhi.
- 4 Docks & Harbour Engineering, Bindra S.P., Dhanpat Rai Publications,
- 5 Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House
- 6 Kadiyali, L. R. (2018). Transportation Engineering (9th ed.). Khanna Publishers.
- 7 Public Transit Planning and Operation: Modeling, Practice and Behavior by Avishai (Avi) Ceder

Online References:

Sr. No.	Website Name
1.	Introduction to Multimodal Urban Transportation Systems (MUTS) https://onlinecourses.nptel.ac.in/noc21_ce72/preview
2.	Urban Transportation Planning https://ocw.mit.edu/courses/1-252j-urban-transportation-planning-fall-2016/pages/lecture-slides/

List of Assignments.

Sr. No.	List of Assignments	LO
01	Effect of mass transportation system in development of nation, NUTP, sustainable transportation etc.	1
02	Air Transportation System	2
03	Railway Transportation System.	3
04	Water Transportation System and Urban Transit System.	4
05	Transportation Structures.	5

Report/case study.

Students shall form a group of two to four students for preparing a details report suggested in the list below (List is just suggestions. Additional topics can also be adopted). The students shall present the report to the class.

Sr. No.	Suggested List of Reports/case study (any one)	LO
01	Select a recent major Transportation Infrastructure Project (e.g., a new highway, metro line, or port expansion) in your region and write a brief report analyzing its alignment with the National Urban Transport Policy (NUTP) goals	6
02	Write a brief report on National Urban Transport Policy (NUTP) goals	6
03	Design a basic single-runway airport layout for a hypothetical city given a provided Wind Rose Diagram (you must sketch or create a digital image). Determine the Runway Orientation and calculate the Corrected Basic Runway Length given specific elevation and temperature data.	6
04	Prepare a technical note distinct characteristics, advantages, and limitations of Metro Rail and High-Speed Rail (Bullet Trains) as modern rail systems compared to conventional heavy rail.	6
05	Write a brief report on Metro rail planned and operating in different cities in India highlighting the demand, capacity and benefits.	6
06	Write a brief report on monorail planned and operating in different cities in India highlighting the demand, capacity and benefits.	6
07	Select a specific port/harbour in India. Based on its location and function, classify the harbour and sketch a Layout Diagram showing the main components and its benefits.	6
08	Analyze the suitability of three different urban transit modes (Conventional City Bus, Metro Rail, and Shared Auto-Rickshaws/E-Rickshaws) for a hypothetical urban corridor of a given length and population density.	6

Assessment:

Term Work: Term Work shall consist of assignments and report based on the above list. **Term**

Work Marks: 25 Marks (Total marks) = 15 Marks (Assignments) + 05 Marks (Report/case study) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096126	Advanced Design of Steel Structures Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Oral	Total
		Internal assessment							
		Test 1	Test 2	Total					
2096126	Advanced Design of Steel Structures Lab	--	--	--	--	25	25	50	

Lab Objectives:

1. To estimate and apply design loads on steel structures in accordance with IS 875.
2. To analyze the member forces using suitable analytical or software-based methods.
3. To design steel members subjected to axial, flexural, and shear forces as per relevant IS codes.
4. To prepare detailed design reports and fabrication drawings manually or using CAD software.

Lab Outcomes: Student will be able to

1. Calculate dead, live and wind loads on the structure.
2. Analyze the structure by analytical/graphical method.
3. Use steel table for selecting appropriate section.
4. Design the members for various load combinations.
5. Design the bolted and welded connection.
6. Read and Prepare the detailed fabrication drawing and design report.

Text Books:

1. Design of Steel Structure by N. Subramanian, Oxford University Press, New Delhi.
2. Limit state design of steel structures by S. K. Duggal, McGraw Hill Education (India) Pvt. Limited, New Delhi.
3. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S. S., I.K. International Publishing House, New Delhi.
4. Design of Steel Structures by K. S. Sai Ram, Pearson Education, New Delhi.
5. Limit state design of steel structures as per IS 800/2007. by S. Kanthimathinathan. I.K. International Publishing House, New Delhi.
6. Relevant Indian Specifications, Bureau of Indian Standards, New Delhi.

References:

1. Design of Steel Structure by Allen Williams
2. Practical Design of Steel Structure by Karuna Moy Ghosh, Whittles Publishing
3. Structural design and drawing by D. Krishnamurthy, CBS Publishers, New Delhi.
4. Teaching Resources Material for steel structures by INSDAG Kolkata.

List of Experiments.

The Term work shall consist of a Design report and detailed drawings on projects as indicated below and the two-assignment based on connections and PEB structures:

Schedule	Detailed Content	Hrs	LO
Project 1	Design and drawing of steel roof truss (Tubular or angle sections) for industrial shed should consist of the following items.	12	
1 st Week	Introduction, problem statement, Calculation of panel point DL, LL, and WL on truss.	02	LO 1
2 nd Week	Analysis of truss by graphical method/ any software and calculation of design loads in members	02	LO 2
3 rd Week	Design of purlins, Principal rafter, Main Tie, Design of remaining members of truss. etc	02	LO 3
4 th Week	Design of bolted /welded connections and design of sliding and hinged supports including anchor bolts	02	LO 4
5 th Week	To generate/draw fabrication drawings on full imperial size drawing sheet and design report on A4 size pages.	02	LO 5, 6
6 th Week	Assignment on connections.	02	LO 2
Project 2	Analysis and Design of elevated circular tank with conical or Hemispherical bottom using relevant IS Codes.	12	
1 st Week	Introduction, problem statement, selection of tank type and capacity, preliminary dimensions of tank and staging.	02	LO 1
2 nd Week	Calculation of loads – dead load, water load and wind as per IS. Design of circular tank wall, top dome, and bottom (conical or hemispherical).	02	LO 2
3 rd Week	Design of connection for cylindrical, suspended bottom, and between cylindrical part with suspended bottom. Design of ring beam.	02	LO 3
4 th Week	Design of staging system columns, bracings and foundation.	02	LO 4
5 th Week	Preparation of structural drawings on imperial size sheet and design report on A4 pages.	02	LO 5, 6
6 th Week	Assignment on PEB structures.	02	LO 2

The drawing should be drawn in pencil only on minimum of A-1 (imperial) size drawing sheets OR using any software.

Assessment:

Term Work: Term Work shall consist of project based on the above list.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Projects) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the theory syllabus and projects.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096127	Building Services and Repairs Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096127	Building Services and Repairs Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To study various building services such as water supply, sanitation, electrical, HVAC, and fire safety systems.
2. To understand methods of inspection, testing, and maintenance of essential building services.
3. To analyze defects, deterioration, and causes of distress in buildings.
4. To learn different materials and techniques for repair, retrofitting, and waterproofing.
5. To evaluate sustainability and efficiency aspects of building service systems.
6. To enhance practical understanding through field visits and hands-on demonstrations.

Lab Outcomes: Student will be able to

1. Identify and demonstrate various components of building service systems.
2. Inspect and test building installations for performance and safety.
3. Analyze causes of common defects and propose appropriate repair measures.
4. Apply knowledge of materials and methods for waterproofing and retrofitting.
5. Interpret field and experimental data to suggest maintenance strategies.
6. Integrate sustainable practices in building service and repair design.

Text Books:

1. S. K. Duggal, Building Materials, New Age International.
2. S. C. Rangwala, Water Supply and Sanitary Engineering, Charotar Publishing.
3. P. C. Varghese, Maintenance, Repair and Rehabilitation of Concrete Structures, PHI Learning.

References:

1. S. C. Sharma, Building Construction and Materials, Khanna Publishers.
2. IS 3067: 2021 – Code of Practice for General Design Details and Preparatory Work for Damp-Proofing and Waterproofing.
3. IS 15988: 2013 – Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings.

Online Resources:

Sr. No.	Website Name
1.	https://rajivdabhi.wordpress.com/building-services-course-code-4360605/
2.	NPTEL: Building Repair and Maintenance, https://nptel.ac.in/courses
3.	IGBC/GRIHA Green Building Manuals, https://igbc.in

List of Experiments.

