Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

Shree Rahul Education Society's (Regd.)

Shree L.R. Tiwari College of Engineering

Shree L.R. Tiwari Educational Campus,

Mira Road–East, Thane-401107.

Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai

Department of Civil Engineering

Curriculum TY A.Y 2026-27

Third Year Syllabus

Revision: R-2025

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class centre for socio- economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mindset essential for success in today's evolving professional landscape.

1. **Curriculum Design:** Theme-Based, Experiential, and Outcome-Oriented The autonomous curriculum adopts a bottom-up, learner-centric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socio-economic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.

2**. Purpose of Autonomy:** Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the IDEA Lab—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impactful solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.

3. **Alignment with National Education Policy-2020:** Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.

4. **Innovative Pedagogy Initiative by IQAC As part of its transformation strategy**, IQAC has introduced an innovative pedagogy model centred on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.

5. **Empowering Faculty as Mentors and** Innovators: SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instil Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment**.**

Sincerely,

IQAC Chairperson
SLRTCE

COO
Rahul Education

PREFACE

Board of Studies – Civil Engineering
Shree L. R. Tiwari College of Engineering

Civil Engineering plays a vital role in the planning, design, construction, and maintenance of infrastructure that supports the growth and development of society. As one of the core branches of engineering, it contributes significantly to the development of sustainable, safe, and resilient infrastructure systems. The Civil Engineering program at Shree L. R. Tiwari College of Engineering is designed to develop students' technical knowledge, practical skills, and professional competencies to meet the evolving needs of the civil engineering profession.

The Board of Studies (BoS) in Civil Engineering is committed to ensuring that the curriculum remains relevant, industry-oriented, and aligned with current technological developments and professional practices. The program provides a strong foundation in key areas such as structural engineering, geotechnical engineering, transportation engineering, water resources engineering, environmental engineering, and construction management. The curriculum focuses on developing technical competence, analytical thinking, problem-solving abilities, and professional ethics among students.

The Board regularly reviews and updates the syllabus in accordance with the guidelines of regulatory bodies, industry expectations, emerging technologies, and societal needs. Emphasis is placed on experiential learning through laboratory work, field visits, internships, mini-projects, design projects, and industry interactions. Students are encouraged to apply engineering principles and modern engineering tools to solve real-world infrastructure challenges.

In alignment with the vision and mission of the Department and the Institute, the program promotes sustainable engineering practices, innovation, lifelong learning, and professional responsibility. The curriculum aims to develop graduates who can contribute effectively to the planning, design, construction, operation, and maintenance of infrastructure systems while addressing environmental and societal concerns.

The Board of Studies remains dedicated to fostering an academic environment that supports quality education, skill development, research orientation, and industry engagement. Through continuous improvement of the curriculum and teaching-learning processes, the Board strives to prepare competent civil engineers who can contribute meaningfully to the profession and support the sustainable development of society and the nation.

Ms. Prajakta V. Mukadam
Chairperson
Board of Studies
Civil Engineering

A. Abbreviations

AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co-Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
EMC	Entrepreneurship/economics/management courses
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
OE	Open Elective
OJT	On Job Training
P	Practical
PROJ	Project
PCC	Program Core Course
PCCL	Program Core Course Lab
PEC	Program Elective Course
RM	Research Methodology
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

Curriculum Structure and Examination Scheme for B. Tech. in Civil Engineering (TY with Effect from AY 2026-2027) Curriculum Structure – TY Semester-V

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)	Examination Scheme				Exam Duration for Theory (in Hrs.)	Term Work	Practical / Oral	Total
												In-Semester Assessment			End Semester Exam (ESE)				
			L	T	P	L	T	P	SL	Notional Learning		IAT-I	IAT-II	Total					
11211501	PCC	Theory of Reinforced Concrete Structures	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
11211502	PCC	Geotechnical Engineering	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
11211503	PCC	Transportation Engineering	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
11212504	PCC LAB	Geotechnical Engineering Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25 (PR)	50
11212505	PCC LAB	Transportation Engineering Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25 (OR)	50
11212506	PCC LAB	IDEA LAB 3	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
1122157WW	PEC-I	Program Elective Course I	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
9931158WW	MDM-II	Multidisciplinary Minor II	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
11412509	VSEC	AUTO CAD and BIM Fundamental	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	--	25
99511510WW	OE-III*	Open Elective III*	2	--	--	30	--	--	30	60	2	--	--	--	--	--	25	--	25
Total			**17**	**–**	**8**	**285**	**–**	**90**	**285**	**630**	**21**	**100**	**100**	**200**	**300**	**12.5**	**125**	**2.5**	**700**

***Recommended that OE to be offered in the form of MOOCs (NPTEL/SWAYAM).**

Program Elective Course-I	
Course Code	**Name of the Course**
112215701	Building Design and Drawing
112215702	Building Services & Repairs
112215703	Advanced Structural Mechanics
112215704	Air and Noise Pollution & Control

Open Elective-III	
Course Code	**Name of the Course**
9951151001	International Financial Management
9951151002	Marketing Management - I
9951151003	HR Analytics
9951151004	Operations and Supply Chain Management
9951151005	Quantitative Investment Management
9951151006	Economics of Banking and Finance Markets
9951151007	Corporate Finance
9951151008	Principles of Behavioral Economics

Students who achieve a CGPI of 7.5 or higher by the end of the semester VI are eligible to pursue an additional 18 credits from the semesters V to VIII to qualify for a B. Tech degree with Honors.

Curriculum Structure and Examination Scheme for B. Tech. in Civil Engineering

(TY with Effect from AY 2026-2027) Curriculum Structure – TY Semester-VI

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)	Examination Scheme				Exam Duration for Theory (in Hrs.)	Term Work	Practical & Oral	Total
												In-Semester Assessment			End Semester Exam (ESE)				
			L	T	P	L	T	P	SL	Notional Learning		IAT-I	IAT-II	Total					
11211601	PCC	Design and Drawing of Steel Structures	3	--	--	45	--	--	45	90	3	20	20	40	60	3	–	–	100
11211602	PCC	Environmental Engineering	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
11211603	PCC	Hydraulics and Water Resources Engineering	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
11212604	PCC LAB	Environmental Engineering Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25 (PR)	50
11212605	PCC LAB	Design and Drawing of Steel Structures Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25 (PR)	50
11812606	Project	Dissertation I	--	--	2	--	--	30	--	30	1	--	--	--	--	--	50	50	100
1122167WW	PEC-II	Program Elective Course I	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
9931168WW	MDM-III	Multidisciplinary Minor III	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
98451609	VEC	Professional Communication and Ethics - II	2	--	--	30	--	--	30	60	2	–	–	–	–	–	25	–	25
99511610WW	OE-IV*	Open Elective IV*	2	--	--	30	--	--	30	60	2	–	–	–	–	–	25	--	25
Total			**19**	--	**6**	**285**	--	**90**	**285**	**660**	**22**	**100**	**100**	**200**	**300**	**12.5**	**150**	**100**	**750**

***Recommended that OE to be offered in the form of MOOCs(NPTEL/SWAYAM)**

Program Elective-IV	
Course Code	**Name of the Course**
112216701	Advanced Geotechnical Engineering
112216702	Urban Infrastructure Planning
112216703	Computational Structural Analysis
112216704	Transportation Planning and Management

Open Elective-IV	
Course Code	**Name of the Course**
9951161001	Moral Thinking: Introduction to Values and Ethics,
9951161002	Ethics in Engineering Practice,
9951161003	Introduction to Psychology,
9951161004	Direct foreign language courses (like German, French),
9951161005	Financial Institutions and Markets,
9951161006	Investment Management
9951161007	Introduction to Sociology
9951161008	Cultural Studies Language for Competitive Exams

Note:

1. Questions based on self-learning must not be asked in internal assessment and End Semester Exam

2. IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.

3. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

4. Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. The subject with no term work and practical will have no assessment on self-learning topics. This may involve laboratory work using the latest tools or preparing technical write-ups/research papers on advanced topics.

SEMESTER – V

Semester –V

Theme: Urban Systems

Aligned with UNSDG: SDG 3 – Good Health and Well-being, SDG 6 – Clean Water and Sanitation, SDG 7 – Affordable and Clean Energy, SDG 9 – Industry, Innovation and Infrastructure, SDG 11 – Sustainable Cities and Communities, SDG 12 – Responsible Consumption and Production, SDG 13 – Climate Action, and SDG 16 – Peace, Justice and Strong Institutions under United Nations.

Problem Statement 1:

To study challenges in urban systems and demonstrate a very basic system for improved service efficiency.

Problem Statement 2:

To observe urban resource usage and demonstrate a very basic system for better coordination.

Problem Statement 3:

To study urban service practices and demonstrate a very basic system supporting sustainability.

Problem Statement 4:

To observe operational patterns in urban environments and demonstrate a very basic system for improvement.

Problem Statement 5:

To study urban infrastructure needs and demonstrate a very basic system for better management.

Problem Statement 6:

To study mobility-related challenges in urban environments and explore approaches that improve movement and accessibility.

Problem Statement 7:

To investigate the interaction between urban services and citizens and identify opportunities for improved service delivery.

Problem Statement 8:

To observe public service usage and demonstrate a very basic system for efficient operation.

Problem Statement 9:

To study urban system behavior and demonstrate a very basic system supporting organized functioning.

Problem Statement 10:

To observe service-related challenges in urban areas and demonstrate a very basic system for enhancement.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11211501	**Theory of Reinforced Concrete Structures**	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11211501	**Theory of Reinforced Concrete Structures**	20	20	40	60	2.5	--	--	100

Rationale:

Working Stress Method (WSM) makes use of the concept of modular ratio based on the higher factor of safety in evaluating the stresses in two different materials of the RCC i.e., steel and concrete. The Limit State Method (LSM) is based on the statistical probability which provides the rational solution to the design problems. The philosophy which lies behind LSM uses multiple safety factors format which attempts to provide adequate safety at the ultimate load as well as adequate serviceability at service load by considering all possible limit states. The subject involves the application of working stress method and limit state method in the analysis and design of various elements of the civil engineering structures.

Course Objectives:

1. To develop clear understanding of design philosophy amongst the students for the design of reinforced concrete structure using the working stress method (WSM) and limit state method (LSM).
2. To study 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 and columns.
4. To study the concept of Serviceability and Durability for deflection and crack width calculation in RCC structures.
5. To develop the concept of design using design charts and curves for columns subjected to axial load and moment.
6. To study the concept of reinforced concrete footing design subjected to axial load and moment.

Course Outcomes:

1. Understand the fundamentals of WSM. Analyze and design singly and doubly reinforced concrete beams using Working Stress Method
2. Apply principles of Limit State Method including characteristic loads, strengths, and safety factors.
3. Analyze and design RCC beams for flexure, shear, bond, and torsion using Limit State Method as per IS 456:2000.
4. Design one-way and two-way slabs with proper reinforcement detailing using Limit State Method.

5. Design columns and isolated footings considering axial load and bending using Limit State Method. Understand the use of readymade design charts and curves from Special Publications of Bureau of Indian Standards.
6. Analyze and design various reinforced concrete footings using the concept of Limit State Method.

Prerequisite:

1. **Fundamentals of mechanics:** Understanding of stress–strain behavior, equilibrium of forces, and preparation of free body diagrams for analyzing structural elements.
2. **Structural analysis basics**: Knowledge of determinate structures, including calculation and interpretation of shear force diagrams (SFD) and bending moment diagrams (BMD).
3. **Material properties & calculations**: Familiarity with properties of concrete and steel, basic RCC components, and ability to perform algebraic calculations used in structural design.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Stress, strain, bending, shear force and moment concepts. Equilibrium of forces and free body diagrams. Determinate structures, SFD and BMD. Properties of concrete and steel. Basic understanding of RCC components. Algebra and basic calculations used in design.		
I	Working Stress Method:	Concept of reinforced concrete, Working Stress Method (WSM) of design for reinforced concrete, permissible stresses as per IS:456-2000; stress-strain curve of concrete and steel, characteristics of concrete and steel reinforcement. Concept of balanced, under reinforced and over reinforced sections. Analysis and design of singly reinforced and doubly reinforced rectangular beams for Flexure.	8	CO1
		Self-learning Topics: Study real RCC beam drawings and identify reinforcement details Compare WSM with Limit State Method using simple beam examples Plot stress–strain curves of concrete and steel using lab/test data	8	
II	Limit State Method:	Introduction to limit state method of design as per IS:456-2000. Concepts of probability and reliability, characteristic load, characteristic strength, partial safety factors for loads and materials, introduction to various limit states of collapse and serviceability.	8	CO2
		Self-learning Topics: Case study: safety and failure of RCC structures Identify different limit states in actual structures (cracks, deflection, failure)	8	

III	Limit State of Collapse: Flexure, Shear, Bond and Torsion:	Design of Singly and doubly reinforced Rectangular and Flanged sections for flexure, shear and bond. Design of beams subjected to bending, shear and torsion.	7	CO3
		Self-learning Topics: Understand anchorage length and bond from site practices Solve combined bending, shear, and torsion numerical problems	7	
IV	Design of Slabs using Limit state method:	Design of simply supported one-way slabs as per IS:456-2000. Design of simply supported two-way slabs as per IS:456-2000.	7	CO4
		Self-learning Topics: Study reinforcement detailing (bar spacing, cover, distribution steel) Visit site or review slab casting procedure (formwork, reinforcement placement)	7	
V	Limit State of Collapse – Compression :	Limit state of collapse: compression for short and slender column. Introduction to Members subjected to combined axial and uniaxial as well as biaxial bending. Development of interactive curves and their use in column design.	7	CO5
		Self-learning Topics: Study column reinforcement details from structural drawings from Site. Understand column failure modes using case studies.	7	
VI	Design of Foundations:	Design of Isolated square and rectangular footings subjected to axial load and moment. Introduction to basic concepts of combined rectangular pad footing, slab beam type footing and Raft foundation.	8	CO6
		Self-learning Topics: Observe excavation, PCC, reinforcement placement (site/video-based) Compare different types of foundations used in practice	8	

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. Ultimate Strength Design for Structural Concrete: Arthur, P. D. and Ramakrishnan, V., Wheeler and Co. Pvt. Ltd.
5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
6. Fundamentals of Reinforced Concrete: Sinha & Roy, S. Chand and Co. Ltd.
7. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.
8. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.

9. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

References:

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications.
2. Reinforced Concrete: Syal and Goel; Wheeler Publishers.
3. Reinforced Concrete Design: Pillai, S.U. and Menon, Devdas, Tata Mc-Graw Hill Publishing House, New Delhi.
4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi
5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.
6. RCC Design (WSM and LSM): Punmia, B. C., Jain, A. K., and Jain, Arun, K., Laxmi Publications.
7. Limit State Design of Reinforced Concrete (as per IS: 456-2000): Punmia, B. C., Jain, A. K., and Jain, Arun, K., Laxmi Publications.
8. Relevant IS Codes: BIS Publications, New Delhi.

