COIMBATORE INSTITUTE OF TECHNOLOGY, COIMBATORE – 641 014
(An Autonomous Institution affiliated to ANNA UNIVERSITY, CHENNAI)
DEPARTMENT OF CIVIL ENGINEERING
REGULATIONS 2023 CHOICEBASEDCREDITSYSTEM

B.E. CIVIL ENGINEERING

VISION

To provide quality education in Civil Engineering and to become a state-of-the-art source of world-class Civil Engineers and Researchers

MISSION

- To impart quality education in diverse areas of civil engineering to achieve the industrial expectations.
- To offer state-of the art facilities towards academic and research excellence
- To nurture intellectual knowledge in modern technologies of Civil Engineering for enhancing entrepreneurship qualities and employability skills

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1: To equip the graduates with sufficient knowledge and capabilities to become leaders in industry and academia.

PEO 2: To promote research culture and self-development with an aptitude for lifelong learning among graduates.

PEO 3: To inculcate professional ethics with a commitment to the society and environment

PROGRAM OUTCOMES(POs)

Twelve Graduate Attributes as given by NBA as per Washington Accord agreement should be considered for all the UG programmes without any change for POs.

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of

the information to provide valid conclusions

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: The graduates of this programme with proficiency in mathematics and physical science will excel in the core areas of civil engineering such as Structural, Environmental, Geotechnical, Water resources engineering and Construction Management

PSO2: The graduates will plan, produce detailed drawings, write specifications, prepare cost estimates

PSO3: The graduates will interact with stakeholders effectively and execute quality construction work

MAPPING OF PROGRAMME EDUCATIONAL OUTCOMES WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC COUTCOMES

PEOs	**PROGRAMMEOUTCOMES**												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	3	3	3	2	2	2	2	2	2	2	2	2	3	2	2
2	2	2	2	2	1	2	2	2	1	2	1	3	1	1	1
3	2	2	2	1	1	3	3	3	2	2	1	2	1	2	2

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B.E. CIVIL ENGINEERING

CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23FYH111	Technical English	HSC	2	2	0	4	4
2	23FYM111	Matrices and Calculus	BSC	3	1	0	4	4
3	23FYP111	Physics for Civil Engineers	BSC	3	0	0	3	3
4	23FYC111	Engineering Chemistry for Civil Engineers	BSC	3	0	0	3	3
5	23CE111	Construction Materials	PCC	3	0	0	3	3
PRACTICALS								
1	23CE121	Engineering Graphics- I	ESC	0	0	4	4	2
2	23CE122	Engineering Practices Laboratory	ESC	0	0	2	2	1
3	23CE123	C Programming Laboratory	ESC	0	0	4	4	2
ONE CREDIT COURSES								
1	23FYH121	Heritage of Tamil	OC	1	0	0	1	1
MANDATORY COURSES								
1	23MC101	Induction Programme	MC	15 DAYS			-	-
2	23MC102	Soft Skills - I	MC	1	0	0	-	-
			TOTAL	**17**	**3**	**10**	**30**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23FYH211	Professional English	HSC	3	0	0	3	3
2	23FYM211	Fourier Series and Transforms	BSC	3	1	0	4	4
3	23CE211	Engineering Mechanics	ESC	3	0	0	3	3
4	23CE212	Engineering Geology	ESC	3	0	0	3	3
5	23CE213	Construction Technology	PCC	3	0	0	3	3
PRACTICALS								
1	23FYH221	English Communication Competency Laboratory	HSC	0	0	4	4	2
2	23CE221	Engineering Graphics- II	ESC	0	0	4	4	2
3	23FPC221	Basic Sciences Laboratory	ESC	0	0	4	4	2
ONE CREDIT COURSES								
1	23FYC221	Environmental Science and Engineering	OC	1	0	0	1	1
2	23FYH222	Tamil's & Technology	OC	1	0	0	1	1
CO-CURRICULAR ACTIVITES								
1	23CC	23CC221- NSS	OC	15 HOURS			1	1
2		23CC222- YRC						
3		23CC223- RSP						
4		23CC224- Sports						
			TOTAL	**18**	**1**	**12**	**31**	**25**