Sr. No.	List of Experiments (Any six)	Hrs	LO
01	Study of water supply system components in multistorey buildings.	2	LO1
02	Demonstration of sanitary fittings, traps, and plumbing layouts.	2	LO1
03	Inspection and report on fire-fighting installation (hydrants, sprinklers).	2	LO2
04	Study and demonstration of HVAC system components (split/central AC).	2	LO2
05	Identification of common defects in structures (cracks, dampness, leakage) with case documentation.	2	LO3
06	Practical on waterproofing materials and their application techniques.	2	LO4
07	Visit/report on building repair and maintenance site (e.g., waterproofing/retrofit site).	2	LO5
08	Study of energy-efficient and green building services (lighting, ventilation, solar systems).	2	LO6

Assessment:

Term Work: Term work shall consist of practicals and project-based work from the above list. The term work journal must include at least 6 assignments and one site visit report.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An oral/practical examination will be conducted based on the above syllabus and journal work.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096128	Ground Improvement Techniques Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096128	Ground Improvement Techniques Lab	--	--	--	--	--	25	25	50

Lab Objectives

1. To study compaction and consolidation characteristics of modified soil.
2. To study and examine shear strength parameters and to determine the strength of sub-grade of modified soil
3. To make the students understand shallow and deep compaction techniques, importance of pre-compression and vertical drains.
4. To make the students understand application and design of stone column technique.
5. To make the students learn the concepts, purpose and effects of grouting and grouting mix design
6. To study the concept of reinforced earth, soil nailing, ground anchors and applications of geosynthetics materials.

Lab outcomes

On completion of this course, the students will be able to:

1. Determine consolidation parameters such as coefficient of compressibility, coefficient of volume change, coefficient of consolidation, rate of consolidation of modified soil.
2. Plot the compaction curve and then determine the optimum moisture content and maximum dry density of modified soil.
3. Determine cohesion and angle of shearing resistance for various soil types and to determine the CBR value of soil for pavement design.
4. Design of stone column as per IS 15284 (Part 1) :2003
5. Understand the concept of grouting, soil stabilization and liquefaction in soils.
6. Design of reinforced earth structures and Anchor Capacity

Text Books:

1. Soil Mechanics and Foundation: Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications
2. Soil Mechanics and Foundation Engineering: K.R. Arora; Standard publishers and Distributors
3. Basic and Applied Soil Mechanic: Gopal Ranjan and A.S. Rao; New Age International
4. Soil Dynamics: *Shamsher Prakash*, McGraw-Hill book company
5. B. M. Das (1990). "Earth Anchors", Elsevier.
6. P. P. Raj (2016). "Ground Improvement Techniques", Second edition, Laxmi Publications (P) LTD.
7. M. R. Hausmann (1990). "Engineering Principles of Ground Modification", McGraw-Hill Inc.,US.
8. Nihar Ranjan Patra (2012). "Ground Improvement Techniques", Vikas Publishing.
9. Relevant IS codes

References:

1. IS15284 (Part 1): Design and Construction for Ground Improvement–Guidelines: (Stone Column), Bureau of Indian Standards, New Delhi, (2003).
2. IS 13094 (1992): "Selection of ground improvement techniques for foundation in weak soils – Guidelines"
3. IS 14343:1996 "Choice of Grouting Materials for Alluvial Grouting – Guidelines"
4. IS 15284-1 (2003): "Design and construction for ground improvement - Guidelines, Part 1: Stone columns"
5. R.M. Koerner (1984). "Constructional and Geotechnical Methods in Foundation Engineering (McGraw-Hill series in construction engineering and project management), McGraw-Hill Inc.,US.
6. FHWA Report No. Rd 83/026, (1983) Design and Construction of Stone Columns, Vol I.
7. B. M. Das (2011). "Principles of Foundation Engineering", 7th edition, Cengage Learning.
8. R.M.Koerner (1999). "Designing with Geosynthetics", 4th Edition, Prentice Hall, Jersey.
9. Theoretical Soil Mechanic: K. Terzaghi; John Wiley and Sons
10. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley and sons

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/105101176
2	https://nptel.ac.in/courses/105106052

DETAILED SYLLABUS

S. No.	List of Experiments (Any 4)	Hours	LO Mapping
1	Determination of pre-consolidation pressure and coefficient of consolidation from one dimensional consolidation test on modified soil	02	LO1
2	Determination of optimum moisture content and maximum dry density using light/heavy compaction test on modified soil	02	LO2
3	Determination of shear strength parameters of modified soil using direct shear test/ tri-axial compression test	02	LO3

4	Determination of undrained cohesion using unconfined compression test of modified cohesive soil	02	LO3
5	Determination of CBR value using CBR test on modified / reinforced soil	02	LO3
6	Test on Geosynthetic materials for various application 1. Direct shear and Pull out test (strength test) 2. Hydraulic Properties test: Permeability/ Permittivity test (Drainage test) 3. Test on Geofoam: Density, water absorption, compressive & tensile strength 4. Load Test (On small scale model with geosynthetics material)	02	LO6

List of Assignments:

S. No.	List of Assignments/ Tutorials	LO Mapping
1.	Identification & study of problematic soil, ground improvement techniques and Emerging trends	LO1
2.	Shallow and Deep Compaction techniques	LO2
3.	Precompression : Vertical drains (IS 18309:2023) & PVDs -IS 15284 (Part 2): 2004 (Reaffirmed-2020)	LO1
4.	Stabilization & Liquefaction of Soil	LO5
5.	Grouting and Grouting mix calculations (IS 14343 :1996), IS 4999 (1991)	LO5
6.	Stone Columns: Design & construction of Stone column (IS 15284 (Part 1) :2003)	LO4
7.	Reinforced Earth and Anchors (Theory)	LO6
8.	Design of Geosynthetic reinforced embankment on soft soil (IRC 113:2013)	LO6
9.	Design of reinforced soil walls (IRC SP 102: 2014)	LO6
10.	Capacity of shallow horizontal strip anchor by using Mononobe-Okabe method.	LO6

Assessment:

Term Work: Term Work shall consist of at least 04 practicals based on the experiment list. Also, Term work Journal must include 06 assignments as listed. Practical's and assignments to be selected such that termwork covers all lab outcomes.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Oral Exam: An Oral exam will be held based on the above syllabus

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096129	Appraisal and Implementation of Infrastructure Project Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096129	Appraisal and Implementation of Infrastructure Project Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To prepare SWOT analysis of major infrastructure project.
2. To prepare detailed project report of any one infrastructure project.
3. To forecast the demand for any proposed infrastructure project.
4. To evaluate technical appraisal through technology choice, availability of resources, and schedule for infrastructure project.
5. To prepare financial & economical appraisal for infrastructure project using various decision-making criteria.
6. To study methods of infrastructure project implementation based on Public Private Partnership (PPP) model.

Lab Outcomes: Student will be able to

1. Prepare SWOT model for major infrastructure project.
2. Draft Detailed Project Report (DPR) on infrastructure project.
3. Analyze demand forecasting of infrastructure project.
4. Understand technical soundness of infrastructure project.
5. Know about financial & economical appraisal for infrastructure project.
6. Gain knowledge of infrastructure project implementation methods.