Online References:

Sr. No.	Website Name
1.	NPTEL – Reinforced Concrete Structures / Design Courses https://nptel.ac.in/courses/civil-engineering
2.	IIT Bombay – RCC Lecture Materials https://www.civil.iitb.ac.in
3.	National Programme on Technology Enhanced Learning / SWAYAM https://swayam.gov.in

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11211502	Geotechnical Engineering	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11211502	Geotechnical Engineering	20	20	40	60	2.5	--	--	100

Rationale:

Geotechnical Engineering provides a comprehensive understanding of soil as a fundamental engineering material. The course introduces the origin, formation, and classification of soils, enabling identification and prediction of their behavior. It covers essential phase relationships and index properties required for evaluating soil characteristics. The study of clay mineralogy and consistency limits helps in understanding the plastic and compressible nature of fine-grained soils. Concepts of particle size distribution and classification systems are vital for engineering applications. The course also explains permeability and seepage behavior, which are crucial in hydraulic structure design. The principle of effective stress is introduced to understand soil strength and stability. Compaction techniques are studied to improve soil properties for construction. Additionally, soil exploration methods provide practical knowledge of subsurface investigation for safe and economical foundation design.

Course Objectives:

1. To study origin and mode of formation of soil as well as functional relationships among different unit weights, volumetric ratios, and water content.
2. To study clay mineralogy and plasticity characteristics of soils.
3. To comprehend particle size distribution and classification of soils as per IS code.
4. To study permeability and seepage flow of water through the soil.
5. To understand the concept of total stress, neutral stress and effective stress in soil.
6. To understand compaction characteristics of soils as well as the techniques of soil exploration, assessing the subsoil conditions and engineering properties of various soil strata

Course Outcomes:

1. Explain the basic concepts of the physical and engineering properties of soil and derive the relationships among various unit weights & other parameters.
2. Comprehend clay mineralogy and plasticity behavior of clay.
3. Analyze grain size distribution of soil and classify the soil as per IS code.
4. Evaluate the coefficient of permeability of different types of soils and draw the flow net diagram to estimate seepage discharge
5. Compute the effective stress and pore water pressure inside the soil mass under different geotechnical conditions.
6. Evaluate the compaction parameters in laboratory and field as well as understand the necessity and methods of soil exploration

Prerequisite:

A basic understanding of engineering mechanics and fundamental physical properties such as mass, volume, and force is essential for studying geotechnical engineering. Knowledge of elementary physics, particularly concepts like pressure, density, and fluid behavior, helps in understanding soil-water interaction. Familiarity with basic mathematics, including ratios, graphs, and simple equations, is required for analyzing soil relationships and solving numerical problems. An introductory idea of geology, especially rocks and soil formation processes, supports better comprehension of soil origin and types. Awareness of construction practices and building materials provides practical context for the application of soil properties in foundation engineering. Additionally, basic exposure to laboratory testing methods and data interpretation is helpful for understanding soil investigation and analysis techniques

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Geotechnical Engineering, Basic Definitions & Relationships	Definitions and scope of Geotechnical Engineering: rocks, soil, origin & mode of formation and types of soil obtained, soil mechanics, rock mechanics, geotechnical engineering. Soil phase systems, volumetric ratios: void ratio, porosity, degree of saturation, air voids, air content. Weight-volume relationship: different unit weights, water content, specific gravity of soil solids, mass and absolute specific gravity. Functional relationships among different unit weights, volumetric ratios, and water content. Relative density, relative compaction. Different methods to determine water content, specific gravity and unit weight of soil. Soil structure (flocculated and dispersed) and its engineering significance.	7	CO1

		Self-learning Topics: Case studies on foundation failure due to poor soil investigation Advanced soil formation processes Field methods for estimation of soil properties Use of digital tools/software for soil analysis Study of IS codes related to index properties	7	
II	Clay Mineralogy and Plasticity Characteristics of Soils	Explanation about clay minerals, e.g., Montmorillonite, Illite and Kaolinite; formation of clay minerals and their role in plastic behavior of soil. Definition of plasticity of soil, consistency of soil, determination of liquid limit, plastic limit, shrinkage limit. Definitions of shrinkage parameters, plasticity index, liquidity index, consistency index, activity, sensitivity and thixotropy of soil. Importance of consistency limits. Expansive soils (black cotton soil) – behavior and problems in construction.	8	CO2
		Self-learning Topics: Microstructure of clay minerals Behavior of expansive soils Role of mineralogy in soil stabilization Interpretation of Atterberg limits Use of additives like lime, cement, fly ash	8	
III	Particle Size Distribution and Classification of Soils	Wet & dry sieve analysis, sedimentation analysis, hydrometer method of analysis, limitations of sedimentation analysis. Particle size distribution curve/gradation curve and its uses. Introduction to cohesive and cohesionless soil. Necessity of soil classification, Indian standard particle size classification, Indian standard soil classification system as per IS: 1498, boundary classification. Field identification of soils (visual and manual tests).	7	CO3
		Self-learning Topics: Soil classification for construction sites Comparison of IS classification and USCS Limitations of sieve and hydrometer analysis Use of gradation curves in filter design Soil suitability for embankments	7	
IV	Permeability of Soils & Seepage Analysis	Types of soil water, definition of hydraulic head, hydraulic gradient, Darcy's law, validity of Darcy's law, permeability of soil. Determination of coefficient of permeability of soil in laboratory using constant head and variable head methods, factors affecting permeability of soil. Determination of in-situ permeability with pumping out and pumping in tests. Permeability of stratified soil deposits. Definition of	8	CO4

		seepage and its importance in hydraulic structures, flow net diagram, flow lines, equipotential lines, phreatic line, factor of safety against piping failure.**:** Basic seepage control methods (drainage, cut-offs, filters).		
		Self-learning Topics: Application in dams and canals Seepage failure case studies Field permeability testing Design of filters and drainage systems Flow net construction	8	
V	Effective Stress Principle	Definition of geostatic stresses, total stress, pore water pressure, and effective stress. Effect of water table fluctuations, surcharge, capillary action and seepage pressure on effective stress. Quicksand condition. Introduction to consolidation (basic concept).	7	CO5
		Self-learning Topics: Application in foundation design Effect of water table changes Capillary rise effects Consolidation settlement basics. Quicksand condition analysis	7	
VI	Compaction of Soil & Soil Exploration	Theory of compaction, determination of optimum moisture content (OMC) and maximum dry density (MDD) by light and heavy compaction tests. Factors affecting compaction, effect of compaction on soil properties, soil structure, placement water content, relative compaction. Necessity of soil exploration, methods of soil investigation, methods of boring, sampling techniques. Penetration tests: SPT, SCPT and DCPT. Representation of data using borehole logs. Plate Load Test – basic concept and application.	8	CO6
		Self-learning Topics: Field compaction techniques Highway and embankment case studies Lab vs field compaction comparison Modern soil exploration methods SPT and Plate Load Test basics	8	

Text Books:

1. Basic and Applied Soil Mechanics: Gopal Ranjan, A S R Rao; New Age International Publishers.
2. Soil Mechanics and Foundation Engineering: V. N. S. Murthy; CBS Publishers & Distributors
3. Soil Mechanics and Foundation Engineering: K. R. Arora; Standard Publishers and Distributors, New Delhi.
4. Soil Mechanics and Foundations: B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications (P) LTD., New Delhi
5. Geotechnical Engineering: C. Venkatramaiah; New Age International Private Limited
6. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley; Sons.

References:

1. An Introduction to Geotechnical Engineering: Robert D. Holtz, William D. Kovacs; Prentice-Hall, New Jersey
2. Soil Mechanics: R. F. Craig; Spon Press, Taylor and Fransis Group
3. Soil Mechanics: T. W. Lambe, R. V. Whitman; John Wiley & Sons
4. Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi
5. Soil Mechanics in Engineering Practice: Karl Terzaghi, Ralph B Peck, Gholamreza Mesri; John Wiley & Sons

Online Refereces:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/101/105101201/
2.	https://archive.nptel.ac.in/courses/105/105/105105168/

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11211503	Transportation Engineering	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11211503	Transportation Engineering	20	20	40	60	2.5	--	--	100

Rationale:

An efficient transportation system is essential for sustainable economic development of the country and plays a significant role in promoting national and global integration. An efficient Transportation system helps in increasing productivity and enhances competitiveness of the economy. Hence, the transport sector is considered as an important component of the economy and a common tool used for development. Three basic modes of transportation include land,water and air. The course deals with understanding of basics of different modes of transportation (Highways, railways, airways and waterways). The highways owing to its flexibility in catering
door-to- door service is one of the important modes. This course deals with the investigation, planning, design, construction and maintenance of highways in addition to traffic planning, operation and control

Course Objectives:

1. To understand the principles of different modes of transportation systems.
2. To gain knowledge of airport, railway, dock, harbour, and bridge engineering fundamentals.
3. To develop skills in highway planning, design, construction, and maintenance.
4. To analyze traffic characteristics and apply traffic engineering principles
5. To understand pavement design and evaluation techniques.
6. To introduce modern tools and sustainable practices in transportation engineering.

Course Outcomes:

1. To understand the principles of different modes of transportation systems.
2. To Understand the fundamentals of highway planning
3. Plan and design highway geometric elements.
4. Analyze traffic flow and implement traffic control measures.
5. Design flexible and rigid pavements using standard methods.
6. Evaluate transportation systems with modern techniques and sustainability concepts.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Transportation Engineering requires students to have a basic understanding of Engineering Mechanics, Strength of Materials, and Surveying concepts such as leveling, contouring, and alignment. Knowledge of Construction Materials and construction practices used in roads and pavements is essential for understanding pavement design and highway construction. Students should also be familiar with basic Mathematics, including geometry and statistics, for traffic analysis and transportation planning. In addition, a general awareness of traffic systems, safety measures, and environmental considerations.		
I	**Introduction to Transportation Systems**	Airport Engineering: Airport planning and site selection, Runway orientation and design, Airport layout and components, Railway Engineering: Components of railway track, Gauges, rails, sleepers, ballast, Points and crossings, Dock & Harbour Engineering: Classification of harbours, Harbour planning and layout, Dock structures and breakwaters, Bridge Engineering: Types of bridges, Components of bridges, Basic design considerations	7	CO1
		Self-learning Topics: Green transportation concepts, Smart mobility solutions, Cost-benefit analysis, Demand and supply in transport, Use of technology in transport	7	
II	**Highway Planning and Alignment**	Importance and classification of roads, Highway planning in India, Road patterns and network planning, Alignment and surveys (map, reconnaissance, preliminary, final), Factors affecting alignment, Highway project formulation	8	CO2
		Self-learning Topics: Environmental impact assessment (EIA),	8	
III	**Highway Geometric Design**	Cross-sectional elements (camber, width, shoulders), Sight distance (SSD, OSD, ISD) and design, Design of Super elevation and transition curves, Vertical alignment, gradients and Grade Compensation	8	CO3
		Self-learning Topics: Level of Service (LOS A–F), Surface drainage , Subsurface drainage	8	
IV	**Traffic Engineering**	Traffic characteristics (speed, volume, density), Traffic surveys and analysis, Traffic control	7	CO4

		devices (signals, signs, markings), Design of traffic signals, Parking studies, Road safety and accident analysis		
		Self-learning Topics: Smart traffic signals, GPS and traffic monitoring, Automated traffic management systems,	7	
V	**Pavement Materials and Design**	Properties of pavement materials, Subgrade evaluation, Flexible pavement design (CBR method), Rigid pavement design, Factors affecting pavement design, IRC guidelines overview	8	CO5
		Self-learning Topics: RAP (Reclaimed Asphalt Pavement), Self-healing asphalt, , Distress prediction models	8	
VI	**Highway Construction, Maintenance & Modern Trends**	Highway construction methods, Quality control in construction, Maintenance of roads (routine & periodic), Pavement failures and repairs, Introduction to expressways and smart roads	7	CO6
		Self-learning Topics: , Structural Overlay Design (Flexible & Rigid Pavements), Use of AI in Pavement Distress	7	

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. Docks and Harbour Engineering: Bindra, S. P.; Dhanpat Rai and Sons,New Delhi.
4. Highway Engineering: Khanna, S.K. and Justo, C. E. G.; Nem Chand and Bros., Roorkee.

References:

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. Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House.
4. Transportation Engineering and Planning: C.S. Papacostas and P.D. Prevedouros; Prentice Hall India Learning Pvt. Ltd., New Delhi.

Online References:

Sr. No.	Website Name
1.	www.ite.org
3	https://libguides.scu.edu/transportation-eng

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11212504	Geotechnical Engineering Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11212504	Geotechnical Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives

1. Determination of moisture content, specific gravity of soil solids and in-situ field density of soils as well as field identification of fine-grained soils
2. To determine the grain size distribution of soils and consistency or Atterberg limits of fine- grained soils
3. To determine coefficient of permeability of soils in laboratory
4. To determine compaction characteristics of soils in laboratory
5. To determine the density index (relative density) of cohesionless soil
6. To determine field SPT ‘N’ value by Standard Penetration Test

Lab Outcomes:

1. Determine the physical and engineering properties of soil
2. Determine the plasticity characteristics of soil
3. Carry out sieve analysis of soil, plot grain size distribution curve and determine the IS classification of soil
4. Determine coefficient of permeability of soils
5. Determine the compaction characteristics of soils
6. Compute the field SPT ‘N’ value and prepare the bore log

List of Experiments (At least 8)

Sr No	List of Experiments	Hrs	LO
01	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	2	LO1
02	Specific gravity of soil grains by density bottle method or Pycnometer method	2	LO1
03	Field density using core cutter method	2	LO1
04	Field identification of fine-grained soils	2	LO2
05	Grain size distribution of coarse-grained portions (gravel and sand) of soil by sieve analysis	4	LO3
06	Determination of liquid (Casagrande method), plastic and shrinkage limits	4	LO2
07	Determination of liquid limit by cone penetrometer method	2	LO2
08	Determination of co-efficient of permeability using constant head method	2	LO4
09	Determination of co-efficient of permeability using falling head method	2	LO4
10	Compaction test, IS light compaction test/ Standard Proctor test	2	LO5
11	Compaction test, IS heavy compaction test/ Modified Proctor test	2	LO5
12	Relative density (or, density index) test	2	LO1
13	Study of Standard Penetration Test (SPT) data and preparation of bore log from field investigation records	2	LO6

Sr No	List of Assignment
01	Soil Phase System and Relationships between Index Properties of Soil
02	Atterberg Limits, Clay Mineralogy and Plasticity Characteristics of Soil
03	Particle Size Distribution, Gradation Curves and Soil Classification as per IS:1498
04	Darcy's Law, Flow Nets and Seepage through Soils and Earth Dams
05	Effective Stress Principle and Effect of Water Table Fluctuation on Soil Behavior
06	Soil Compaction Theory and Methods of Soil Exploration (SPT and Plate Load Test)

Text Books:

1. Soil Mechanics and Foundation Engineering: K. R. Arora; Standard Publishers and Distributors, New Delhi.
2. Soil Mechanics and Foundations: B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications (P) LTD., New Delhi
3. SCI/SCOPUS Indexed Refereed International Journals (For Case Studies)

References:

1. Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi.
2. Standard Geotechnical Engineering Handbook
3. NPTEL Video lectures on Practical.