SEMESTER – III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23M311	Differential Equations and Random Variables	BSC	3	1	0	4	4
2	23CE311	Mechanics of Solids I	ESC	3	0	0	3	3
3	23CE312	Concrete Technology	PCC	3	0	0	3	3
4	23CE313	Mechanics of Fluids	PCC	3	0	0	3	3
5	23CE314	Surveying	PCC	3	0	0	3	3
PRACTICALS								
1	23CE321	Strength of Materials Laboratory	ESC	0	0	4	4	2
2	23CE322	Survey Laboratory	PCC	0	0	4	4	2
3	23CE323	Building Planning and Drawing	ESC	0	0	4	4	2
MANDATORY COURSES								
1	23MC301	Soft Skills – II – Design Thinking	MC	15 HOURS			1	1
2	23MC302	Human Value and Professional Ethics	MC	15 HOURS			1	1
TOTAL				**17**	**1**	**12**	**30**	**24**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23CE411	Mechanics of Solids II	ESC	3	0	0	3	3
2	23CE412	Highway and Railway Engineering	PCC	3	0	0	3	3
3	23CE413	Applied Hydraulics and Hydraulic Machinery	PCC	3	0	0	3	3
4	23CE414	Water Supply Engineering	PCC	3	0	0	3	3
5	23CE415	Construction Management	HSC	3	0	0	3	3
PRACTICALS								
1	23CE421	Environmental Engineering Laboratory I	ESC	0	0	2	2	1
2	23CE422	Hydraulics Laboratory	PCC	0	0	4	4	2
3	23CE423	Concrete Laboratory	PCC	0	0	4	4	2
MANDATORY COURSES								
1	23MC401	Value Added Course - I	MC	15 HOURS			-	-
2	23MC402	Community Service and Engineering	MC	15 HOURS			-	-
			TOTAL	**17**	**0**	**10**	**27**	**20**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTAC T PERIODS	CREDITS
				L	T	P		
THEORY								
1	23CE511	Structural Analysis - I	PCC	3	0	0	3	3
2	23CE512	Design of Reinforced Concrete Structural Elements	PCC	3	0	0	3	3
3	23CE513	Mechanics of Soils	PCC	3	0	0	3	3
4		ELECTIVE –I / OPEN ELECTIVE-I	PEC/OEC	3	0	0	3	3
5		ELECTIVE –II	PEC	3	0	0	3	3
PRACTICALS								
1	23CE521	Highway Engineering Laboratory	PCC	0	0	4	4	2
2	23CE522	Quantity Surveying Laboratory	PCC	0	0	4	4	2
3	23CE523	Geo-Informatics Laboratory	PCC	0	0	4	4	2
	PROJ	INPLANT TRAINING*	PROJECT				1	1
MANDATORY COURSES								
1	23MC501	Value Added Course – II	MC	**15 HOURS**			**-**	**-**
2	23MC502	Seminar and Technical Writing	MC	15 HOURS			**-**	**-**
			TOTAL	**18**	**0**	**12**	**30**	**22**

**** 2 weeks of Inplant Training need to be completed during 4th semester vacation***

SEMESTER – VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23CE611	Structural Analysis - II	PCC	3	0	0	3	3
2	23CE612	Design of Steel Structures	PCC	3	0	0	3	3
3	23CE613	Foundation Engineering	PCC	3	0	0	3	3
4		ELECTIVE –III / OPEN ELECTIVE - II	PEC/OEC	3	0	0	3	3
5		ELECTIVE – IV	PEC	3	0	0	3	3
PRACTICALS								
1	23CE621	Soil Mechanics Laboratory	PCC	0	0	4	4	2
2	23CE622	Project Planning Laboratory	PROJECT	0	0	4	4	2
3	23CE623	Building Information Modelling Laboratory	PCC	0	0	2	2	1
	PROJ	MINI PROJECT	PROJECT	0	0	4	4	2
MANDATORY COURSES								
1	23MC601	Hackathon	**MC**	**15 HOURS**			**1**	**1**
			TOTAL	**16**	**0**	**14**	**30**	**23**