Sr. No.	Activity Based on Tutorial	Hrs	LO
01	Assignment No.1: Prepare SWOT analysis of any two of the following • Building Infrastructure project • Road Infrastructure project • Hydropower Infrastructure project	02	LO1
02	Assignment No.2: Prepare Detailed Project Report (DPR) on any one of the following: • Highway infrastructure project, • Water Supply Project • Railway infrastructure project • Sanitation project	02	LO2

03	Assignment No. 3: Evaluation of secondary information, methods of demand forecasting by qualitative, quantitative and casual methods, uncertainties involved in demand forecasting.	02	LO3
04	Assignment No.4: Technical analysis, factors have a bearing on choice of technology, importance of location and site in technical appraisal, organizational structure.	02	LO4
05	Assignment No.5: Break even analysis, illustrate various methods of financial appraisal and economical appraisal.	02	LO5
06	Assignment No.6: Project finance, sources of project finance, PPP model, implementation methods of infrastructure project like BOT, BOOT, BLT, BLT etc.	02	LO6
07	Case Study on complete appraisal of any one of the following projects: • Highway Infrastructure Project • Metro Rail Infrastructure Project • Power Infrastructure Project	02	LO3- LO5
08	Feasibility study on any one of the following projects: • Dam Infrastructure Project • Bridge Infrastructure Project • Expressway Infrastructure Project	02	LO3- LO5

Recommended Books:

1. Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
2. Infrastructure Development & Financing in India - N. Mani (New Century Publications).
3. Infrastructure & economic development - Anu Kapil (Deep & Deep Publications).
4. Construction Management: Planning and finance - Cormican D. (Construction press, London).

Reference Books:

1. Real Estate, Finance and investment - Bruggeman.Fishr (McGraw Hill).
2. The cost management toolbox; A Managers guide to controlling costs and boosting profits. - Oliver, Lianabel (Tata McGraw Hill).
3. Reference Guide for PPP project appraisal prepared by Infrastructure Finance Secretariat, Department of Economic Affairs, Ministry of Finance Govt. of India.
4. NPTEL: Civil Engineering-Name of Course:Principles of Construction Management.

Online References:

Sr. No.	Website Name
1.	https://www.pppinindia.gov.in
2.	NPTEL: Civil Engineering-NOC:Principles of Construction Management. https://nptel.ac.in/courses/105104161

Assessment:

Term Work: Term Work shall consist of activity based on tutorial mentioned in the above list (Assignment No. 7 & Assignment No 8 attempt **any one** Assignment)

Term Work Marks: 25 Marks (Total marks) = 12 Marks (Assignments) + 04 Marks (Case study) + 04 Marks (Feasibility study) + 05 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus

Program Elective Course – 3 Lab

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096130	Sustainable and Smart Building Materials Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096130	Sustainable and Smart Building Materials Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the concepts of smart and sustainable materials used in eco-efficient construction and their applications in modern buildings.
2. To analyze the environmental impact of construction materials using Life Cycle Assessment (LCA) tools and basic energy consumption calculations.
3. To study the concept of eco-labelling and Life Cycle Costing (LCC) for selected sustainable materials and interpret their sustainability indices.
4. To develop hands-on knowledge through model preparation, simulations, and field observations related to sustainable and smart buildings.
5. To enhance problem-solving, teamwork, and design-thinking skills through tutorial-based activities and project-oriented learning.
6. To acquaint the students with smart building materials.

Lab Outcomes: Student will be able to

1. Explain the properties, functions, and roles of smart and sustainable materials in eco-efficient construction.
2. Perform basic LCA calculations and interpret environmental indicators such as embodied energy, carbon footprint, and resource efficiency.
3. Compare different building materials based on eco-labelling and LCC parameters to determine their sustainability potential.
4. Design and demonstrate a working or conceptual model showcasing smart or sustainable features using locally available materials.
5. Demonstrate and report on innovative materials such as self-healing concrete through experimental or literature-based study.
6. Use simulation or analytical tools to estimate energy consumption and suggest improvements for efficient building performance.

Text Books:

1. D. Michelle Addington, Daniel L. Schodek, "Smart Materials and New Technologies For the architecture and design professions", Harvard University. ISBN0750662255
2. Sustainability Engineering: Concepts, Design and Case studies by Allen D.T. and Shonnard D.R., Prentice Hall.

3. Sustainability Engineering: Concepts, Design and Case studies by Bradley A.S.; Adebayo A.O, and Mario P., Cengage learning.
4. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2015, 3rd edition, Springer, New York.
5. Venkatarama Reddy, B. V., and. Jagadish, K., S. “Embodied energy of common and alternative building materials and technologies”. Energy and Buildings. 35, 129-137, 2003.

References:

1. Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.
2. SP-7 (National Building Code of India), Bureau of Indian Standards.

Online Resources:

Sr. No.	Website Name
1.	https://igbc.in/igbc
2.	https://edgebuildings.com/
3.	https://beeindia.gov.in/sites/default/files/BEE_ECSBC_2024.pdf

List of Experiments.

Sr. No.	List of Experiments/Tutorials (Any Eight)	Hrs	LO
01	Prepare a detailed report on smart and sustainable materials for eco-efficient construction.	2	1
02	LCA tool uses & calculation (Introductory Level)	2	2
03	Prepare a detailed report of eco-labeling and LCA/LCC of selected materials.	2	3
04	Prepare a sustainable and smart model (if possible working) with acquired knowledge	2	4
05	Study / Prepare a detailed report on self-healing concrete	2	5
06	Energy consumption calculation or simulation software to know energy consumption of any type of building	2	6
07	Field Survey – Site Visit of sustainable and smart building to have a practical knowledge of each component	2	1
08	Tutorial 1 – Problem-Solving Sessions	2	2
09	Tutorial 2- Design/Project-Based Tutorials- comparison between traditional building and green building with different parameters	2	3
10	Practical on Recycled aggregate concrete	2	5
11	Analysis and design of solar panel as smart and sustainable materials	2	6

Assessment:

Term Work: Term Work shall consist of practicals and project based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096131	Traffic Engineering and Transportation Planning Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096131	Traffic Engineering and Transportation Planning Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. Develop practical skills in conducting field-based traffic and transportation studies.
2. Analyze transportation data to derive performance measures such as speed, flow, delay, and capacity.
3. Apply principles of travel demand modeling and traffic assignment using computational and spreadsheet tools.
4. Familiarize students with transportation software like PTV VISSIM, VISUM, CUBE, and TransCAD.
5. Integrate modern data sources such as GPS and GIS for transport planning and management applications.
6. Encourage sustainable and intelligent transportation system practices through laboratory investigations.

Lab Outcomes: Student will be able to

1. Conduct traffic and transportation field surveys such as speed–delay, O–D, parking, and pedestrian studies.
2. Analyze and interpret collected traffic data for operational and planning purposes.
3. Perform trip generation, mode split, and traffic assignment exercises using analytical and spreadsheet tools.
4. Evaluate capacity and Level of Service (LOS) as per Indo-HCM 2017 and design signalized intersections using Webster’s method
5. Demonstrate the use of transportation simulation and planning software such as VISSIM, VISUM, CUBE, and TransCAD.
6. Integrate GPS and GIS data for travel demand analysis and route optimization in smart transportation applications.

Text Books:

1. Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi.
2. Khanna, S. K. and Justo, C. E. G., Highway Engineering, Nem Chand & Bros., Roorkee.
3. Papacostas, C. S. and Prevedouros, P. D., Transportation Engineering and Planning, Prentice Hall of India.
4. Indian Roads Congress (IRC) publications – IRC:106, IRC:93, Indo-HCM 2017.

References:

1. May, A. D., Traffic Flow Fundamentals, Prentice Hall.
2. O'Flaherty, C. A., Transport Planning and Traffic Engineering, Butterworth-Heinemann.
3. TRB Highway Capacity Manual, HCM 2016.
4. IRC SP:55-2014 – Guidelines on Safety in Road Construction Zones.
5. Manuals of PTV VISSIM/VISUM, CUBE, and TransCAD.

Online Resources:

Sr. No.	Website Name
1.	Indian Roads Congress (IRC): https://www.irc.nic.in
2.	Ministry of Road Transport and Highways (MoRTH): https://morth.nic.in
3.	Transportation Research Board (TRB): https://www.trb.org
4.	NPTEL Courses – Traffic Engineering Laboratory, Transportation Systems Analysis, Intelligent Transportation Systems: https://nptel.ac.in
5.	PTV Group (VISSIM/VISUM): https://www.ptvgroup.com
6.	TransCAD Official: https://www.caliper.com
7.	NATPAC: https://natpac.kerala.gov.in

List of Experiments.