Online Resources:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/105101160

Assessment:

- Term Work

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

Laboratory Work	:	10 Marks
Assignment	:	10 Marks
Attendance	:	05 Marks

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11212505	Transportation Engineering Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11212505	Transportation Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1.To determine Penetration grade and Viscosity grade of bitumen.
2.To find the Softening point and Ductility value of bitumen.
3.To determine Impact, Abrasion and Crushing value of aggregate.
4.To carry out shape test on aggregates.
5.To carry out Classified volume study and plot speed profile at mid-block section.

Lab Outcomes:

1. Classify Bitumen on basis of Penetration and Viscosity grade.
2. Select Bitumen as per suitability on basis of Softening point and Ductility value.
3. Determine suitability of aggregate on basis of Impact value, Abrasion value and Crushing value.
4. Differentiate Elongated and Flaky aggregates on basis of Shape test.
5. Carry out Classified volume study at mid-block section of road.
6. Plot speed profile curve (S-Curve) at mid-block section

List of Experiments:

Sr. No	List of Experiments (Minimum Eight)	Hours	LO Mapping
1	Penetration Test on Bitumen	2	LO1
2	Viscosity Test on Bitumen.	2	LO1
3	Softening Point Test on Bitumen	2	LO2
4	Ductility Test on Bitumen	2	LO2
5	Determination of Aggregate Impact Value	2	LO3
6	Determination of Aggregate Crushing Value	2	LO3
7	Determination of Abrasion Value of Road Aggregate	2	LO3
8	Shape Test of Aggregate	4	LO4
9	Classified Volume count at mid-block section	8	LO5
10	Speed profile study at mid-block section	4	LO6

Sr No	List of Assignment
01	Modes of Transportation, Components of Railway Track, Runway Correction Docks and Harbour
02	Classification of road as per modified Nagpur Road Plan, Highway Alignment, Grade Compensation, Extra Widening
03	Origin and Destination Studies, Rotary Islands, Traffic Control Device, Level of Service, Parking Studies
04	Rigid and Flexible Pavement, Equivalent Single Wheel Load, Test performed on Aggregate and Bitumen
05	Water Bound Macadam, Penetration Macadam, Cement Concrete Pavement, Cement Stabilization, Geo-Synthetics
06	Structural and Functional evaluation of Pavement, Benkelman Beam, Highway Maintenance, Pavement Failures

Text Books:

1. Highway Engineering: Khanna, S.K. and Justo, C. E. G.;Nem Chand and Bros., Roorkee
2. Principles, Practice and Design of Highway Engineering (Including Airport Engineering)" Sharma, S.K.; S. Chand and Company Pvt. Ltd., New Delhi.
3. Highway Material and Pavement Testing: Dr. S. K. Khanna, Dr. C. E. G. Justo and Dr. A. Veeraragavan. Nem Chand and Bros., Roorkee, India
4. Traffic Engineering and Transport Planning: Kadiyali, L.R., Khanna Publishers, Delhi

References:

1. Principles and Practice of Highway Engineering: Kadiyali, L. R.; Khanna Publsihers, Delhi.
2. Relevant specifications of MORTH and relevant IRC codes

Online Resources:

Sr. No	Website Name
1	https://ts-nitk.vlabs.ac.in/
2	https://nptel.ac.in/courses/105105107

Assessment:

Term Work

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

Laboratory Work and Traffic Survey : 10 Marks
Assignment : 10 Marks
Attendance : 05 Marks

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
11212506	**IDEA LAB 3 - (Innovation Design Engineering and Apply)**	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11212506	**IDEA LAB 3 - (Innovation Design Engineering and Apply)**	**--**	**--**	**--**	**--**	**--**	**25**	**25**	**50**

Rationale:

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SDG. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a structured assessment framework is implemented.

1. Project assessment is carried out using standardized IDEA Lab rubrics with multiple evaluation parameters.
2. One of the key parameters is **Engineering Subject-Based Assessment**, which focuses on the effective application of same-semester subject knowledge in project work, ensuring integration of theoretical learning with practical implementation.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.

3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme..
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Students must ensure that their IDEA Lab project meaningfully incorporates concepts from all core subjects of the current semester and maintain a project logbook as evidence of subject-wise application.
- Faculty in-charge must guide students to apply concepts from subjects studied in the same semester to their IDEA Lab projects.
- The term work evaluation will partially reflect the effective application of subject-specific knowledge.
- Faculty should regularly review the integration of academic content within the project work.

2) Implementation Strategy – IDEA Lab Learning Model

- A theme-based learning structure shall be implemented where each semester is anchored to a broad contextual domain such as Healthcare, Smart Cities, Energy, Agriculture, or Governance, providing the overall learning direction.
- From the identified theme, a system-level, open-ended problem statement shall be defined, serving as a solution-neutral framework that enables interdisciplinary thinking and innovation.

- The learning sequence shall follow a structured flow: Theme → Problem Statement → Same Semester Subject Application → Design–Implementation Experience, ensuring progressive transformation from context to solution.
- Themes shall provide the context (defining the domain of work), while problem statements shall provide the purpose, enabling students to identify meaningful real-world challenges.
- Subjects shall be treated as engineering tools, where each subject contributes specific knowledge components to solve different aspects of the problem.
- Students shall be encouraged to take ownership of their learning and projects, fostering curiosity, exploration, social relevance, and a mindset of creative risk-taking.
- Structured brainstorming and ideation sessions shall be conducted at the beginning of the semester to guide students in problem identification and development of solution pathways through collaborative and interdisciplinary thinking.
- Guest lectures and expert talks shall be organized by inviting industry experts, researchers, and innovators aligned with the semester theme and subject areas to provide exposure to real-world challenges, trends, and opportunities.
- A mechanism shall be implemented to ensure uniqueness and originality of projects by systematically reviewing ideas to avoid duplication and encouraging novel, technology-driven solutions.
- Platforms shall be created for collaborative learning and discussion, enabling students to present ideas, receive peer and mentor feedback, and refine solutions through iterative engagement.
- Content beyond syllabus for as subject shall be integrated with IDEA Lab themes and problem statements to ensure deeper interdisciplinary application and enhanced conceptual understanding.
- Preference shall be given to ensuring same-semester academic alignment, where subject faculty contribute to effective contextual integration of project-based learning.
- Continuous monitoring and documentation shall be ensured through logbooks, milestone tracking, and periodic progress reviews to maintain academic rigor and outcome alignment.
- Coordination with subject faculty shall be ensured for effective mapping of theoretical concepts into project execution and for evidence-based term work assessment.
- The IDEA Lab shall function as an institutional mechanism for implementing the CDIO (Conceive–Design–Implement–Operate) framework, promoting experiential and outcome-based learning through structured mini-projects.

Implementation Notes:

- Guide will assess subject's contribution using specific evidence such as:
  - Logbooks
  - Subject-specific outputs (e.g., simulations, designs)
  - Paper publications or review presentations

3) Guidelines for Assessment

Assessment Month	**Marks**
Month 1 (Formative 1)	50 marks
Month 2 (Formative 2)	50 marks
Month 3 (Formative 3)	50 marks

Total Assessment Structure

Component	Marks	Assessed By
Term work – Project Execution	25 Marks	Project Guide – Average of all innovation
Viva Voce (Final Evaluation)	25 Marks	External Examiner

Criteria	Excellent (10)	Good (8)	Satisfactory (6)	Needs Improvement (4)
1. Innovation	Highly original and disruptive idea solving a real-world or futuristic problem	Novel idea with a creative approach to a known problem	Moderately innovative; adapts existing solutions	Common or repetitive idea with minimal novelty
2. Design	User-centric, systematic design with professional-level tools, prototyping, or simulations	Logical structure; clearly presented using standard tools	Functional design but limited user perspective or refinement	Poor or confusing design with lack of user consideration
3. Engineering	Applies concepts from all same-semester subjects with clear integration and interdisciplinary depth	Applies knowledge from 4 or more subjects with relevance	Applies 2–3 subjects with moderate clarity	Applies 1 subject with weak or shallow connection
4. Implementation	Complete, fully functional prototype with rigorous testing and real-world validation	Working model with minor errors; partially tested	Prototype is incomplete; basic testing or debug attempt	Poorly implemented; fails to function properly
5. Application	Strong real-world relevance with alignment to SDGs/National Missions; impact clearly identified	Clear practical use-case with user/market relevance	Some practical value but limited clarity on impact	Vague or irrelevant application; weak user connect

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112215701	Building Design and Drawing	3	--	–	45	--	–	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112215701	Building Design and Drawing	20	20	40	60	2.5	–	–	100

Rationale:

Building Design and Drawing is an essential course for developing planning, drafting, and visualization skills required in civil engineering practice. It enables students to understand building bye-laws, functional planning, working drawings, service layouts, elevations, sections, and project documentation. The course also introduces CAD and BIM tools for accurate digital drafting, modelling, coordination, and presentation of building projects. It helps students prepare complete building drawings and reports as per professional and regulatory requirements.

Course Objectives:

1. To develop knowledge of building planning principles including layout, orientation, bye-laws, and functional requirements.
2. To understand preparation of working drawings such as site plan, floor plan, and foundation plan.
3. To impart skills in drafting building drawings using CAD tools.
4. To enable students to prepare elevation, sectional elevation, and perspective drawings.
5. To develop the ability to prepare complete project reports including planning and basic design calculations.
6. To introduce modern tools like BIM and AutoCAD for digital building modelling and coordination.

Course Outcomes:

1. Apply building planning principles for designing efficient building layouts.
2. Prepare detailed working drawings including site plan, floor plan, and service drawings.
3. Use CAD tools effectively to develop accurate building drawings.
4. Develop elevation, sectional, and perspective views for visualization.
5. Compile a complete building project report with planning and calculations.
6. Develop digital building models using BIM and AutoCAD tools.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basic knowledge of engineering drawing and drafting, understanding of scales and dimensioning, fundamentals of building materials and construction, and familiarity with basic computer operations. Knowledge of elementary AutoCAD commands and visualization skills will be helpful.		
1	Building Planning & Bye-laws	Principles of planning (aspect, prospect, privacy, grouping) Orientation and ventilation Building bye-laws and DCR Requirements of residential buildings	07	CO1
		Self-Learning: National Building Code (NBC) basics Types of buildings. Smart and sustainable buildings	07	
2	Working Drawings	Line plan and site plan. Floor plan and parking plan Foundation plan and centre line plan Area statement	08	CO2
		Self-Learning: Standard symbols used in drawings Scale selection Plot area calculations	08	
3	Service Drawings	Electrical layout plan Plumbing and sanitation plan Water supply and drainage layout	08	CO3
		Self-Learning: Electrical symbols and wiring basics Plumbing fixtures and pipe fittings Rainwater harvesting system	08	
4	Elevation & Section	Building elevation Sectional elevation Construction details and notes	08	CO4
		Self-Learning: Types of sections Detailing of building components Architectural presentation techniques	08	
5	Perspective & Project Report	Perspective drawing Basic 3D visualization Preparation of project report	07	CO5
		Self-Learning: One-point and two-point perspective Case studies of buildings	07	

		Introduction to BOQ (Bill of Quantities)		
6	BIM & AutoCAD	Introduction to BIM (Building Information Modeling) AutoCAD interface and basic commands 2D drafting (plans, sections, layouts) Introduction to 3D modelling (Revit/SketchUp) Plotting and file management	07	CO6
		Self-Learning: Advanced AutoCAD commands Basics of Revit software Clash detection in BIM Real-life BIM project examples	07	

Text Books:

1. M. G. Shah, C.M. Kale and S. Y. Patki, Building drawings with an integrated Approach to Built-Environment, Tata McGraw Hill, New Delhi (5^{th} Edition or Latest edition)
2. .Dr. S.V. Deodhar , Building Science and planning, Khanna Publishers.
3. .David V. Chadderton , Building Services Engineering (sixth edition or latest edition), London and New York.
4. Jan A. Van Der Westhuizen , Drawing for Civil Engineering.

Reference Books:

1. National Building Code -2016 (Latest)
2. Building Design and construction by Frederick Merrit, Tata McGraw Hill.
3. Times Saver Standards of Architectural Design Data by Callender, Tata McGraw Hill.
4. I.S. 962-1989 Code for practice for Architectural and Building Drawings.
5. Development plan and DCP Rules of urban local body, Volume 12, New Delhi.
6. Model Building bye laws by MoUD, GoI.

Online References:

Sr. No.	Website Name
1.	https://libguides.scu.edu/civilengineering
2.	https://guides.lib.purdue.edu/civeng
3	https://ncbc.nic.in

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.

- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112215702	Building Services & Repairs	3	--	--	45	--		45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112215702	Building Services & Repairs	20	20	40	60	2.5	--	--	100

Rationale: Modern buildings require efficient services such as water supply, sanitation, electrical systems, and maintenance. Understanding building services along with repair and rehabilitation techniques helps engineers ensure safety, durability, and functionality of structures.

Course Objectives:

1. Understand various building services systems.
2. Learn water supply and sanitation systems.
3. Study electrical and fire safety systems.
4. Understand causes of deterioration in structures.
5. Learn repair and rehabilitation techniques.
6. Apply computer applications in building services.

Course Outcomes:

1. Explain different building services and components.
2. Design basic water supply and drainage systems.
3. Understand electrical and fire safety systems.
4. Identify defects and deterioration in buildings.
5. Suggest suitable repair and rehabilitation methods.
6. Use software tools for building services planning.