Sr. No.	List of Experiments (Any Eight)	Hrs	LO
Part A – Field Studies (Any Two) (Manual / Instrument-Based)			
01	Speed and Delay Study – using moving observer and spot speed methods.	06	LO1,LO2
02	Origin–Destination (O–D) Survey – cordon or roadside interview method.	06	LO1,LO2
03	Parking Studies – accumulation, duration, and turnover characteristics.	06	LO1,LO2
04	Pedestrian Volume and Behavior Study – walkway and crossing characteristics.	06	LO1,LO2
Part B – Tut/Analytical / Computational Studies (Any Four)			
01	Trip Generation and Distribution Analysis using sample household	02	LO3

	data.		
02	Mode Split and Traffic Assignment Exercises – simple problem-solving using spreadsheet tools.	02	LO3
03	Travel Demand Forecasting – introduction to model calibration and validation concepts.	02	LO3
04	Capacity and Level of Service (LOS) Calculation as per Indo-HCM 2017.	02	LO4
05	Design of Signalized Intersection using Webster's method.	02	LO4
Part C – Software-Based Exercises (Introductory Level) (Any Two)			
Introduction to Transportation and Traffic Simulation Tools:			
01	PTV VISSIM / VISUM – network modeling and traffic flow simulation.	02	LO5
02	CUBE- strategic planning and travel demand forecasting	02	LO5
03	TransCAD – travel demand and network modeling.	02	LO5
04	Use of GPS, GIS, and mobile data in travel demand analysis and route planning	02	LO6

Assessment:

Term Work: Term Work shall consist of practicals assignments and exercise based on the above list, such that Term work Journal covers all lab outcomes.

Term Work Marks: 25 Marks (Total marks) = 08 Marks (Experiment) + 04 Marks (Assignments) + 04 Marks (Software based exercise) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the Theory syllabus and Lab work.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096132	Earthquake Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096132	Earthquake Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To experimentally study the dynamic behavior of structural systems under simulated earthquake loads.
2. To familiarize students with response measurement equipment and vibration analysis.
3. To perform code-based seismic analysis and design using computational tools.
4. To understand the importance of ductile detailing and retrofitting through model studies.

Lab Outcomes:

Upon successful completion of the laboratory course, students will be able to:

1. Measure natural frequency, damping, and mode shapes of structural systems.
2. Analyze SDOF systems for various ground motions
3. MDOF systems for various ground motions.
4. Perform equivalent static analysis and response spectrum analysis
5. Simulate and interpret earthquake response using computer software.
6. Apply IS 1893 and IS 13920 provisions in practical design scenarios.

Text Books:

1. Duggal, S.K: 'Earthquake Resistant Design of Structures'; *Oxford University Press, New Delhi*
2. Agarwal, P. and Shrikhande, M.: 'Earthquake Resistant Design of Structures'; *Prentice Hall India, New Delhi, 4th Edition, 2007.*
3. A. K. Chopra: 'Dynamics of Structures- Theory and Application to Earthquake Engineering', *Prentice Hall Publication.*

References:

1. R. W. Clough and Joseph Penziene: 'Dynamics of Structures', *Mc. Graw Hill Publication.*
2. David Key: 'Earthquake Design Practice for Buildings'; *Thomas Telford Publishers.*
3. James M. Kelly: 'Earthquake Resistant Design with Rubber'; *Springer-Verlog Publication.*
4. D. J. Dowrick: 'Earthquake Resistant Design for Engineers and Architects'; *John Wiley and Sons.*
5. Robinson: 'Passive Vibration control'

Online Resources:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc25_ce101/course

List of Experiments.

Sr. No.	List of Experiments (Any Eight)	Hrs	LO
01	Study of Seismic Instruments Demonstration of seismograph, accelerograph, and vibration sensor setup.	2	LO1
02	Free Vibration Test of a Cantilever Beam: Determination of natural frequency and damping ratio experimentally.	2	LO1
03	Forced Vibration Test on a SDOF Model: Determination of amplitude vs. frequency response and resonance curve.	2	LO1, LO2
04	Dynamic Response of a Two-Story Frame Model: Observation of mode shapes and modal frequencies using vibration exciter or shake table.	2	LO1, LO3
05	Shake Table Test on a Building Model: Determination of displacement, acceleration, and failure pattern during simulated earthquakes	2	LO3, LO5
06	Base Isolation System Demonstration: Comparison of response of isolated and fixed-base models under dynamic excitation.	2	LO3, LO6
07	Response of SDOF System to Ground Motion Numerical solution using MATLAB.	2	LO2, LO5
08	Seismic Coefficient and Base Shear Calculation Using IS 1893 (Part 1): 2016 for a sample RC frame.	2	LO4, LO6
09	Response Spectrum Analysis using ETABS / STAAD. Pro / SAP2000: Model creation, modal analysis, and base shear verification.	2	LO4, LO5
10	Equivalent Static Method (Code-Based Design) Determination of design lateral forces and story shear as per IS 1893.	2	LO4, LO6
11	Ductile Detailing Demonstration (IS 13920) Drawing reinforcement detailing for beam-column joints, shear walls, and columns.	2	LO6

Assessment:

Term Work: Term Work shall consist of practical and project based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096133	Construction Equipment and Technology Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096133	Construction Equipment and Technology Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the basic working principles and operational mechanisms of various construction equipment.
2. To study the selection criteria and performance evaluation of equipment used in civil construction projects.
3. To familiarise students with modern construction techniques and equipment management practices.
4. To enable students to calculate equipment productivity and cost efficiency for given site conditions.
5. To develop hands-on experience with equipment simulation, field demonstrations, and safety procedures.
6. To inculcate skills related to maintenance planning and sustainability aspects in equipment management.

Lab Outcomes: Student will be able to

1. Identify and classify various construction equipment based on their function and application.
2. Demonstrate understanding of working mechanisms through model studies and simulations.
3. Analyse and compute the output and cost of owning and operating construction machinery.
4. Apply suitable equipment selection for different site conditions and project types.
5. Evaluate the performance and maintenance requirements of earthmoving, lifting, and concreting equipment.
6. Present case studies demonstrating the use of modern construction technologies and sustainable practices.

Text Books:

1. S.C. Sharma – Construction Equipment and Management, Khanna Publishers.
2. R.L. Peurifoy & Ledbetter – Construction Planning, Equipment, and Methods, McGraw-Hill.
3. Mahesh Varma – Construction Equipment Planning and Applications, Metropolitan Book Co. Pvt. Ltd.

References:

1. IRC:43-2015 – *Recommended Practice for Plants, Tools, and Equipment for Construction and Maintenance of Concrete Roads.*
2. IRC SP:97-2013 – *Guidelines on Compaction Equipment for Road Works.*
3. Sankar, S.K. & Saraswati, S. – *Construction Technology*, Oxford University Press.

Online Resources:

Sr. No.	Website Name
1.	NPTEL: Construction Methods and Equipment Management https://nptel.ac.in/courses/105103206
2.	MIT Open CourseWare: Advanced Construction Techniques- https://ocw.mit.edu/
3.	NPTEL: Construction Technology & Management https://elearn.nptel.ac.in/?v=c86ee0d9d7ed

List of Experiments.

Sr. No.	List of Tutorials/Assignments (Any Eight)	Hrs	LO
01	Poster presentation on equipment: bulldozers, scrapers, dumpers, excavators, etc. – different parts, suitability, working principles, etc.	2	LO1
02	Report writing on compaction equipment and determination of compaction efficiency.	2	LO1, LO2
03	Numerical on Productivity and cost analysis of construction equipment.	2	LO3
04	Study of pile driving and dewatering equipment through videos/models/simulation.	2	LO2
05	Demonstration on concreting equipment – batching plant, transit mixer, concrete pump, and vibrators.	2	LO2
06	Site Visit report/case study on construction equipment used at an actual project site (RMC, Metro, or Highway).	2	LO4
07	Simulation-based study of tower cranes, elevators, and hoisting mechanisms.	2	LO2, LO5
08	Preparation of a working model of construction equipment	2	LO5
09	Assignment on recent innovations – drones, 3D printing, GPS-controlled machines, and robotics in construction.	2	LO6
10	Mini project: Equipment selection and planning for a given construction scenario	2	LO4, LO6

Assessment:

Term Work: Term Work shall consist of tutorials and project based on the above list. Also, Term work must include at least 6 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Tutorials) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096134	Smart Cities Lab	-	2	-	-	1	-	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096134	Smart Cities Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize students with smart city concepts and frameworks, enabling them to understand the integration of technology in urban development.
2. To develop skills in GIS and Remote Sensing tools for analyzing spatial data and supporting smart city planning and decision-making.
3. To provide hands-on experience in IoT-based data collection and analysis for applications such as traffic, waste, and energy management.
4. To introduce the use of Artificial Intelligence techniques for urban system optimization and smart city governance.
5. To enable students to design sustainable environmental management systems, focusing on pollution monitoring, resource efficiency, and renewable energy.
6. To train students in the application of smart technologies for disaster preparedness and response, using drones, sensors, and AI-based risk analysis.

Lab Outcomes: After successful completion of the lab, students will be able to:

1. Design basic smart city models integrating multiple smart technologies for efficient urban management.
2. Apply GIS and Remote Sensing techniques to collect, visualize, and interpret geospatial data for smart city applications.
3. Develop and test IoT-based prototypes for real-time monitoring of urban services such as lighting, traffic, and waste.
4. Implement AI algorithms for predictive analytics in smart transportation, energy optimization, and public service systems.
5. Evaluate and propose sustainable environmental management solutions using smart sensors and automation technologies.
6. Demonstrate the use of smart tools in disaster management scenarios, including drone-based mapping, early warning systems, and post-disaster assessment.

Text Books:

1. Jo Beall (1997); "A city for all: valuing differences and working with diversity"; Zed books limited, London (ISBN: 185649-477-2).
2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4).
3. Arup Mitra; "Insights into inclusive growth, employment and wellbeing in India"; Springer (2013), New Delhi (ISBN: 97881-322-0655-2)
4. Mission statement & guidelines on Smart City Scheme". Government of India - Ministry of Urban Development [http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines\(1\).pdf](http://smartcities.gov.in/upload/uploadfiles/files/Smart%20City%20Guidelines(1).pdf)

References:

1. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony M. Townsend.
2. GIS for Urban and Regional Planning" by Peter O'Connell.
3. Artificial Intelligence in the 21st Century" by Stephen Lucci and Danny Kopec
4. Internet of Things for Smart Cities: Technologies, Big Data and Security by Zaigham Mahmood

Online References:

Sr. No.	Website Name
1.	NPTEL (National Program on Technology Enhanced Learning) 1. Integrated Waste Management for a Smart City. https://nptel.ac.in/courses/105105160 or https://onlinecourses.nptel.ac.in/noc19_ce31/preview. 2. Smart Grid: Basics to Advanced Technologies" https://onlinecourses.nptel.ac.in/noc24_ee148/preview. 3. Introduction To Internet Of Things By Prof. Sudip Misra IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs53/preview 4. Applied AI: Smart City https://srmuniv.digimat.in/nptel/courses/video/106106238/L55.html 5. Disaster Recovery And Build Back Better, IIT Roorkee https://nptel.ac.in/courses/124107010
2.	Coursera: 1. Management of Urban Infrastructures https://www.coursera.org/learn/managing-urban-infrastructures-1 2. Smart Cities, Management of Smart Urban Infrastructures https://www.classcentral.com/course/urban-planning-ecole-polytechnique-federale-de-la-8677
3.	Websites : 1. https://tomorrow.city/a/technology-for-smart-cities-the-pillars-of-urban-planning-of-the-future 2. https://www1.nyc.gov/assets/forward/documents/NYC-Smart-Equitable-City-Final.pdf 3. https://smartcity.go.kr/wp-content/uploads/2019/08/Smart-city-broschureENGLISH.pdf

List of tutorials

Sr. No.	List of Tutorials	Hrs	LO
A	List of Assignments (Any 4)		
01	Objective: Study the concept, components, and architecture of a smart city. Task: Analyze an existing smart city (e.g., Pune, Singapore, or Barcelona) and prepare a short report on how technology integration improved city management. Expected Output: 3–4 page report with diagrams, data insights, and conclusions.	2	LO1
02	Objective: Apply GIS and Remote Sensing techniques for spatial analysis. Task: Create a GIS-based land-use map or flood-risk zone map of a selected area using open-source data (e.g., QGIS). Expected Output: Thematic map and a short interpretation report.	2	LO2
03	Objective: Design an IoT-based monitoring system. Task: Prepare a conceptual design and flow diagram for a “Smart Waste Management” or “Smart Street Lighting” system using sensors and cloud data. Expected Output: IoT system block diagram, component list, and description.	2	LO3
04	Objective: Use AI/ML approaches for city data analysis. Task: Use a small dataset (e.g., traffic data or air quality data) and demonstrate how AI can predict congestion or pollution levels. Expected Output: Analytical report with basic AI workflow (even simulated).	2	LO4
05	Objective: Design a smart solution for environmental monitoring. Task: Develop a project plan for real-time water or air quality monitoring using smart sensors and dashboards. Expected Output: Proposal with system layout, components, and sustainability benefits.	2	LO5
06	Objective: Explore technology-based approaches for disaster management. Task: Prepare a case study on the use of drones, GIS, or sensors in disaster response (e.g., flood, earthquake, or landslide). Expected Output: 3-page report with visuals and evaluation of success/failure factors.	2	LO6
B	Class Test		
01	Smart City concept, IoT architecture, GIS/Remote Sensing principles. Format: Short answer and application-based questions.	2	LO1 to LO3
02	AI in urban systems, Environmental and Disaster Management technologies. Format: Problem-solving and case study-based questions.	2	LO4 to LO6

C	Quiz		
01	Topics: Smart city fundamentals, IoT components, GIS basics. Format: 15 objective/multiple-choice questions.	2	LO1 to LO3
02	Topics: AI, environmental management, disaster technology. Format: 15 objective/multiple-choice questions with short reasoning.	2	LO4 to LO6
D	Presentation		
01	Smart City Innovation Presentation (CO1–CO6) Objective: Encourage innovative thinking and communication skills. Task: Each student/group presents a <i>Smart City Innovation Proposal</i> — e.g., Smart Water Grid, Smart Transport Hub, or Smart Disaster Command Center. Duration: 8–10 minutes per team. Evaluation Criteria: Creativity, feasibility, technical depth, and presentation quality.	2	LO1 to LO6
E	Site Visit		
01	Smart City or Technology Implementation Visit (CO1–CO6) Location Options: • Smart City Mission Office / Municipal Data Command Center (e.g., Navi Mumbai Smart City) • Urban GIS Lab / Environmental Monitoring Station • Disaster Management Control Room or IoT Innovation Center Objective: Observe real-world smart technologies and understand integration challenges. Activity: Students must prepare a short field report highlighting observed technologies, data use, and management systems.	2	LO1 to LO6

Assessment:

Term Work: Term Work shall consist of (Any 4 Assignments, 1 Class Test, 1 quiz , 1 presentation And 1 site visit) based on the above list.

Term Work Marks: 25 Marks (Total marks) = 12 Marks (Assignments, class test, quiz) + 04 Marks (Presentation) + 04 Marks (Site visit) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

Vertical – 4

VSEC

Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2096411	Computer Aided Structural Design and Drawing (Capstone Mini-Project)	-	2*+2	-	-	2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2096411	Computer Aided Structural Design and Drawing (Capstone Mini-Project)	--	--	--	--	--	50	25	75

Lab Objectives:

1. To understand the role and scope of computer-aided tools in structural engineering.
2. To apply relevant IS codes for load estimation, modeling, and design.
3. To develop and analyze structural models using industry-standard computational tools.
4. To apply IS 3370:2020 and computational tools for the design and detailing of RCC water tanks.
5. To design RCC and steel elements with practical detailing and codal compliance.
6. To explore advanced computational techniques including Python and AI/ML applications.