Prerequisite:

- Basic Building Construction
- Engineering Materials
- Environmental Engineering basics
- Engineering Drawing

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Building Services	Importance of building services Types: Water supply, sanitation, electrical, HVAC Planning considerations	07	CO1
		Self-learning Topics: Smart building concepts, Green buildings basics, Role of services in high-rise buildings	07	
II	Water Supply and Plumbing Systems	Sources of water supply Layout of plumbing system Pipes, fittings, valves Domestic water supply system	08	CO2
		Self-learning Topics: Rainwater harvesting, Pipe materials comparison, Plumbing layouts in apartments.	08	
III	Sanitation and Drainage System	Types of drainage systems Sewer pipes and traps Layout of drainage system Septic tank basics	08	CO3
		Self-learning Topics: Modern drainage systems, Wastewater treatment basics, Plumbing codes	08	
IV	Electrical and Fire Safety Systems	Electrical wiring systems. Lighting and illumination. Fire hazards and protection systems. Fire extinguishers and alarms.	08	CO4
		Self-learning Topics: Solar power systems, Energy-efficient lighting, Fire safety regulations.	08	
V	Building Repairs and Rehabilitation	Causes of deterioration, Cracks and defects, Repair materials Repair techniques and strengthening	07	CO5
		Self-learning Topics: Structural audit, Corrosion protection methods, Case studies of building failures.	07	
VI	Computer Applications in Building Services	AutoCAD for plumbing and electrical layouts Building service drawings Introduction to BIM BOQ preparation basics	07	CO6
		Self-learning Topics: Revit basics, Excel for cost estimation, Software for building services design	07	

Text Books:

1. S.C. Rangwala – *Building Construction*
2. B.C. Punmia – *Building Construction*
3. K.K. Chitkara – *Construction Project Management*

References:

1. M.K. Gupta – *Building Services*
2. E.G. Butcher – *Smoke Control in Fire Safety*
3. Relevant IS Codes for Plumbing & Fire Safety

Online References:

Sr. No.	Website Name
1.	NPTEL
2.	CPWD
3	AutoCAD

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.

Both options should be of **similar difficulty level** and assess similar learning outcomes.

- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112215703	Advanced Structural Mechanics	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112215703	Advanced Structural Mechanics	20	20	40	60	2.5	--	--	100

Rationale:

The structures are subjected to various types of loading/ forces. These are axial force, shear force, bending moment, torsion etc. This course enables the students with the knowledge in conformity with analysis of behaviour of structural members under different types of loading. The course facilitates in imparting theoretical concepts and physical understanding, which in turn will help in solving structural mechanics problems, mostly involving beams & thin-walled structures under different loading conditions.

Course Objectives:

1. To develop a fundamental understanding of continuum mechanics and elasticity relevant to structural analysis.
2. To equip students with matrix methods for analyzing moderately complex structural systems.
3. To introduce the basic concepts of inelastic and plastic behavior in structures.
4. To familiarize students with stability concepts and simple buckling analysis of structural members.
5. To provide an introduction to computational techniques such as FEM and basic structural dynamics.
6. To enable students to apply structural mechanics concepts to practical civil engineering problems and interpret results effectively.

Course Outcomes:

1. Apply continuum mechanics principles to structural problems
2. Solve elasticity problems using analytical methods
3. Analyze structures using matrix and computational methods
4. Evaluate plastic behavior and collapse loads
5. Assess stability and buckling of structures
6. Apply FEM and dynamic analysis techniques

Prerequisite:

1. Strong understanding of **Engineering Mechanics and Strength of Materials** – equilibrium, internal forces, stress–strain behavior, SFD & BMD
2. Basic knowledge of **Structural Analysis** – determinate structures, deflection concepts, and behavior of beams, trusses, and frames
3. Fundamental skills in **Mathematics and Computing** – algebra, matrices, calculus, and basic use of tools like Excel or structural software

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	A basic understanding of Engineering Mechanics and Strength of Materials (equilibrium, internal forces, SFD & BMD) is required, along with fundamental Structural Analysis concepts for beams and frames. Students should also have knowledge of basic mathematics (algebra, matrices, calculus) and simple computational tools like Excel or structural software.		
I	Continuum Mechanics & Fundamentals	Stress & strain tensors, invariants Hooke's law (3D). Strain-displacement relations Compatibility & equilibrium equations Energy principles	8	CO1
		Self-learning Topics: Tensor calculus applications Advanced energy theorems	8	
II	Advanced Theory of Elasticity	Governing equations. Plane stress & plane strain. Airy stress function. Thick cylinders, torsion problems	8	CO2
		Self-learning Topics: Complex variable methods Contact stresses (Hertz theory)	8	
III	Matrix and Computational Structural Analysis	Stiffness & flexibility methods Indeterminacy concepts Matrix analysis of structures Sub structuring & basics of nonlinear analysis	7	CO3
		Self-learning Topics: MATLAB/Python for matrix analysis Introduction to nonlinear structural analysis	7	
IV	Plasticity and Inelastic Analysis	Yield criteria (Tresca, von Mises) Plastic hinge concept Limit analysis Collapse mechanisms	7	CO4
		Self-learning Topics: dvanced yield criteria (Drucker-Prager)	7	

		Hardening rules		
V	Stability and Buckling	Euler buckling theory Energy methods Beam-columns & lateral buckling Plate buckling (intro)	7	CO5
		Self-learning Topics: Post-buckling behavior Stability of shells	7	
VI	Finite Element Method & Structural Dynamics	Variational methods FEM formulation (1D/2D) Shape functions & stiffness matrix Free vibration & modal analysis	8	CO6
		Self-learning Topics: Nonlinear FEM Time-history analysis	8	

Text Books:

1. Theory of Elasticity, S. P., & Goodier, J. N. (1970). Theory of Elasticity (3rd ed.). McGraw-Hill.
2. Advanced Strength and Applied Elasticity, Ugural, A. C., & Fenster, S. K. (2003). Advanced Strength and Applied Elasticity (4th ed.). Prentice Hall.
3. Matrix Analysis of Structures, Kassimali, A. (2012). Matrix Analysis of Structures (2nd ed.). Cengage Learning.
4. Concepts and Applications of Finite Element Analysis, Cook, R. D., et al. (2001). Concepts and Applications of Finite Element Analysis (4th ed.). Wiley.
5. Structural Stability of Steel: Concepts and Applications for Structural Engineers, Galambos, T. V. (1998). Structural Stability of Steel: Concepts and Applications for Structural Engineers. Wiley.

References:

1. Elasticity: Theory, Applications, and Numerics, Sadd, M. H. (2009). Elasticity: Theory, Applications, and Numerics (2nd ed.). Academic Press.
2. Mathematical Theory of Elasticity, Sokolnikoff, I. S. (1956). Mathematical Theory of Elasticity (2nd ed.). McGraw-Hill.
3. Structural Analysis, Reddy, C. S. (2010). Basic Structural Analysis. Tata McGraw-Hill.
4. Matrix Structural Analysis, McGuire, W., Gallagher, R. H., & Ziemian, R. D. (2000). Matrix Structural Analysis (2nd ed.). Wiley.
5. Theory of Plasticity, Chakrabarty, J. (2006). Theory of Plasticity (3rd ed.). Butterworth-Heinemann.
6. Plastic Analysis and Design of Steel Structures, Horne, M. R. (1971). Plastic Analysis and Design of Steel Structures. Butterworths.
7. Theory of Elastic Stability, Timoshenko, S. P., & Gere, J. M. (1961). Theory of Elastic Stability (2nd ed.). McGraw-Hill.
8. Structural Stability, Chajes, A. (1974). Structural Stability Theory and Practice. Prentice Hall.
9. Finite Element Method, Zienkiewicz, O. C., & Taylor, R. L. (2000). The Finite Element Method (5th ed.). Butterworth-Heinemann.
10. Dynamics of Structures, Chopra, A. K. (2017). Dynamics of Structures (5th ed.). Pearson.

Online References:

Sr. No.	Website Name
1.	NPTEL. (n.d.). *Courses on Structural Analysis, Elasticity, and FEM*. Available at: https://nptel.ac.in
2.	MIT OpenCourseWare. (n.d.). *Continuum Mechanics & Structural Dynamics Courses*. Available at: https://ocw.mit.edu
3.	MATLAB. (n.d.). *Documentation and Tutorials*. Available at: https://www.mathworks.com
4.	Python. (n.d.). *Scientific Libraries (NumPy, SciPy)*. Available at: https://www.python.org
5.	ResearchGate. (n.d.). Available at: https://www.researchgate.net
6.	Google Scholar. (n.d.). Available at: https://scholar.google.com

Summary of Internal Assessment (IA) and End Semester Examination (ESE)
Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.

Both options should be of **similar difficulty level** and assess similar learning outcomes.

- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112215704	Air & Noise Pollution Control Measure	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112215704	Air & Noise Pollution Control Measures	20	20	40	60	2.5	--	--	100

Rationale:

Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires, possibly causing diseases, death to humans, damage to living organisms. Noise pollution impacts millions of people on a daily basis. The most common health problem it causes is Noise Induced Hearing Loss (NIHL). Exposure to loud noise can also cause high blood pressure, heart disease, sleep disturbances, and stress. This subject is intended to make students aware about the noise and air pollution, various sources which contribute in degradation of air quality, assessing the air quality through air quality index, and various air and noise pollution control methods and equipment used by industries

Course Objectives:

1. To understand the basic concepts of air and noise pollution.
2. To identify the sources and effects of air and noise pollution.
3. To study different methods and equipment for air pollution control.
4. To understand the measurement and monitoring of air pollutants and noise levels.
5. To learn various noise pollution control techniques.
6. To understand environmental standards, rules, and acts related to pollution control.

Course Outcomes:

1. Identify major sources of air and noise pollution.
2. Explain the effects of air and noise pollution on health and environment.
3. Select suitable air pollution control devices for industries.
4. Measure and analyze noise pollution using basic instruments.
5. Apply air and noise pollution control measures in real-life situations.
6. Understand national standards and environmental laws for pollution control.

Prerequisite: Environmental Science

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of Environmental Engineering, including sources and effects of air and noise pollution. Understanding of fluid mechanics, basic chemistry, and environmental standards will help in studying pollution monitoring and control techniques. Familiarity with sustainable practices and public health concepts is also beneficial for understanding pollution mitigation measures		
I	**Introduction to Air Pollution**	Definition and concept of air pollution Types of air pollutants (Primary and Secondary pollutants), Sources of air pollution (Natural and man-made sources), Classification of pollutants (Gaseous and particulate pollutants) Effects of air pollution on human health, Effects on plants, animals, and environment Global air pollution problems (Smog, Acid rain, Greenhouse effect)	7	CO1
		Self-learning Topics: Aerosol dynamics: nucleation, coagulation, condensation, Wind profiling and mixing height.	7	
II	**Air Pollution Monitoring and Standards**	Air quality standards and need of monitoring, National Ambient Air Quality Standards (NAAQS), Air Quality Index (AQI), Sampling of air pollutants (basic methods), Air monitoring instruments (basic introduction), Stack emission monitoring Meteorological factors affecting pollution dispersion	7	CO2
		Self-learning Topics: Black Carbon monitoring, Gas analyzers,	7	
III	**Control of Particulate Pollution**	Introduction to particulate matter (PM10 and PM2.5), Collection principles of particulate matter, Gravity settling chamber (construction and working), Cyclone separator (construction and working), Fabric filter / Bag filter (construction and working) Electrostatic precipitator (ESP) (basic working principle) Wet scrubbers (types and working) Selection of particulate control equipment for industries	8	CO3
		Self-learning Topics: Fractal structure of particulate matter, Control challenges for nanoparticles, Filter cake formation and dynamic filtration	8	

IV	**Control of Gaseous Pollution**	Introduction to gaseous pollutants (SO_2, NOx, CO, VOCs), Absorption process (scrubbers and towers), Adsorption process (activated carbon method) Condensation method (basic concept), Combustion method (thermal oxidation), Catalytic converters and their applications Control of SO_2 emissions, Control of NOx emissions and industrial control systems	8	CO4
		Self-learning Topics: Catalytic converters for VOC and CO control, Advanced desulfurization using activated carbon and catalysts	8	
V	**Noise Pollution and Measurement**	Definition and concept of noise pollution, Sources of noise pollution (traffic, industrial, construction) Units of sound measurement (Decibel dB, dBA), Frequency, wavelength, and sound pressure level, Effects of noise on human health (stress, hearing loss, sleep disturbance), Noise measurement instruments (sound level meter), Noise standards (CPCB / WHO guidelines)	7	CO5
		Self-learning Topics: Peak noise vs RMS noise analysis, Noise Climate (NC) and Noise Criteria curves, Traffic Noise Index (TNI)	7	
VI	**Noise Control Measures and Environmental Laws**	Noise control at source (machine maintenance, design improvement), Noise control along transmission path (barriers, insulation), Noise control at receiver (ear plugs, ear muffs), Acoustic materials and silencers, Industrial noise control techniques, Traffic noise control measures, Environmental laws and acts (Air Act 1981, Environment Act 1986), Role of CPCB and SPCB in pollution control	8	CO6
		Self-learning Topics: Sound power vs sound pressure modeling, Vibration isolation and damping techniques	8	

Text Books:

1. Air Pollution: Rao. M. N. and Rao, H. V. N., Tata McGraw Hill Publication, New Delhi.
2. Environmental Pollution Control Engineering: Rao C.S., New Age International Publishers.
3. Noise Pollution: Agarwal S.K., APH Publishing Corporation.
4. Noise Pollution and Control Strategy: Singal S.P., Alpha Science International LTD.

References:

1. Air Pollution: Part A- Analysis and Part B-Prevention and Control: Ledbetter, J. O., Make Dekker Inc., New York.
2. Air Pollution: Wark and Warner, Harper and Row, New York.
3. Air Pollution Vol.1: Tripathi, A. K., Ashish Publication House, New Delhi

Online References:

Sr. No.	Website Name
1.	https://ndma.gov.in/
2.	https://sdma.maharashtra.gov.in/en/

Summary of Internal Assessment (IA) and End Semester Examination (ESE)
Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.

Both options should be of **similar difficulty level** and assess similar learning outcomes.

- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11412509	AUTO CAD and BIM Fundamental	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11412509	AUTO CAD and BIM Fundamental	--	--	--	--	--	25	--	25

Lab Objectives:

Lab course aims to

1. To develop the ability to prepare civil engineering drawings using AutoCAD.
2. To introduce Building Information Modelling concepts using Autodesk Revit.
3. To enable students to create plans, sections, and elevations as per standard practices.
4. To integrate CAD drafting with BIM-based modeling workflow.
5. To develop skills in extracting drawings and quantities from BIM models.
6. To prepare students for real-world digital construction documentation and coordination.