Lab Outcomes:

Student will be able to

1. Explain the significance of software tools and differentiate between proprietary and open-source platforms.
2. Apply computational methods for load estimation, modeling, and structural analysis of beams and frames.
3. Design RCC elements including slabs, beams, staircases using software tools.
4. Analyze and design special RCC structures like water tanks with codal provisions.
5. Analyze and design steel truss with proper connection detailing.
6. Implement Programming Language /Python/ AI and optimization algorithms for intelligent structural design and performance evaluation.

Text Books:

1. C.S. Reddy, Basic Structural Analysis, Tata McGraw Hill Education, New Delhi.
2. P.C. Varghese, Limit State Design of Reinforced Concrete, PHI Learning Pvt. Ltd., New Delhi.
3. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill Education, New Delhi.
4. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi.
5. S.K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill Education, New Delhi.
6. N. Subramanian, Design of Steel Structures, Oxford University Press, New Delhi.
7. P. Dayaratnam, Design of Water Tanks, Wheeler Publishing, New Delhi.
8. S. Rajasekaran, Computer Aided Design and Analysis, S. Chand & Company Ltd., New Delhi.
9. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
10. S. Anand, Python Programming for Engineers, McGraw Hill Education, New Delhi.

Reference Code :

1. Bureau of Indian Standards, IS 456:2000 — Plain and Reinforced Concrete – Code of Practice, BIS, New Delhi.
2. Bureau of Indian Standards, IS 3370 (Part 1–4):2020 — Concrete Structures for Storage of Liquids, BIS, New Delhi.
3. Bureau of Indian Standards, IS 800:2007 — General Construction in Steel – Code of Practice, BIS, New Delhi.
4. Bureau of Indian Standards, IS 875 (Part 1–5):Latest Version — Design Loads for Buildings and Structures, BIS, New Delhi.
5. Bureau of Indian Standards, SP 34:1987 — Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi.

References:

1. K. U. Muthu and A. Meera, *Computer Aided Analysis and Design of Structures*, I.K. International Publishing House Pvt. Ltd.
2. Structural Modeling, Analysis & Design Using Staad Pro Software Paperback – 15 October 2015 by Vignesh Kumar M (Author); Publisher: LAP Lambert Academic Publishing; Genre: Business & Economics; ISBN: 9783848447671, 9783848447671
3. Reinforced Concrete: Syal and Goel, Wheeler Publishers.
4. V. Sridhar, Artificial Intelligence and Machine Learning for Engineers, Pearson Education, New Delhi.
5. Edwin H. Gaylord and Charles N. Gaylord, Structural Engineering Handbook, McGraw Hill Education, New York.
6. M. Ghali and A.M. Neville, Finite Element Analysis of Structures through STAAD.Pro, Pearson Education, Singapore.
7. Romano Fabrizio, *Learning Python*, Packt Publishing Limited.
8. Paul Barry, Head First Python – A Brain Friendly Guide, SPD O'Reilly, 2nd Edition.
9. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education.
10. Introduction to Machine Learning with Python: A Guide for Data Scientists Paperback – 7 October 2016; by Andreas C. Mueller (Author), Sarah Guido (Author); ISBN-10: 1449369413; ISBN-13: 978-1449369415, 1st Edition; Publisher O'Reilly

Online Resources:

Sr. No.	Website Name
1.	Design of Reinforced Concrete Structures–IIT Kharagpur (Prof. Nirjhar Dhang) https://onlinecourses.nptel.ac.in/noc25_ce123/preview
2.	Design of Steel Structures–IIT Kharagpur (Prof. Damodar Maity). https://onlinecourses.nptel.ac.in/noc25_ce121/preview
3.	The Joy of computing using Python – IIT Ropar (Prof. Sudarshan Iyengar). https://nptel.ac.in/courses/106106182
4.	AI Applications in Civil Engineering https://www.udemy.com/share/10acbi3@tsmqgy-ePe46AAXuTTNc4tAD
5.	Optimization Methods for Civil Engineering –IIT Guwahati (Prof. Rajib Kumar Bhattacharjya) https://onlinecourses.nptel.ac.in/noc25_ce105/preview

Detailed Syllabus

Module	Course Module / Contents	Hours	CO Mapping
1	Introduction to Computer Aided Structural Design & Drawing	03	CO1
	1.1 Role of computer-aided tools in structural engineering/Civil Engineering.		
	1.2 Overview of design codes (IS 456, IS 800, etc.).		
	1.3 Comparison: proprietary vs. open-source tools.		
	1.4 Case studies of software used in industry.		
2	Load Calculation, Modeling, Analysis and Design	12	CO2
	Analytical Understanding and Design Concepts		
	2.1 Classification and estimation of loads: Dead, Live and Wind.		
	Load transfer mechanism through slabs, beams, and columns and codal combination provision (IS 875- (Part 1–5) & IS 1893 (Part 1)).		
	Structural modeling concepts and boundary conditions.		
	Computational Practice		
	2.2 Study of basic commands and tools for modelling a structural element.		
	Analysis and design of determinate and in-determinate structure (Beam and Frame).		
	2.3 Developing a model of simple plan of a building (square or rectangular).		
	Modeling of RCC framed structure (G+1).		
	Analysis and Design of R. C. C. framed structure (G+1).		
3	Design of RCC Elements	11	CO3
	Analytical Understanding and Design Concepts		
	3.1 Slabs: Design of one-way and two-way continuous slabs (Restrained conditions).		
	3.2 Beams: Design of Continuous beam.		
	3.3 Staircases: Introduction to types of staircases. Design of dog-legged staircase.		

Module	Course Module / Contents		Hours	CO Mapping
	3.4	Shear Wall -Introduction, purpose, placement, design principles.		
	3.5	Reinforcement detailing principles for RCC members.		
	Computational Practice			
		Design of slab, beam, staircase using computational tool. Preparation of reinforcement schedules and drawings.		
4	Design of Special RCC Structure		08	CO4
	Analytical Understanding and Design Concepts			
	4.1	Classification of Water Tank, Permissible Stresses.		
		Design of circular water tank resting on ground (IS 3370:2020). Crack width control, uplift, and stress checks.		
	4.2	Introduction to design of elevated water tank, frame and shaft type of staging.		
	Computational Practice			
		Design of RCC tank using computational tool. Reinforcement detailing of water tank.		
5	Design of Steel Truss		10	CO5
	Analytical Understanding and Design Concepts			
	5.1	Design loads and member forces (IS 800:2007). Connection detailing — bolted and welded joints.		
		Computational Practice		
	Analysis and design of steel truss with connection detailing using suitable computational tool			
6	Programming,Python, AI/ML Applications in Structural Design and Optimization		08	CO6
	Analytical Understanding and Design Concepts			
	6.1	Function and data structure in python		
	6.2	Structural Analysis and Design Optimization		
	6.3	Application of AI and Machine Learning in Structural Engineering		
	6.4	Design Optimization Techniques using Genetic Algorithms and Neural Networks		
	6.5	Case Studies and Applications		
	Computational Practice			
	Programming /Python in design of RCC or steel members. Case study using real dataset to perform predictive analysis and validate design outcomes.			

Sr. No.	List of lab work (Part I)	Hrs	LO
All computations must be performed both manually and using appropriate software tools to ensure accuracy and validate results.			
01	Prepare a comparative chart of at least five structural design software packages, including both proprietary and open-source tools, highlighting their key features, applications, and code compliance.	1	LO1
02	Modelling and Analysis of Determinate and Indeterminate Beams.	4	LO2
03	Modelling and Analysis of RCC Framed Structure (G+1).	4	LO2
04	Design, and detailing of G+1 RCC framed structure including slabs, beams, columns, footing and staircase.	4	LO3
05	Design and reinforcement detailing of RCC circular water tank.	4	LO4
06	Analysis and detailing of steel truss connections.	4	LO5
07	Python Program to Analyze & Design RCC or Steel Members (Any One) RCC: Design a simply supported rectangular beam Output: Required Ast, bar selection, min. steel . OR Steel: Design a tension member (Fe410) with bolted connection. Output: Design capacity (yield/net-section/block-shear).	4	LO6
Sr. No.	List of lab work (Part II) (Any One)	Hrs	LO
01	Detailed reinforcement drawings for RCC one-way slab, two-way slab on an A3 size drawing sheet as per standard drafting conventions.	1	LO3
02	Detailed reinforcement drawings for staircase on an A3 size drawing sheet as per standard drafting conventions.	1	LO3

Assessment:

Term Work: Term Work shall consist of Lab work (Part I) and Lab Work (Part II) and presentation (Group of 3-4 Students) of any one computational tool utilized in Lab work (Part I).

All computations in Lab Work (Part I) must be performed both manually and using appropriate software tools to ensure accuracy and validate results.

Term Work Marks: 50 Marks (Total marks) =

30 Marks (Lab Work I) + 5 Marks (Presentation) + 10 Marks (Lab Work II) + 5 Marks (Attendance)

Vertical – 5

AEC

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
AEC601	Professional Skills	--	2*+2	--	--	2	-	2

		Theory					Teamwork	Practical / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
AEC 601	Professional Skills	--	--	--	--	--	25		25

Course Rationale:

This course equips engineering students with professional communication, ethical values and soft skills essential for global industry demands. It enhances technical writing, presentation and interpersonal abilities through practical sessions, fostering confidence, teamwork and social responsibility as competent engineering professionals.

Course Objectives - Students are expected to learn to:

1. **Develop** effective speaking, presentation, group discussion and interview skills required for employability and professional success.
2. **Analyse and evaluate** AI-generated content for accuracy, bias, credibility and ethical professional use.
3. **Prepare** clear, concise and professional technical/business documents such as resumes, reports, SOP and formal correspondence.
4. **Demonstrate** managerial and collaborative skills required for conducting meetings, preparing proposals and workplace communication.
5. **Apply** interpersonal, critical thinking, negotiations, time management, leadership, decision-making and adaptability skills for lifelong learning and career growth.
6. **Exhibit** ethical values, intellectual property awareness, digital responsibility and professionalism in workplace practices.

Course Outcomes - Students will be able to:

1. **Demonstrate** effective speaking skills through participation in group discussions, interviews, presentations and collaborative activities.
2. **Analyse and evaluate** AI-generated content in terms of quality, bias, reliability and ethical use for academic and professional purposes.
3. **Create** professional documents such as resumes, cover letters, statements of purpose, reports and other technical/business correspondence using standard formats.
4. **Organise and execute** professional meetings, proposals and technical papers using appropriate workplace communication strategies and digital tools.
5. **Apply and demonstrate** interpersonal skills such as leadership, critical thinking, negotiation, decision-making, time management and adaptability to support career growth and lifelong learning.
6. **Exhibit** ethical practices, digital responsibility and awareness of intellectual property rights in professional environments.

DETAILED SYLLABUS

Sr. No.	Name of the Module	Content	Hours	CO Mapping
1	Employability Skills: Advanced Speaking	1.1. Group Discussions (GDs) - Purpose, Evaluation parameters, GD etiquette - Types: Factual (Regular & Controversial), Abstract, Case-based (Textual & Picture-based) and Role-plays (Textual & Cue-card-based) - Online GDs and digital collaboration etiquette (Zoom, Google-Meet, MS Teams etc.) 1.2. Personal Interviews - Planning and preparation for Technical and HR interviews - Interview types: Structured, Stress, Behavioural and Case-based - Virtual interviews, AI-assisted interview simulations and post-interview reflections (Google Interview Warmup, Yoodli, Pramp etc.) 1.3. Presentation Strategies - Purpose, Audience analysis, Content organisation - Slide design, Text, Infographics and AI-based presentation design (Canva, Beautiful.ai, Gamma AI etc.) - Division of roles, collaborative preparation and seamless transitions	8	CO1
2	Critical AI Literacy	Nature of AI Generated Language - Understanding AI-generated language as probabilistic output and distinguishing between Fluency and Accuracy while identifying risks such as AI Slop and Hallucination Evaluating AI Content - Differentiating between Evidence and Assertion and applying verification strategies to assess Accuracy, Clarity and Depth Bias, Framing and Information Silos - Understanding linguistic Bias, Framing, Information Silos and Selective Exposure that shape AI responses and limit perspective Drafting, Editing and Prompt Engineering with AI - Using AI for Drafting and Editing through effective Prompt Engineering while maintaining originality, specificity and professional voice Identifying Low-Quality AI Content - Identify	4	CO2

		markers of low-quality AI content, such as repetition, lack of depth, and absence of concrete detail, while applying ethical practices that distinguish Assistance from Substitution and ensure responsible AI use		
3	Employability Skills: Advanced Technical Writing	3.1. Cover Letter & Resume • Difference between Bio-data, Resume and CV • Resume types: Chronological, Functional and Hybrid • Resume structure and content • Digital resumes, Application Tracking System (ATS) friendly formatting and LinkedIn portfolio integration 3.2. Reports • Purpose: Importance of reports in engineering and industry decision-making • Classification of Reports: <i>Subject Matter - Technical, R&D, Operations, Finance, Marketing etc.</i> <i>Time Interval - Periodic, One-time, Special</i> <i>Function - Informational, Examinational and Analytical</i> <i>Reader Writer Relationship – Administrative, Professional and Independent</i> <i>Format – Memo, Letter, Short, Long, E-Reports, Digital Dashboards</i> <i>Digital and AI-aided reporting formats (Power BI, Google Data Studio, ChatGPT etc. for summaries)</i> • Parts of a Long Formal Report <i>Prefatory Parts: Title Fly, Title Page, Letter of Transmittal, Table of Contents, List of Illustrations, Executive Summary</i> <i>Report Proper (Main Body): Introduction, Intervening chapters with headings as per the topic, Result & Analysis, Summary (Informational) Or Summary & Conclusions (Examinational) Or Summary, Conclusions & Recommendations (Analytical)</i> <i>Appended Parts: Appendix, List of References, Glossary, Index</i> • Language and Style of Reports <i>Tense, person and voice appropriate to reports</i> <i>Numbering and labelling conventions for figures, tables, charts, equations etc.</i> <i>Referencing formats (APA, MLA etc.)</i> <i>Plagiarism checks (Turnitin, Grammarly, other AI-detectors etc.)</i>	8	CO3

		3.3. Statement of Purpose (SOP) • Purpose: SOPs for international internships, funding for research programs and higher education • Structure: <i>Paragraph 1 - Hook (introducing yourself in a unique manner and demonstrating your passion for the field)</i> <i>Paragraph 2 - Academic Background</i> <i>Paragraph 3 - Research-oriented Endeavours</i> <i>Paragraph 4 - All-round Development</i> <i>Paragraph 5 - Reasons for choosing the Program and Institution</i> <i>Paragraph 6 - Conclusion and Thank-you note</i>		
4	Workplace Managerial Skills	4.1. Conducting Business Meetings • Types of Meetings: <i>Executive Meetings - Decide</i> <i>Management Meetings - Implement</i> <i>Committee Meetings - Recommend</i> <i>Review Meetings - Evaluate</i> <i>Planning Meetings - Design the future</i> <i>Crisis Meetings - Resolve urgency</i> • Roles and Responsibilities: <i>Chair - Leads meeting, maintains order, ensures decisions</i> <i>Secretary - Records minutes, documents decisions, tracks actions</i> <i>Core Members - Discuss issues, contribute ideas, make decisions</i> <i>Specialists - Provide expertise, clarify issues, support decisions</i> • Documentation: <i>Notice, Agenda and Minutes</i> • Meeting Platforms and AI Assistance: <i>Virtual and hybrid meeting management, online etiquette, use of collaborative tools (Google Meet, Slack, Trello etc.)</i> <i>Digital documentation, e-Minutes and collaborative platforms like Notion or Microsoft OneNote</i> 4.2. Writing Proposals • Types: Solicited vs. Unsolicited • Format: Memo, Short and Long • Parts of a Short Proposal: <i>Purpose of the proposal</i> <i>Need for the proposal (SWOT analysis)</i> <i>Description of the plan (budget, timeline etc.)</i> <i>Evidence of ability to deliver</i> <i>Benefits to both parties</i>	6	CO4