Lab Outcomes:

1. To prepare accurate 2D civil engineering drawings using AutoCAD.
2. To develop building plans and sections using standard drafting practices.
3. To interpret and convert CAD drawings into BIM models.
4. To create building models using Revit with architectural components.
5. To generate drawings and schedules from BIM models.
6. To develop an integrated CAD–BIM project for a residential building.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
1	Preparation of 2D layout: Room layout and foundation plan using proper scale and standards	2	LO1
2	Preparation of sectional elevation from given plan including dimensioning and level marking	4	LO2
3	Drafting of residential building plan (G+1) with doors, windows, and annotations	2	LO2

4	Introduction to BIM workflow and Revit interface; understanding CAD to BIM transition	2	LO3
5	Project setup in Revit: Levels, grids, and linking CAD drawing (import AutoCAD plan)	2	LO3
6	Creation of walls, floors, and structural components based on imported CAD plan in Revit	2	LO4
7	Placement of doors, windows, stairs, and architectural components in Revit	2	LO4
8	Development of complete G+1 residential BIM model with coordinated elements using Revit	4	LO4
9	Generation of plans, elevations, and sections from BIM model using Revit	2	LO5
10	Creation of schedules (door, window, area) and basic quantity take-off in Revit	4	LO5
11	Mini Project: Integrated AutoCAD drawing + BIM model with sheets and schedules	4	LO6

Sr No	List of Assignment
1	Case study assignment: Understanding BIM workflow and comparison between CAD and BIM (short report + screenshots from Revit interface)

Textbooks:

1. M. G. Shah, C.M. Kale and S. Y. Patki, building drawings with an integrated Approach to Built-Environment, Tata McGraw Hill, New Delhi (5th Edition or Latest edition)
2. Daniel John Stine (2022), Residential Design Using AutoCAD 2022, SDC Publications, 2021, 163057449X, 9781630574499
3. Dr. S.V. Deodhar , Building Science and planning, Khanna Publishers.
4. Thompson, M. (2025). Civil engineering modeling with AutoCAD and Revit: Learn modern CAD BIM and structural modeling workflows for real-world construction projects.

Reference Books:

1. National Building Code -2016 (Latest)
2. Building Design and construction by Frederick Merrit, Tata McGraw Hill.
3. Times Saver Standards of Architectural Design Data by Callender, Tata McGraw Hill.
4. I.S. 962-1989 Code for practice for Architectural and Building Drawings.
5. Development plan and DCP Rules of urban local body, Volume 12, New Delhi.
6. Model Building bye laws by MoUD, GoI.

Online Resources:

Sr. No.	Website Name
1.	Autodesk Official Learning Portal – https://www.autodesk.com/education

Assessment:

Term Work: Term Work shall consist of at least 8 to 10 practicals' based on the above list.

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

SEMESTER – VI

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)				Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11211601	Design and Drawing of Steel Structures	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11211601	Design and Drawing of Steel Structures	20	20	40	60	3	--	--	100

Rationale:

Steel structures are preferred due to their higher strength, speed of construction and aesthetic view. Civil Engineers must have knowledge of designing and detailing of steel structures to make structures safe and serviceable during its life span. I.S. code specifying the use of Limit State design philosophy for design of steel structures and its various components. This course is designed to provide basic knowledge of design and detailing of steel structures.

Course Objectives:

1. To introduce the fundamental concepts of reinforced concrete and behavior of concrete and steel under load.
2. To understand the Working Stress Method (WSM) and analyze RCC sections under permissible stress conditions as per IS 456:2000.
3. To impart knowledge of Limit State Method (LSM) including safety, reliability, and limit state philosophy.
4. To develop skills in analysis and design of RCC members (beams, slabs, columns) under flexure, shear, bond, torsion, and compression.
5. To understand the behavior and design of structural components such as slabs, columns, and foundations under different loading conditions.
6. To familiarize students with practical aspects, reinforcement detailing, and real-life applications through self-learning and case studies.

Course Outcomes:

1. Explain the behavior of reinforced concrete, stress–strain relationships, and material properties of concrete and steel. (Understanding)
2. Analyze and design RCC beams using Working Stress Method for flexural conditions. (Apply)
3. Apply Limit State Method concepts to evaluate safety, reliability, and various limit states of RCC structures. (Apply)
4. Design RCC members (beams and slabs) for flexure, shear, bond, and torsion using LSM as per IS 456:2000. (Analyze & Design)
5. Design compression members and foundations, including columns and isolated footings under axial load and bending. (Design)
6. Interpret structural drawings and demonstrate practical understanding of reinforcement detailing, construction practices, and failure modes. (Evaluate).

Prerequisite:

1. **Basic Mechanics & Strength of Materials:** Understanding of stress–strain behavior, bending, shear force, and moment concepts.
2. **Structural Analysis Fundamentals:** Knowledge of equilibrium of forces, free body diagrams, and analysis of determinate structures including SFD and BMD.
3. **Material Properties & Basic RCC Concepts:** Familiarity with properties of concrete and steel, basic RCC components, and algebraic calculations used in design.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Strength of Materials (bending stress, shear stress, torsion, and deflection) and Structural Analysis (SFD, BMD, and analysis of trusses and frames) are essential. Students must understand Engineering Mechanics (equilibrium, load transfer) and be able to read and prepare structural drawings with basic detailing skills. Knowledge of steel properties (stress–strain behavior, buckling) and familiarity with design provisions as per IS 800:2007 are required.		
I	Introduction	Types of steel structures, Properties of Structural Steel, Indian Standard Specifications and Sections, Advantages and limitations of WSM, permissible stresses in WSM. Introduction to Limit State Design, partial safety factors for load and resistance, design load combinations, section classification such as plastic, compact, semi-compact and slender.	8	CO1
		Self-learning Topics: Study real-life steel structures (bridges, towers). Prepare section identification charts	8	
II	Design of Bolted And Welded Connections	Design of bolted and welded connections for axial force, beam to beam and beam to column connections. Framed, stiffened and unstiffened seat connections, bracket connections.	8	CO2
		Self-learning Topics: Practice drawing connection details	8	

		Identify weld symbols in design drawings		
III	Design of Tension & Flexural Members	Design strength due to yielding, rupture and block shear. Design of tension members with welded and bolted end connection using single angle section & double angle section. Design strength in bending, effective length, Lateral torsion buckling behavior of unrestrained beams, design of single rolled section with or without flange plates, design strength of laterally supported beams, low and high shear, design strength of laterally unsupported beams, web buckling, web crippling, shear lag effect and deflection.	7	CO3
		Self-learning Topics: Case study on behavior of tension members under axial load, Failure modes (rupture, yielding, block shear).. Draw bending and shear diagrams Study beam failure videos/simulations	7	
IV	Design of Compression Member	Introduction, types of compression members, classification of cross sections, types of buckling, effective length of column and slenderness ratio, buckling curves, design of compression members as struts using single angle sections & double angle section. Design of axially loaded column using rolled steel sections, design of built-up column, laced and battened Columns.	7	CO4
		Self-learning Topics: Plot buckling curves Analyze failure cases of columns	7	
V	Design of Column Bases	Design of slab bases & gusseted base. With detailing	7	CO5
		Self-learning Topics: Sketch detailed base plate designs Study real construction site photos	7	
VI	Design of Truss	Design of determinate truss. Calculation of dead load, live load and wind load acting on truss. Load combinations and calculation of internal forces. Design and detailing of members. Support detailing. Design of angle section purlin.	8	CO6
		Self-learning Topics: Study different types of roof trusses and identify load transfer mechanisms in determinate trusses. Study support conditions and detailing of truss supports including base plates and anchorage.	8	

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
7. Limit state design of steel structure by Dr. V.L. Shah and Gore, Structure publication Pvt. Pune.

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

Online References:

Sr. No.	Website Name
1.	NPTEL – *Design of Steel Structures* https://nptel.ac.in/courses/civil-engineering
2.	SWAYAM – *Steel Structure Design Course* https://swayam.gov.in
3.	IIT Bombay – *Steel Design Lecture Notes* https://www.civil.iitb.ac.in

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **3 Hours**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11211602	Environmental Engineering	3	--	--	45	--		45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11211602	Environmental Engineering	20	20	40	60	2.5	--	--	100

Rationale:

Environmental Engineering is engineering focused on protecting human health and the environment by improving natural systems and designing solutions for pollution control, resource management, and sustainable development.

Course Objectives:

1. To understand the principles of water supply and distribution systems.
2. To learn water treatment processes with design aspects.
3. To develop knowledge of plumbing, rainwater harvesting, and sewerage systems.
4. To analyze and design sewer systems and treatment units.
5. To Learn wastewater treatment processes with design aspects.
6. To understand solid waste management and pollution control techniques.

Course Outcomes:

1. Explain components of water supply and distribution systems.
2. Design basic water treatment units.
3. Apply concepts of rainwater harvesting and plumbing systems.
4. Analyze and design sewerage systems and appurtenances.
5. Evaluate wastewater treatment processes and perform design calculations.
6. Understand and apply solid waste management and pollution control measures.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of Chemistry, Biology, Fluid Mechanics, and basic Civil Engineering concepts. Students should understand water resources, sanitation, and environmental issues to study water treatment, wastewater management, solid waste management, and pollution control effectively.		
I	**Water Supply System**	Sources of water supply (surface and groundwater), Intake structures: types and design considerations, Water demand: types and variations, Water quality standards (physical, chemical, biological), Drinking water standards (BIS/WHO overview), Components of water supply system, Distribution systems: types (dead-end, grid, radial, ring), Methods of distribution and storage	8	CO1
		Self-learning Topics: Smart metering and billing systems, Pump selection optimization (centrifugal, submersible, etc.), Energy-efficient pumping systems	8	
II	**Water Treatment**	Objectives of water treatment, Treatment units and flow diagram, Aeration, coagulation, flocculation, Sedimentation and filtration (slow and rapid sand filters), Disinfection methods (chlorination, UV, ozonation).Design of Sedimentation Tank and Calculations on dosage of Chlorine, Miscellaneous Treatment: Defluorination Hardness Removal Methods, Iron Magnese Removal	8	CO2
		Self-learning Topics: Optimization using Jar Test modeling, Removal of micropollutants (pharmaceuticals, pesticides) Ion exchange resins for hardness, nitrate, fluoride removal	8	
III	**Rainwater Harvesting & Plumbing Systems**	Rainwater harvesting: methods and importance, Rooftop and surface runoff harvesting, Plumbing systems in buildings, Types of pipes, Pipe fittings and layouts, Traps: types, House drainage system	8	CO3
		Self-learning Topics: Rainfall–runoff modeling (SCS Curve Number method), Pressure management in multi-store buildings, Smart valves and pressure controllers	8	
IV	**Sewerage System**	Introduction to sewerage systems, Types of sewerage systems, Physical and chemical characteristics, Numerical on BOD Design of	7	CO4

		sewer, Sewer appurtenances: Manholes, Drop manholes, Flushing tanks, Clean Out, Street Inlet		
		Self-learning Topics: Smart sewer networks using IoT sensors, Risk-based asset management, Structural assessment of pipelines		
V	**Wastewater Treatment**	Characteristics of wastewater, Treatment stages: Primary treatment, Secondary treatment: activated sludge process, trickling filters, Sludge treatment and disposal. Design of Trickling Filter, Rural and Low-cost sanitation: Septic Tank and Soak Pit Operation, suitability and Design	7	CO5
		Self-learning Topics: Biological Nitrogen Removal (nitrification–denitrification), Smart & AI-Based Wastewater Systems, Advanced Oxidation Process	7	
VI	**Solid Waste Management & Pollution Control**	Solid waste: types and sources, Collection, segregation, transportation, Disposal methods: Landfilling, Incineration, Composting, Air pollution: Sources and effects, Control measures (cyclones, scrubbers, filters), Noise pollution: Sources and impacts, Control measures and standards	7	CO6
		Self-learning Topics: Material Flow Analysis, Life Cycle Thinking in waste streams, Route optimization using AI & GIS, Leachate modeling & treatment, Flue gas desulfurization (FGD), Remote sensing for pollution tracking	7	

Text Books:

1. Water Supply Engineering: 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. Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan

References:

1. Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S.K. Garg, Khanna Publishers New Delhi
2. Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A.Christian
3. Integrated solid waste management, Tchobanoglous. Theissen and Vigil, McGraw Hill Publication.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/127/105/127105018/
2.	https://archive.nptel.ac.in/courses/105/103/105103205/

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11211603	**Hydraulics and Water Resources Engineering**	**3**	**--**	**--**	**45**	**--**	**--**	**45**	**90**	**3**

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11211603	**Hydraulics and Water Resources Engineering**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: The course Applied Hydraulics and Water Resources Engineering provides fundamental and applied knowledge of fluid flow, hydraulic machines, and open channel systems. It integrates concepts of irrigation, hydrology, and groundwater for efficient water management. The subject emphasizes practical applications in design and operation of water resource structures. It prepares students to address real-world challenges in sustainable water resources development and infrastructure.

Course Objectives:

1. To understand principles of fluid flow and their application in hydraulic machines.
2. To study the performance and operation of turbines and pumps.
3. To analyze flow behavior in open channels and related hydraulic systems.
4. To understand crop water requirements, hydrograph analysis, and groundwater flow for application in irrigation planning, flood estimation, and groundwater development.
5. To study Dams i.e., gravity dam, its various components and analysis and suitable conditions of earthen dam and its seepage analysis.
6. To understand channel design theories and irrigation canal structures for efficient water conveyance.