		<i>Conclusion</i> 4.3. Structuring and Formatting Technical Papers • Components: Title, Author(s) & Affiliations, Abstract, Keywords/Index Terms, Introduction, Sections with different headings, Results, Discussion, Conclusion, Acknowledgement, References, Biography • Formatting and referencing (IEEE style) • Use of AI tools for grammar check, plagiarism validation and submission to international conferences		
5	21st Century Professional Skills	5. Interpersonal Skills • Emotional Intelligence • Critical thinking, Reflection & Self Analysis • Leadership and Motivation Strategies • Conflict Management and Negotiation • Time Management • Anger and Stress Management • Decision Making and Adaptability	6	CO5
6	Digital Ecosystems and Ethics	6.1. Intellectual Property Rights (IPR) • Categories: Copyrights, Trademarks, Patents, Industrial Designs, Geographical Indications, Integrated Circuits and Trade Secrets • AI-generated content ownership, open-source ethics, digital rights management • Social Media Content and Legal Responsibility 6.2. Case Studies on Corporate and Engineering Ethics • Real-world ethical dilemmas • Corporate Social Responsibility (CSR) • Environmental Social Governance (ESG) • Sustainability and Green Engineering • AI Ethics in Design and Automation	4	CO6

ASSESSMENTS

List of Compulsory Assignments for Term Work:

Module 1: GD documentation with Topic, Type and Highlights in 5 bullet points

Module 2: Assignment on Prompt Engineering

Module 3: A - Cover Letter, Resume and **B** - Statement of Purpose

Module 4: Meeting Documentation (Notice, Agenda & Minutes)

Module 5: Activities on Interpersonal Skills

Module 6: Case study on Ethical Dilemma

(To be conducted in the form of short notes, quizzes, role plays, case studies, presentations or MCQs)

SUGGESTED ASSIGNMENTS

Module No. & Title	Assignments and Activities
Module 1 Employability Skills: Advanced Speaking	• Conduct 4-5 types of Group Discussions and attach the summary and photographs as proof of activity • Prepare group presentation slides, based on the report topic (Examination or Analytical) using the latest presentation software (PowerPoint, Canva, Prezi etc.) and engage students in giving critical feedback • Present an 'Elevator Pitch' for either self-introduction or product or new business idea • Conduct mock interviews
Module 2 Critical AI Literacy	• Select an essay/article/video generated by AI (or give a general prompt) and analyse and detect AI bias (gender pronouns, gender-based occupational stereotypes, racial identifiers, historical bias etc.) • Differentiate between weak and strong prompts • Source verification task • AI versus human writing analysis
Module 3 Employability Skills: Advanced Technical Writing	• Draft a professional Cover Letter and Resume • Write a Statement of Purpose (SOP) for higher studies or internships • Develop or enhance a LinkedIn profile showcasing technical and project achievements • Prepare a book-format analytical/informational report using IEEE/APA/MLA referencing and plagiarism check tools (Grammarly/Turnitin). Main body should be minimum 20 pages excluding the Preparatory and Appended parts
Module 4 Workplace Managerial Skills	• Conduct a mock meeting with assigned roles (Chairperson, Secretary, Members) and generate documentation with the help of the latest software • Write a short proposal addressing an engineering or sustainability problem • A quiz on the formatting aspects of a Technical Paper
Module 5 21st Century Professional Skills	• Activities for developing team work, leadership, emotional intelligence etc. • Problems and Puzzles on Critical thinking • Case-studies or Role-plays or Questionnaires on Conflict Resolution, Negotiation Skills and Decision Making • Application of SWOT analysis • Eisenhower Matrix to analyse a daily time log

Module No. & Title	Assignments and Activities
Module 6 Digital Ecosystems and Ethics	• Conduct an awareness quiz on IPR laws and ethical business practices. • Analyse a corporate ethics case study • Digital footprint audit of Self Profile • Fake News and Deep Fake verification task

IMPORTANT NOTE

1. The main project/book report should contain a minimum of 20 pages, excluding prefatory and appended matter.
2. Each project group must consist of a minimum of 4 and a maximum of 6 students.
3. End-semester presentation will be based on the book/project report.

GUIDELINES FOR TERM WORK MARKS DISTRIBUTION

Components	Marks	Description
6 Compulsory Assignments	5	Based on completion and quality of module-wise tasks.
Attendance & Participation	5	Class engagement, teamwork, and professionalism.
GD	5	Based on group and individual performance
Report Hardcopy	5	Quality, structure and originality of the report
Oral Report Presentation	5	Based on group and individual performance

RECOMMENDED RESOURCES:

1. Raman, M., & Sharma, S. (2022). *Technical communication: Principles and practice* (4th ed.). Oxford University Press.
2. Anderson, P. V. (2018). *Technical communication: A reader-centred approach* (9th ed.). Cengage Learning.
3. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2008). *Basic business communication* (11th ed.). McGraw-Hill.
4. Institute of Electrical and Electronics Engineers. (2020). *IEEE code of ethics*. IEEE.
5. American Society of Mechanical Engineers. (2021). *ASME code of ethics of engineers*. ASME.
6. Guffey, M. E., & Loewy, D. (2018). *Essentials of business communication* (11th ed.). Cengage Learning.
7. Sharma, R. C., & Mohan, K. (2017). *Business correspondence and report writing* (4th ed.). Tata McGraw-Hill Education.
8. Ram, A. (2018). *Place mentor: Tests of aptitude for placement readiness*. Oxford University Press.

9. Kumar, S., & Lata, P. (2018). *Communication skills: A workbook*. Oxford University Press.
10. Butterfield, J. (2017). *Verbal communication: Soft skills for a digital workplace*. Cengage Learning.
11. Crawford, K. (2021). *Atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University Press.
12. Kearns, M., & Roth, A. (2019). *The ethical algorithm: The science of socially aware algorithm design*. Oxford University Press.

ONLINE RESOURCES:

1. Ravichandran, T. (n.d.). *Enhancing soft skills and personality* [NPTEL course]. National Programme on Technology Enhanced Learning. <https://nptel.ac.in>
2. Ravichandran, T. (n.d.). *Developing soft skills and personality* [SWAYAM MOOC]. SWAYAM. <https://swayam.gov.in>
3. Coursera. (n.d.). *Business communication for success* [Online course]. <https://www.coursera.org>
4. edX. (n.d.). *Business communication for success* [Online course]. <https://www.edx.org>
5. All India Council for Technical Education. (n.d.). *Employability enhancement and life skills modules*. AICTE NEAT. <https://neat.aicte-india.org>
6. Indian Institute of Technology Guwahati. (n.d.). *Virtual English and communication virtual lab*. Virtual Labs. <https://ve-iitg.vlabs.ac.in/>
7. Indian Institute of Technology Bombay. (n.d.). *Professional communication virtual lab*. Virtual Labs. <http://vlabs.iitb.ac.in/vlabs-dev/labs/communication/>
8. TCS iON. (n.d.). *Communication skills* [Online course]. <https://www.tcsion.com/courses/tcs-ion/communication-skills/>
9. TCS iON. (n.d.). *Introduction to soft skills* [Online course]. <https://www.tcsion.com/courses/interview-and-job-prep/introduction-to-soft-skills/>
10. TCS iON. (n.d.). *Presentation skills* [Online course]. <https://www.tcsion.com/courses/tcs-ion/presentation-skills/>

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-
Dr. Rajendra B. Magar
BoS-Chairman-Civil Engineering
Faculty of Technology

Sd/-
Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-
Prof. Shivram S. Garje
Dean
Faculty of Science & Technology