Course Outcomes:

1. Apply principles of hydraulics to analyze jet impact and hydraulic machines.
2. Evaluate performance of turbines and pumps in practical situations.
3. Analyze uniform and non-uniform flow in open channels.
4. Apply principles of crop water requirements, hydrograph analysis, and groundwater flow to evaluate irrigation demand, estimate runoff, and analyze well hydraulics for sustainable water resource management.
5. Analyze and design gravity dams and earthen dams with spillways for sustainable development.
6. To apply Kennedy's and Lacey's theories for channel design and explain irrigation canal structures such as falls, regulators, outlets, escapes, and cross drainage work.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Hydraulics and Water Resources Engineering requires basic knowledge of Fluid Mechanics, Engineering Mathematics, and Applied Mechanics. Students should understand fluid properties, pressure, flow concepts, and basic surveying principles to study pipe flow, open channel flow, hydraulic structures, and water resource management		
I	Hydraulic Machines – Basics & Turbines	Impulse momentum principle, jet impact on flat plates (stationary and moving), jet impact on curved vanes, classification of hydraulic machines, hydraulic turbines types, Pelton turbine, Francis turbine, Kaplan turbine, efficiencies of turbines, draft tube concept, cavitation	07	CO1
		Self learning topics: velocity triangles, jet impact on inclined plates, specific speed and unit quantities, characteristic curves	07	
II	Pumps and Hydraulic Systems	Centrifugal pumps working, heads and efficiencies, priming, cavitation in pumps, series and parallel operation, NPSH concept, hydraulic ram, hydraulic press, hydraulic accumulator, hydraulic lift and crane	07	CO2
		Self learning topics: multistage pumps, velocity triangles in pumps, model testing, detailed NPSH	07	
III	Open Channel Flow	Types of flow in channels, uniform flow, Manning's equation, most economical channel sections, specific energy, critical depth, backwater curve concept	08	CO3
		Self-learning topics: Chezy's formula, GVF equation, momentum equation, afflux	08	
IV		Water Requirement of Crops: delta	08	CO4

	Hydrology, Irrigation Water Requirement, and Groundwater Engineering	and duty of crops, relationship between delta and duty of crops Hydrograph: Flood hydrograph- Its components and baseflow separation, Unit hydrograph, application of unit hydrograph, methods of deriving unit hydrograph, S-hydrograph and its application. Ground water resources and occurrence of ground water. Well hydraulics: steady state flow conditions in wells. Equilibrium equations for confined and unconfined aquifer. Aquifer tests. Difference between open well and tube well, Well Losses		
		Self-learning topics: Irrigation Methods, national water policy, root zone soil water, infiltration, consumptive use, frequency of irrigation, missing rainfall data, flood routing,	08	
V	Dams and Spillways	Gravity Dams: Definition, typical cross section and components of gravity dam, forces acting on gravity dam, modes of failure of gravity dam, structural stability analysis of gravity dam, elementary and practical profile of gravity dam, low and high gravity dam, galleries in gravity dam – Function of gallery and different cross-sections of gallery, adopted in practice, joints in gravity dam. control of cracking in concrete dams. Earthen Dam: Types of earthen dams and methods of construction of earthen dam, causes and failures of earthen dams, seepage line/phreatic line for different conditions and its location using graphical method, seepage control through embankment and through foundations. Spillways: Introduction, types of spillways – its working and functionality	08	CO5
		Self learning topics: Reservoir, various zones of storage reservoir, control level fixation for a reservoir. Introduction to reservoir sedimentation and control measures	08	
VI	Canal Design and Irrigation Structures	Kennedy's theory and method of channel designs silt supporting capacity according to Kennedy's theory. Lacey's regime theory and application of Lacey's theory for designing channel cross-section. Comparison between Kennedy's theory and Lacey's theory.	07	CO6

		Canal Falls and types of canal falls, canal escapes and types of canal escapes, canal regulators and types of canal regulators, canal outlets and types of canal outlets, cross drainage works and types of cross drainage work.		
		Self-learning topics: Introduction to sediment transport in channels, Classification of canals, canal alignment, canal losses, canal lining,	07	

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.
9. Irrigation and Water Power Engineering: B.C. Punmia, PandeB.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi
10. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN9789383656899.
11. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
12. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.
13. Design of Irrigation Structures: S. K. Sharma, S. Chand and Co.

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.
8. Theory and Design of Irrigation Structures: R. S. Varshney and R, C. Gupta, Nem Chand
9. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
10. Design of Small Dams: USBR.
11. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
12.Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/108108076
2.	https://www.nptelprep.in/courses/105105110

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11212604	Environmental Engineering Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11212604	Environmental Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand and apply standard laboratory procedures for the analysis of physical, chemical, and biological characteristics of water, wastewater, and solid waste samples.
2. To determine important water quality parameters such as pH, turbidity, chlorides, dissolved oxygen, and residual chlorine using standard testing methods.
3. To evaluate solid waste characteristics by determining moisture content and various solid fractions including total solids, suspended solids, dissolved solids, and volatile solids.
4. To assess the pollution strength of wastewater through the determination of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).
5. To study water treatment processes and determine the optimum coagulant dosage using the Jar Test for effective treatment.
6. To develop laboratory skills in sampling, experimentation, data analysis, interpretation of results, and preparation of technical reports related to environmental engineering.

Lab Outcomes:

1. To determine physical characteristics of water and wastewater samples using standard laboratory procedures.
2. To analyze chemical properties of water and sewage such as chlorides and residual chlorine.
3. To evaluate treatment requirements of water using coagulation and jar test analysis.
4. To determine dissolved oxygen and assess oxygen balance in water and wastewater samples.
5. To assess organic pollution strength of sewage using BOD and COD tests.
6. To evaluate characteristics of solid waste through moisture content and related analysis.

List of Experiments:

Sr. No	List of Experiments (Minimum Eight)	Hrs	LO Mapping
1	Determination of pH of water/ sewage sample /solid waste.	2	LO1
2	Determination of Turbidity in water sample.	2	LO1
3	Determination of Total Solids, suspended solids, dissolved solids, volatile solids.	4	LO1
4	Determination of chlorides.	2	LO2
5	Determination of Optimum dose of coagulant by using Jar Test.	2	LO3
6	Determination of Dissolved Oxygen	4	LO4
7	Determination of Residual chlorine	2	LO2
8	Determination of Bio Chemical Oxygen Demand of sewage sample	4	LO5
9	Determination of Chemical Oxygen Demand of sewage sample	4	LO5
10	Determination of moisture content of solid waste.	4	LO6

Sr No	List of Assignment
01	Intake Structure, Water Distribution System, Physical, Chemical and Biological Characteristics of Water
02	Coagulation and Flocculation, Break Point Chlorination, Treatment of River Water
03	Methods of Water Softening, Zeolite Process, Water Connection, Single Pipe and Single Stack Plumbing System
04	Laying and Testing of Sewers, Separate and Combined Sewerage System
05	Activated Sludge Process, Self-Purification of Streams, Zones of Pollution
06	Municipal Solid Waste Disposal Methods, Impacts of Air Pollution on Man and Environment

Text Books:

1. Water Supply Engineering: 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. Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan.
2. CPHEEO Manual on Water Supply and Treatment.
3. CPHEEO Manual on Sewage and Treatment.

Online Resources:

Sr. No	Website Name
1	https://ee1-nitk.vlabs.ac.in/
2	https://ee2-nitk.vlabs.ac.in/

Assessment:

Including laboratory work, Site Visit Report and Assignment, Distribution of marks for Term Work shall be as follows

Laboratory Work: 10 Marks
Assignment: 10 Marks
Attendance: 05 Marks

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11212605	**Design and Drawing of Steel Structures Lab**	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11212605	**Design and Drawing of Steel Structures Lab**	--	--	--	--	--	25	25	50

Lab Objectives:

1. To develop understanding of design principles of steel structural members as per IS 800:2007.
2. To impart skills in design and detailing of tension and compression members.
3. To train students in design of steel connections (bolted and welded).
4. To enable preparation of structural drawings for steel components such as beams, columns, and trusses.
5. To familiarize students with use of design aids, IS codes, and standard tables.
6. To bridge the gap between theoretical design and practical detailing used in industry.

Lab Outcomes:

1. Apply design procedures to analyze and design steel members such as ties, struts, and beams.
2. Design and detail connections including bolted and welded joints as per codal provisions.
3. Prepare detailed structural drawings of steel components using standard drafting practices.
4. Interpret and use IS codes and design tables effectively in solving design problems.
5. Demonstrate practical knowledge of member detailing, including gusset plates, base plates, and splices.
6. Integrate design and drafting skills to produce complete steel structure layouts such as trusses and purlins.

The Project shall be given to a group of students consisting of not more than10 students.

Schedule	List of Projects	Hrs	LO Maping
Project I	**Design and drawing of steel roof truss for industrial shed should consist of the following items.**		
1	Introduction, problem statement, Calculation of panel point DL, LL, and WL on truss.	02	LO1, LO4
2	Analysis of truss by graphical method/ any software and calculation of design loads in members	02	LO1, LO4
3	Design of purlins, Principal rafter, Main Tie, Design of remaining members of truss. etc.	02	LO1
4	Design of bolted /welded connections and design of sliding and hinged supports including anchor bolts	02	LO2, LO5
5	To generate/draw fabrication drawings on full imperial size drawing sheet and design report on A4 size pages.	02	LO3
6	To generate fabrication drawings and design report including estimation of steel required.	04	LO3, LO6
Project 2	**Design and drawing of floor beam system for steel building G+1 should consist of the following items**		
7	Introduction, problem statement and to draw grid floor plan.	02	LO3, LO6
8	Calculation of DL, LL on slab, beams etc. and to analyze frame for BM and SF.	02	LO1, LO4
9	Calculation of design loads on columns and footing.	02	LO1, LO4
10	Design of beams, columns and footings	02	LO1
11	Design of beam end and beam-column connections.	02	LO2, LO5
12	To generate/draw fabrication drawings on Full imperial size drawing sheet and design report on A4 size pages.	02	LO3
13	To generate fabrication drawings and design report including estimation of steel required.	04	LO3, LO6

Sr.No.	**List of Assignment (Any 3)**
1	Classify steel sections and compare WSM with Limit State Design using suitable examples.
2	Design a bolted and welded connection for a given axial load and sketch the detailing.
3	Design a tension member and a laterally supported beam considering all failure modes.
4	Design a steel column (rolled or built-up) and evaluate its buckling strength.
5	Design a slab base or gusseted base with proper detailing for a given column load.

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.

Online References:

Sr. No.	**Website Name**
1.	https://archive.nptel.ac.in/courses/105/105/105105162/

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

Design Report and Drawing: 10 Marks
Assignments: 10 Marks
Attendance: 05 Marks

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
11812606	Dissertation-I	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11812606	Dissertation-I	--	--	--	--	--	50	50	100

Rationale:

In the field of civil engineering, new problems arise every now and then; but a professional civil engineer must know how to precisely identify & state those problems, define the scope & objectives of the probable solution(s), carry out effective review of available literature in the domain of the problem and formulate a systematic methodology to solve the problem. Modem tools and multidisciplinary knowledge are vastly used nowadays for the effective solution of civil engineering problem. It is also important to work effectively & ethically as a team and communicate the work done in the form of written reports. The aim of this course is to acquaint the learners with all of the above-mentioned aspects of the civil engineering field by inculcating the process of research

Course Objectives:

1. To acquaint the learners how to identify problems
2. To accustom the learners how to formulate the scope and objectives
3. To familiarize the learners with the process of review of literature
4. To advice the learners how to formulate a methodology
5. To accustom the learners to work as a team
6. To apprize the learners on proper documentation of work

Course Outcomes: Students will be able to

1. Review & comprehend literature in the selected domain
2. Articulate problem statement & identify the objectives
3. Identify existing methods or solutions to solve identified problem
4. Identify modern engineering tools & other resources to solve the problem
5. Formulate methodology to solve the identified problem
6. Effectively communicate their project work by writing reports & presentations

Guidelines for Major Project (Dissertation-I)
B.Tech. Civil Engineering

1. General Guidelines for Major Project

1. A project group should consist of minimum 1 and maximum of 4 students. Formation of groups with less than three or more than four students shall not be permitted.
2. Students shall identify real-world civil engineering problems through:
    - Field surveys
    - Site visits
    - Industry interaction
    - Literature review
    - Consultation with faculty supervisors
3. The identified need shall be converted into a well-defined project problem statement.
4. Students should do literature survey/visit industry/analyses current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor.
5. Students should use multiple literatures and understand the problem.
6. Students should attempt solution to the problem by experimental/simulation methods.
7. The solution to be validated with proper justification and report to be compiled in standard format.
8. The problem statement of the project should preferably be (but not limited to) from the domains of civil engineering.
9. The solutions to the problem may be multidisciplinary i.e., incorporating concepts, tools, techniques etc. of disciplines apart from Civil Engineering.
    - Building materials
    - Construction management
    - Environmental engineering
    - Geotechnical engineering
    - Structural engineering
    - Surveying
    - Transportation engineering
    - Water Resources engineering
    - Sustainable Infrastructure
    - Smart Cities and Urban Planning
    - Any diversified field of Civil Engineering.
10. Problem maybe multidisciplinary i.e., incorporating concepts, tools, techniques etc. of disciplines other than civil engineering such as architecture, computer engineering, electrical engineering, electronics engineering, mechanical engineering etc.
11. The project work may include:
    - Experimental analysis
    - Design of structures
    - Preparation of working drawing
    - Research on novel materials
    - Development of working models
    - Studies on technical and economic feasibility
    - Application of IOT and software's in relevant fields.
    - Application of any other innovative tools and techniques.
12. Each group shall prepare a detailed implementation plan using Gantt Chart, PERT or CPM covering all activities of Dissertation-I.

13. A project logbook shall be maintained by each group to record weekly progress, observations, calculations, site visits, laboratory investigations, discussions, and faculty remarks.
14. Faculty supervisors shall guide students throughout the project; however, emphasis shall be placed on self-learning, problem-solving, and independent decision-making.
15. Students shall:
    - Conduct literature review
    - Identify multiple alternative solutions
    - Evaluate alternatives using technical, economic, environmental and sustainability criteria
    - Select the optimum solution
16. Students shall prepare a dissertation report as per institute/university guidelines and present their work through seminars, demonstrations, posters, or prototypes wherever applicable.

Review and Progress Monitoring

Dissertation-I (Semester VI)

Review 1

- Need Identification
- Literature Survey
- Problem Statement Finalization
- Objectives and Scope

Review 2

- Methodology Selection
- Preliminary Design/Analysis (concept)
- Software Modeling (if applicable)
- Data Collection Plan / Work Plan of Dessertation –II.
- Feasibility Study

Distribution of Term Work Marks

Component	Marks
Marks awarded by Guide/Supervisor based on Log Book	20
Marks awarded by Review Committee	20
Quality of Project Report	10
Total	50

Guidelines for Assessment of Project Stage- I

Project Stage- I should be assessed based on following points:

1) Quality of problem selected

2) Clarity of Problem definition and Feasibility of problem solution.

3) Relevance to the specialization or field or Industry.

4) Clarity of objective and scope

5) Breadth and depth of literature survey

6) Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)/ Data Collection, etc.

Project Stage I should be assessed through a presentation by a panel of Project I should be assessed through a presentation by the student project group to a panel of internal and external examiners appointed by the Head of the Department/Institute

Assessment Criteria for Dissertation – I (Semester VI)

1. Problem Identification and Literature Survey
2. Innovation and Feasibility of Proposed Solution
3. Planning, Design and Methodology
4. Societal Impact and Cost Effectiveness
5. Documentation, Presentation and Individual Contribution

Guidelines for Practical/Oral Examination

1. The dissertation report shall be prepared as per University/Institute guidelines.
2. The project shall be assessed through:
    - Presentation
    - Demonstration
    - Design Analysis
    - Software Modeling
    - Experimental Validation
    - Viva-Voce Examination
3. The examination panel shall consist of:
    - Internal Examiner
    - External Examiner preferably from Industry, Consultancy, Government Organizations, Research Institutions or Academia.
4. Students shall be encouraged to publish research papers, obtain copyrights, file patents, and develop innovative engineering solutions.
5. Evaluation shall focus on:
    - Problem Definition
    - Technical Soundness
    - Innovation
    - Cost Effectiveness
    - Sustainability
    - Societal Relevance
    - Application of Standards
    - Communication Skills
    - Teamwork and Leadership
    - Quality of Outcomes

Recommended Civil Engineering Project Domains:

- Sustainable Building Materials
- Earthquake Resistant Structures
- Smart Transportation Systems
- Pavement Design and Evaluation
- Water Supply and Distribution Networks
- Wastewater Treatment Technologies
- Solid Waste Management
- Rainwater Harvesting Systems
- Flood Risk Assessment
- GIS-Based Urban Planning
- Green Building Design
- Construction Project Management
- Highway Safety Analysis
- Geotechnical Investigations
- Structural Health Monitoring
- Climate Resilient Infrastructure

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112216701	Advanced Geotechnical Engineering	3	-	-	45	-	-	45	90	03

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112216701	Advanced Geotechnical Engineering	20	20	40	60	2.5	--	--	100

Rationale:

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 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:

1. Evaluate the 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 condition, analyze the stability of slopes.
4. Calculate lateral earth pressure under various soil condition.
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.

Prerequisite:

- Basic concepts of soil mechanics, including soil types and index properties
- Phase relationships in soils and the principle of effective stress
- Fundamentals of permeability and seepage analysis
- Basic engineering mathematics, including logarithmic functions and graphical interpretation
- Mechanics of materials, particularly stress–strain behavior

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Consolidation of soils	Compressibility & settlement, comparison between compaction & consolidation, concept of excess pore water pressure, initial, primary secondary consolidation, spring analogy for primary consolidation, consolidation test results, coefficient of compressibility, coefficient of volume change, compression, expansion, recompression indices, normally and over consolidated soils. Terzhaghi's theory of consolidation (no proof)- assumptions, coefficient of vertical consolidation, distribution of hydrostatic excess pore water pressure with depth & time, time factor, relationship between time factor and degree of consolidation, determination of coefficient of vertical consolidation, pre consolidation pressure. Final settlements of a soil deposit in the field, time settlement curve, field consolidation curve.	08	CO1
		Self-learning Topics: Casagrande method for determination of pre-consolidation pressure. Field settlement analysis using consolidation parameters. Time rate of consolidation using Taylor's method. Secondary consolidation (creep) in soft clay deposits.	08	

		Comparison of laboratory and field consolidation behavior		
II	Shear strength	Introduction, frictional cohesive strength, state of stresses in soil mass, principal stresses, determination of stresses on an inclined plane by using analytical and Mohr's circle method, important characteristics of Mohr's circle. Coulomb theory, Mohr-Coulomb theory- shear strength parameters; Mohr-Coulomb failure envelope- relation between major and minor principal stresses, total & effective stress analysis. Different types of drainage conditions UU, CU and CD: Direct shear test, Triaxial compression test, Unconfined compression test, Vane shear test; comparison between direct & triaxial tests, interpretation of test results of direct shear & triaxial shear tests stress-strain curves. Introduction to liquefaction of Soils.	07	CO2
		Self-learning Topics: Graphical representation of Mohr–Coulomb failure envelope. Interpretation of triaxial test results (UU, CU, CD conditions). Effective stress vs total stress analysis in real field problems. Stress–strain behavior of soils under different loading conditions. Introduction to soil liquefaction and its engineering significance	7	
III	Stability of Slopes	Introduction: Types of slopes, types of slope failures, factors of safety. 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. Stability analysis of finite slopes: i) Taylor's stability number ii) friction circle method iii) Swedish circle.	07	CO3
		Self-learning Topics: Application of Taylor's stability charts in slope analysis Case studies on landslides and slope failures Rainfall-induced slope instability mechanisms Use of geosynthetics in slope stabilization Introduction to slope stability software	7	
IV	Lateral Earth Pressure Theories	Introduction to Lateral Earth Pressure Theories: Concept of lateral earth pressure based on vertical and horizontal stresses, different types of lateral earth pressure. 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. Coulomb's	08	CO4

		wedge theory: i) assumptions, ii) active and passive states in cohesionless soil, iii) active and passive states in cohesive soil.		
		Self-learning Topics: Comparison between Rankine and Coulomb earth pressure theories Effect of water table and surcharge on earth pressure Earth pressure in layered soil systems Introduction to seismic earth pressure concepts Basics of retaining wall design and applications	8	
V	Shallow Foundations	Introduction: types of shallow foundations, definitions of different bearing Capacities. 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. ii) IS Code method. Field methods of determining bearing capacity of shallow foundations: i) standard penetration test and ii) plate load test	08	CO5
		Self-learning Topics: Bearing capacity determination using IS Code methods. Settlement analysis using empirical correlations. Case studies on shallow foundation failures. Interpretation of Standard Penetration Test (SPT) results. Use of plate load test data in foundation design	8	
VI	Pile Foundations	Introduction to pile foundations: necessity of pile foundations, types of pile foundation. Theoretical methods of determining load carrying capacity of pile foundations: i) static formulae and ii) dynamic formulae. Field method of determining load carrying capacity of pile foundations: pile load test. Group action of piles, settlement of pile groups, negative skin friction	07	CO6
		Self-learning Topics: Load carrying capacity of piles using static methods Group action and efficiency of pile foundations Settlement analysis of pile groups Under-reamed piles and their applications in India Introduction to modern deep foundation techniques	7	

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. Theoretical Soil Mechanic: K. Terzaghi; John Wiley and Sons

References:

1. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley and sons
2. Relevant Indian Standard Specification Code: BIS Publications, New Delhi
3. Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House
4. Geotechnical Engineering: Purushothama Raj; Tata McGraw Hill Publications
5. Basic and Applied Soil Mechanic: Gopal Ranjan and A.S. Rao; New Age International

Online References:

Sr. No.	**Website Name**
1	https://onlinecourses.nptel.ac.in/noc22_ce96/preview

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112216702	Urban Infrastructure Planning	3		--	45	-	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112216702	Urban Infrastructure Planning	20	20	40	60	2.5	--	--	100

Rationale: Indian cities are growing rapidly, putting immense pressure on infrastructure and basic services. Lack of proper planning for urban expansion often leads to under-serviced areas facing issues like poor water supply, sanitation, waste management, and safety concerns. This highlights the need for integrated and efficient urban infrastructure planning. There is a strong demand for trained professionals who can address these challenges effectively. Well-skilled urban infrastructure specialists can contribute to sustainable development through proper planning and project implementation.

Course Objectives: The students will be able

1. To develop understanding of urban growth, settlement patterns, housing economics, and infrastructure planning principles.
2. To build understanding of economic principles, land economics, and policy impacts on urban development.
3. To identify the key features of a sustainable infrastructure system and explain how they promote sustainable development;
4. To impart knowledge of transportation systems, traffic management, and economic evaluation of transport projects.
5. To familiarize students with urban governance systems, institutional frameworks, and management strategies.
6. To develop awareness of environmental impact assessment and disaster-resilient infrastructure planning.

Course Outcomes:

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

1. Explain urban systems, housing contributions, and infrastructure distribution for effective planning.
2. Elaborate economic factors and policies influencing urban land use and development.
3. Envisage the various elements required for infrastructure development of a city and describe the concepts, significance and importance of each.
4. Analyze transport systems and propose appropriate traffic management and mobility solutions.
5. Demonstrate modern tool usage for urban management and governance
6. Design environmentally safe and disaster resilient infrastructure.

Detailed Syllabus

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of Civil Engineering fundamentals, Surveying, Environmental Engineering, and Transportation Engineering		
I	Urban Systems: Evolution, Socio-Economic Role and Infrastructure Planning Principles	Origins and growth of cities, effects of cultural influence on physical form; Human settlements as an expression of civilizations; Basic elements of the city; Concepts of space, time, scale of cities. Contribution of housing to micro and macro economy, contribution to national wealth and GDP, housing taxation, national budgets, fiscal concessions; need of affordable housing for urban poor, concept of RERA Role of Infrastructure in Development, Elements of Infrastructure (physical, social, utilities and services); Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, provision of infrastructure, and land requirements; Principles of resource distribution in space; Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards, etc.	8	CO1
		Self learning topics: climate, and traditions shape settlement patterns, Study objectives and key provisions of Real Estate (Regulation and Development) Act, 2016 and its impact, contribution of housing sector to GDP, taxation, and national development	8	
II	**Urban Economics**	General introduction to principles of economics and public finance. Importance of economics in Urban Development and Planning	7	CO2

		Industrial location policies, any other economic activity base policies and their impact on urban development, Role of land economics in preparation of Urban Development plans. Relevant case studies of Urban Land Economics. Economic growth and development, quality of life; Human development index, poverty and income distribution, employment and livelihood; Economic principles in land use planning; Policies and strategies in economic planning, balanced versus unbalanced growth, public sector dominance; changing economic policies, implications on land.		
		Self - learning topics: demand–supply, externalities, public goods, and role of government in urban development, GDP contribution of urban sector, employment patterns, and introduction to Human Development Index and quality of life indicators, Study how liberalization, globalization, and government policies influence land use and development patterns	7	
III	Infrastructure Planning	Zoning, Various growth patterns of town, Housing layouts and road networks in town, Urban aesthetics and landscaping, MRTP and Land Acquisition Acts Planning and Management of Water, Sanitation and Storm Water; Water – sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions and management issues; Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, institutional arrangements, planning provisions and management issues. Storm water – rainfall data interpretation, points of water stagnation, system of natural drains, surface topography and soil characteristics, ground water replenishment, storm water collection and disposal, norms and standards, institutional arrangements, planning provisions and management issues; Solid Waste Disposal and Management Basic principles, generation, characteristics, collection, disposal, management	08	CO3
		Self learning topics: Fire and Electrification, and Social Infrastructure Planning for fire protection, services and space standards, location criteria; Planning for Education, health, civic, cultural	08	

		infrastructure and facilities for transport and other miscellaneous infrastructure services Planning for Education, health, civic, cultural infrastructure and facilities for transport and other miscellaneous infrastructure services		
IV	Traffic and Transportation Planning	Evaluation of urban structure: Transport system, infrastructure and management, transport systems and their types, design and operating characteristics, urban road hierarchy, planning, and management criteria for road and junction improvements, arterial improvement techniques. Traffic management, mass transit system: Problems and prospects. Review of existing traffic management schemes in Indian cities. Case study of various metro rail project envisaged for Mumbai, Navi Mumbai & Pune. Economic evaluation: pricing and funding of transport services and systems, economic appraisal of highway and transport projects. Techniques for estimating direct and indirect road user costs and benefit value of time Intelligent transport system (ITS)	08	CO4
		Self-learning topics: Study of parking management strategies and their impact on congestion in cities like Mumbai, understanding non-motorized transport (NMT) systems such as pedestrian and cycling infrastructure, and evaluation of last-mile connectivity issues in urban transport networks	08	
V	Urban Management and Governance	Introduction to Development Management and Urban Governance- Concept, approaches, components, interface with national goals and political economic system. Urban Development Management Strategies, Tools and Techniques; organizations involved Land and Real Estate Development Economic concepts of land, Land Pricing / valuation; Urban reforms and acts and policies. Overview of Urban Governance Definition, concepts, components, government and governance, hierarchy and structure, forms of governance, process of inclusion and exclusion. Information System and Urban Reforms Spatial and Non - spatial information systems; Use of GIS in overlaying infrastructure facilities, use of remote sensing in identifying and mapping urban structures. Present organizations and involved in urban governance with focus on MCGM, TMC and CIDCO. Urban Local Governance and Participatory Processes	07	CO5

		System, structure, functions, powers, process and resource, performance, interface with NGO's, other agencies.		
		Self-learning topics: public-private partnerships (PPP) in urban infrastructure projects, role of NGOs in urban development, and evaluation of flagship urban missions such as Smart Cities Mission and AMRUT to understand governance effectiveness and implementation challenges	07	
VI	Environmentally Safe and Disaster Resilient Infrastructure	Frame work, statement prediction and assessment of impacts of air, water, noise, cultural and socio-economic environment. Methods of impact analysis, public participation. Environmental protection international and national agencies and legislation, Environment Impact Assessment. Urban Heat Island Effect, Effect of uncontrolled growth of town Disaster response planning, roles and responsibilities of various agencies Emergency operation support and management Planning for Disaster Prone Areas, Planning requisites for disaster prone areas and preventive measures, Vulnerability Analysis	07	CO6
		Self-learning topics: EIA case study analysis of urban infrastructure projects, review of environmental legislation and policies in India, study of role of United Nations Environment Programme and Ministry of Environment, Forest and Climate Change, analysis of Urban Heat Island effect in Mumbai, impact assessment of uncontrolled urban growth on environment, study of disaster management framework under National Disaster Management Authority,	07	

Text Books:

1. The Urban and Regional Planning Reader, edited by Eugenie L. Birch, Published by Routledge, 2008; ISBN 978-0-415-319
2. Housing: The Essential Foundations, edited by Dr. Paul Balchin, Paul Balchin, Maureen Rhoden, Edition Routledge, DOI https://doi.org/10.4324/9780203010426, eBook ISBN 9780203010426
3. New Urban Housing by Hilary French, Publisher: Yale University Press, ISBN0300115784 (ISBN13: 9780300115789)
4. Sociology: A Brief Introduction, by Richard T. Schaefer, Publisher: McGraw-Hill Education, ISBN 10:1259425584, ISBN 13: 9781259425585
5. Sociology: Principles of Sociology with an Introduction to Social Thoughts, by Rao

6. C.N. Shankar, S. Chand Publication
7. Projects: Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw-Hill; ISBN0074516280 (ISBN13: 9780074516287)
8. Introduction to Transportation Planning, by B. Bruton, Michael J. Bruton; Published by Hutchinson Radius; ISBN0091580412 (ISBN13: 9780091580414)

References:

1. Modern Economics by H.L. Ahuja, 19th Revised Edition, Published by S.Chand (G/L) & Company Ltd
2. Economics, An Introductory Analysis by Paul A. Samuelson, William D. Nordhaus, Published July 27th 2004 by Irwin/McGraw-Hill (first published 1948), ISBN0072872055 (ISBN13: 9780072872057)
3. Modelling Transport, by de Dios Ortuzar and Luis G. Willumsen, 4th Edition, Wiley Publication
4. Principles of Urban Transport Systems Planning, by B.G. Hutchinson, Publisher: Scripta Book Co.; ISBN0070315396 (ISBN13: 9780070315396)
5. Traffic Engineering and Transport Planning, L. R. Kadiyali, Khanna Publishers, 1983
6. Remote Sensing and GIS, by Basudeb Bhatta, second Edition, Oxford University press
7. NEPA and Environmental Planning: Tools, Techniques, and Approaches for Practitioners; Charles H. Eccleston; CRC Press
8. Planning for Disaster: How Natural and Manmade Disasters Shape the Built Environment, by William Ramroth; Publisher: Kaplan Business; Original edition; ISBN-13: 978-1419593734.

Online References:

Sr. No.	Website Name
1.	Urban Infrastructure Planning and Management https://nptel.ac.in/domains/discipline/124?course=124_5

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...

- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112216703	Computational Structural Analysis	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112216703	Computational Structural Analysis	20	20	40	60	2.5	--	--	100

Rationale:

As modern structures grow in complexity, traditional analytical methods become limited in their applicability. Computational Structural Analysis provides efficient numerical techniques to address large-scale structural problems. It enables accurate modeling and analysis of complex systems that are difficult to solve manually. The course emphasizes matrix methods for systematic structural formulation.

It also introduces the fundamentals and applications of the finite element method. Students gain exposure to computer-based implementation and analysis tools. Overall, the course prepares learners for advanced design, research, and professional engineering practice.

Course Objectives:

1. To understand numerical and computational techniques used in structural analysis.
2. To apply matrix methods for analyzing complex structural systems.
3. To formulate finite element models for solving structural problems.
4. To implement computational approaches using programming tools.
5. To analyze structural response under static and dynamic loading using software.
6. To evaluate and interpret analysis results for accuracy and practical engineering decisions

Course Outcomes:

1. Apply matrix methods for structural analysis
2. Formulate and solve structural problems computationally
3. Develop finite element models
4. Analyze structures using numerical techniques
5. Perform dynamic analysis using computational methods
6. Use software tools for structural analysis

Prerequisite:

1. Strong understanding of Engineering Mechanics and Strength of Materials – equilibrium, internal forces, stress–strain behavior, SFD & BMD
2. Basic knowledge of Structural Analysis – determinate structures, deflection concepts, and behavior of beams, trusses, and frames
3. Fundamental skills in Mathematics and Computing – algebra, matrices, calculus, and basic use of tools like Excel or structural software

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	A basic understanding of Engineering Mechanics, Strength of Materials, and Structural Analysis is essential for this course. Students should be familiar with concepts such as equilibrium, stress–strain behavior, and analysis of beams and frames. In addition, knowledge of mathematics including algebra, matrices, and basic numerical methods, along with introductory programming or computational tools, is required.		
I	Introduction to Computational Methods	Need for computational analysis Review of matrix algebra Numerical methods: solution of linear equations (Gauss elimination, LU decomposition) Eigenvalue problems (basic concepts)	8	CO1
		Self-learning Topics: Iterative methods (Gauss-Seidel, Jacobi) Condition number and numerical stability	8	
II	Matrix Methods in Structural Analysis	Stiffness method (detailed formulation) Element and global stiffness matrices Transformation matrices Analysis of trusses and beams using matrix methods.	8	CO2
		Self-learning Topics: Matrix analysis of frames Substructuring techniques	8	
III	Finite Element Method – Fundamentals	Basic concepts of FEM Discretization and types of elements Derivation of element stiffness matrix Shape functions (1D elements) Assembly procedure	7	CO3
		Self-learning Topics: Higher-order elements Error estimation in FEM	7	
IV	Finite Element Method – Advanced Applications	2D elements (plane stress/strain) Isoparametric elements Numerical integration (Gauss quadrature) Boundary conditions and solution techniques	7	CO4

		Self-learning Topics: Nonlinear FEM (introductory) Plasticity in FEM	7	
V	Structural Dynamics and Computational Techniques	Equation of motion Free and forced vibration Eigenvalue extraction methods Time integration methods (Newmark's method – basics)	7	CO5
		Self-learning Topics: Response spectrum analysis Damping models	7	
VI	Optimization Techniques in Structural Engineering	Introduction to structural optimization and its importance. Objective functions and design variables. Constraints in structural design (strength, serviceability, economy). Basic optimization methods (trial and error, gradient-based concept – introductory). Application of optimization in simple structural elements (beams and trusses). Role of computational tools in optimization	8	CO6
		Self-learning Topics: Case studies on optimized structural designs. Introduction to optimization using Excel Solver.	8	

Text Books:

1. Matrix Analysis of Structures, Kassimali, A. (2012). Matrix Analysis of Structures (2nd ed.). Cengage Learning.
2. Finite Element Procedures, Bathe, K. J. (1996). Finite Element Procedures. Prentice Hall.
3. Concepts and Applications of Finite Element Analysis, Cook, R. D., et al. (2001). Concepts and Applications of Finite Element Analysis (4th ed.). Wiley.
4. Numerical Methods for Engineers, Chapra, S. C., & Canale, R. P. (2015). Numerical Methods for Engineers (7th ed.). McGraw-Hill.
5. Dynamics of Structures, Chopra, A. K. (2017). Dynamics of Structures (5th ed.). Pearson.

References:

1. Applied Numerical Methods with MATLAB, Chapra, S. C. (2012). *Applied Numerical Methods with MATLAB for Engineers and Scientists* (3rd ed.). McGraw-Hill.
2. Numerical Methods, Balagurusamy, E. (2017). *Numerical Methods*. McGraw-Hill Education.
3. Structural Analysis, Reddy, C. S. (2010). *Basic Structural Analysis*. Tata McGraw-Hill.
4. Matrix Structural Analysis, McGuire, W., Gallagher, R. H., & Ziemian, R. D. (2000). *Matrix Structural Analysis* (2nd ed.). Wiley.
5. The Finite Element Method, Zienkiewicz, O. C., & Taylor, R. L. (2000). *The Finite Element Method* (5th ed.). Butterworth-Heinemann.
6. Introduction to the Finite Element Method, Reddy, J. N. (2006). *An Introduction to the Finite Element Method* (3rd ed.). McGraw-Hill.

7. Structural Dynamics: Theory and Computation, Paz, M., & Leigh, W. (2004). *Structural Dynamics: Theory and Computation* (5th ed.). Springer.
8. MATLAB for Engineers, Moore, H. (2015). *MATLAB for Engineers* (4th ed.). Pearson.

Online References:

Sr. No.	Website Name
1.	NPTEL. (n.d.). *Courses on Numerical Methods, FEM, and Structural Analysis*. Available at: https://nptel.ac.in
2.	MIT OpenCourseWare. (n.d.). *Finite Element Analysis & Structural Dynamics*. Available at: https://ocw.mit.edu
3.	MATLAB. (n.d.). *Documentation and Learning Resources*. Available at: https://www.mathworks.com
4.	Python. (n.d.). *Scientific Libraries (NumPy, SciPy)*. Available at: https://www.python.org

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
112216704	Transportation Planning and Management	3	--	--	45	--		45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
112216704	Transportation Planning and Management	20	20	40	60	2.5	--	--	100

Rationale:

Transportation Planning and Management is a core area of civil and urban engineering that deals with the design, organization, operation, and improvement of transportation systems such as roads, railways, public transit, and traffic networks.

Course Objectives:

1. Understand the fundamentals of transportation systems and the role of transportation in economic development.
2. Analyze travel behavior and transportation demand using planning models
3. Apply techniques of traffic forecasting and transport network design.
4. Assess transportation system performance and management strategies.
5. Evaluate environmental and sustainability issues in transportation planning.
6. Develop integrated transportation planning solutions using case studies.

Course Outcomes:

1. Explain key concepts and components of transportation systems.
2. Perform trip generation, trip distribution, mode choice, and traffic assignment studies.
3. Use forecasting methods for transportation demand and capacity analysis.
4. Formulate management strategies for urban and regional transport problems.
5. Critically analyze environmental impacts of different transport modes.
6. Prepare integrated transport planning reports for real-world scenarios.

Prerequisite: Transportation Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Transportation Planning and Management requires basic knowledge of Transportation Engineering, Surveying, Engineering Mathematics, and Traffic Engineering concepts. Students should understand traffic characteristics, road network planning, data analysis, and urban transportation systems to effectively study transportation planning, traffic management, and sustainable mobility solutions		
I	**Introduction to Transportation Systems**	Introduction to transport systems & components, Historical evolution of transport planning Role of transport in economy growth, Freight vs passenger transport, Transport policy and governance Transport infrastructure overview	7	CO1
		Self-learning Topics: Real-time traffic monitoring using sensors and AI	7	
II	**Travel Behavior and Demand**	Theory of travel demand, Travel surveys and data collection, Trip generation analysis, Trip distribution models Modal split and mode choice, Gravity & entropy models, Trip chaining and tour-based modeling, Elasticity in transport demand Data analysis & interpretation	8	CO2
		Self-learning Topics: Route choice and destination choice modeling	8	
III	**Traffic Forecasting & Transportation Models**	Overview of forecasting techniques, Four-step modeling process, Traffic assignment methods, Network equilibrium concepts, Simulation techniques for planning, Introduction to GIS & data applications, Big Data in transport planning Forecasting case studies Model calibration and validation	8	CO3
		Self-learning Topics: Four-step travel demand model (advanced calibration and validation techniques)	8	
IV	**Transport Infrastructure & Network Design**	Principles of network design Roadway capacity analysis Urban transit systems planning Rail, air, and water transport systems Traffic operations & signal planning Intelligent Transport System (ITS) basics Accessibility & mobility planning	7	CO4
		Self-learning Topics: Network topology optimization	7	
V	**Transport Management & Policy**	Transport management fundamentals, Traffic control devices, Parking and curb space management, public transport management, Pricing,	8	CO5

		tariffs, and taxation, Transport policy evaluation, Institutional and legal issues		
		Self-learning Topics: Network topology optimization	8	
VI	**Sustainability & Emerging Trends**	Environmental impacts of transport Sustainable transport planning Climate change & emissions management Non-motorized transport (NMT) planning Electric vehicles & shared mobility Case studies: city transport plans Course wrap-up & future trends	7	CO6
		Self-learning Topics: Low-carbon and zero-emission transport systems	7	

Text Books:

1. Principles of Transportation Engineering & Planning: Partha Chakroborty & Animesh Das
2. Transportation Engineering and Planning : L.R. Kadiyali
3. Transportation Systems Planning: Methods and Applications: Konstadinos G. Goulias

References:

1.. Transportation Engineering and Planning: C.S. Papacostas and P.D. Prevedouros; Prentice Hall India Learning Pvt. Ltd., New Delhi.

2. Transport Planning and Traffic Engineering: S.K. Khanna & C.E.G. Justo

Online References:

Sr. No.	Website Name
1.	www.ite.org
2.	www.engineeringresource.org
3	https://libguides.scu.edu/transportation-eng

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.

- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98451609	Professional Communication and Ethics - II	2	--	--	30	--		30	60	2

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
98451609	Professional Communication and Ethics - II	--	--	--	--	--	25	--	25

Rationale:

The syllabus is designed to help students face the corporate requirement with respect to interpersonal skills, resume drafting, presentation giving and to crack the interviews.

Course Objectives:

1. To develop students' interpersonal and professional communication skills.
2. To train in group discussion techniques and collaborative communication for selection processes and teamwork.
3. To prepare effective resumes and perform confidently in interviews.
4. To train students to answer confidently and crack HR interviews.
5. To build competence in drafting notices, agendas and minutes of the meetings.
6. To enhance the ability to deliver structured presentations and prepare professional reports.

Course Outcomes:

1. Demonstrate effective communication skills, including clarity, confidence, and appropriate body language in professional settings.
2. Participate actively in group discussions by presenting ideas logically, listening effectively, and demonstrating leadership and teamwork.
3. Prepare well-structured resumes aligned with industry standards and customize them for specific job profiles.
4. Perform effectively in interviews by answering HR and behavioral questions using structured techniques like the STAR method.
5. Draft formal business documents such as notices, agendas, and minutes of meetings with proper format and professionalism.

6. Deliver effective presentations and prepare structured reports with clarity, coherence, and appropriate visual aids.

Prerequisite: Professional Communication & Ethics - I

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Interpersonal Skills**	Definition, importance, and scope of interpersonal skills, Components of interpersonal skills: Emotional Intelligence (self-awareness, self-regulation, motivation, empathy, social skills), Leadership and teamwork concepts, Communication in teams: barriers and effectiveness, Empathy and assertiveness: meaning and significance, Conflict management: types, causes, and resolution strategies.	5	CO1
		Self-Learning Topics: Self-assessment of interpersonal skills via SWOT analysis.	5	
2.	**Group Discussion**	Purpose of Group Discussion in recruitment and teamwork, Types of GD: Topic-based, case-based, abstract, activity-based, Technical vs non-technical GD, Structure of GD: initiation, discussion flow, conclusion, Evaluation parameters: clarity, content, communication skills, leadership, GD etiquette: turn taking, listening, body language, summarizing, Do's and Don'ts in GD.	5	CO2
		Self-Learning Topics: Latest GD topics via (Current affairs, social issues, technology)	5	
3.	**Resume building**	Purpose and importance of resume and CV, Types of resumes: chronological, functional, combination, Key sections of a resume: Objective/Summary, Education, Skills, Projects and achievements, Principles of effective resume writing: clarity, conciseness, relevance, Resume customization for different job roles.	4	CO3
		Self-Learning Topics : Industry specific resume formats (IT, Core, Engineering, Managements).	4	

4.	**HR / Personal Interviews**	Meaning and types of interviews (HR, technical, behavioural), Common HR interview questions and expected responses, STAR method for answering behavioural questions, Interview etiquette: dress code, body language, communication style, Handling stress questions and tricky situations, Basic interview preparation strategies.	5	CO4
		Self Learning Topics : Frequently asked HR and behavioural interview questions.	5	
5.	**Notice, Agenda and Meeting**	Features of formal English: tone, clarity, precision, Types of notices : circulars, warnings, announcements, Format and structure of notices, Agenda of meetings: meaning, elements, and format, Minutes of meetings: purpose, structure, and recording decisions, Importance of professional documentation.	5	CO5
		Self Learning Topics: Study of real meeting, agendas and minutes (Corporate samples).	5	
6.	**General Topic Presentation & Report Making**	Principles of effective presentations, Structure of presentation: introduction, body, conclusion, Audience analysis and communication objectives, Presentation techniques: voice modulation, pacing, transitions, Slide design principles: simplicity, bullet points, visual clarity.	6	CO6
		Self Learning Topics : Learning Different types of reports (Technical, survey, analytical)	6	

Sr. No.	Documents required to be submitted for internal orals:
1.	Reflection report on GD.
2.	Resume drafted in latest format.
3.	Corporate meeting – Frame Notice, Agenda, and minutes of the meeting.
4.	Short report format and a case study for the same.

References:

- Communication Skill for Engineers & Scientists (2nd Edition) by Sangeeta Sharma & Mohan N. Mishra.
- Art of Effective communication in group discussion and interview by O. P.Singh.

Online References:

Sr	**Free Online Courses**
1.	LPU Blog: Comprehensive GD guide with techniques, frameworks, phrases, do's/don'ts, and topic types (campus to corporate): https://www.lpu.in/blog/from-campus-to-corporate-the-ultimate-guide-to-master group-discussion/
2.	Tech Interview Handbook: ATS-friendly resume guide for software engineers (templates, keywords, structure, tools): https://www.techinterviewhandbook.org/resume/

Assessment:
Term work marks – (Total 25 marks)
Group Discussion - 10 marks
Mock PI - 5 marks
Mock Meeting and Roleplay -5 marks
Attendance - 5 marks