SEMESTER – VII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK L	T	P	TOTAL CONTACT PERIODS	CREDITS
THEORY								
1	23CE711	Waste Water Engineering	PCC	3	0	0	3	3
2	23CE712	Prestressed Concrete Structures	PCC	3	0	0	3	3
3	23CE713	Earthquake Resistant Design of Structures	PCC	3	0	0	3	3
4		ELECTIVE -V	PEC	3	0	0	3	3
5		ELECTIVE -VI	PEC	3	0	0	3	3
PRACTICALS								
1	23CE721	Computer Applications Laboratory	PCC	0	0	4	4	2
2	23CE722	Design and Drawing (Concrete & Steel)	PCC	0	0	4	4	2
3	23CE723	Environmental Engineering Laboratory – II	ESC	0	0	2	2	1
			TOTAL	**15**	**0**	**10**	**25**	**20**

SEMESTER – VIII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK L	T	P	TOTAL CONTACT PERIODS	CREDITS
THEORY								
1		ELECTIVE –VII	PEC	3	0	0	3	3
2		ELECTIVE -VIII	PEC	3	0	0	3	3
PRACTICALS								
1	**PROJ**	PROJECT WORK AND VIVA-VOCE	PROJECT	0	0	12	12	6
			TOTAL	**6**	**0**	**12**	**18**	**12**

LIST OF PROFESSIONAL ELECTIVE COURSES:

Sl. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1. STRUCTURAL ENGINEERING								
1.		Design of Concrete Structures	PE	3	0	0	3	3
2.		Advanced Concrete Structures	PE	3	0	0	3	3
3.		Design of Bridges	PE	3	0	0	3	3
4.		Advanced Steel Structures	PE	3	0	0	3	3
5.		Advanced Structural Analysis	PE	3	0	0	3	3
6.		Prefabricated Structures	PE	3	0	0	3	3
7.		Finite Element Method	PE	3	0	0	3	3
8.		Industrial Structures	PE	3	0	0	3	3
9.		Smart Materials and Structures	PE	3	0	0	3	3
10.		Basics of Structural Dynamics	PE	3	0	0	3	3
2. GEOTECHNICAL ENGINEERING								
11.		Ground Improvement Techniques	PE	3	0	0	3	3
12.		Design of Deep Foundation	PE	3	0	0	3	3
13.		Geo Environmental Engineering	PE	3	0	0	3	3
14.		Slope Stability and Landslides	PE	3	0	0	3	3
15.		Earth retaining Structures	PE	3	0	0	3	3
16.		Foundations in Expansive Soils	PE	3	0	0	3	3
17.		Advanced Foundation Engineering	PE	3	0	0	3	3
18.		Reinforced Soil Structures	PE	3	0	0	3	3
3. ENVIRONMENTAL ENGINEERING								
19.		Solid and Hazardous Waste Management	PE	3	0	0	3	3
20.		Environmental Impact Assessment	PE	3	0	0	3	3

SI. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
21.		Climate change and adaptation	PE	3	0	0	3	3
22.		Marine Pollution and Control	PE	3	0	0	3	3
23.		Instrumental Method of Analysis	PE	3	0	0	3	3
24.		Air and Water Quality Modelling	PE	3	0	0	3	3
25.		Air Pollution and Control	PE	3	0	0	3	3
26.		Industrial Wastewater Treatment and Management	PE	3	0	0	3	3
27.		Irrigation Engineering	PE	3	0	0	3	3
4. TRANSPORTATION ENGINEERING								
28.		Pavement Engineering	PE	3	0	0	3	3
29.		Remote sensing and GIS	PE	3	0	0	3	3
30.		Traffic Engineering	PE	3	0	0	3	3
31.		Advanced Surveying	PE	3	0	0	3	3
32.		Urban Transportation Planning	PE	3	0	0	3	3
33.		Transportation Systems Planning & Management	PE	3	0	0	3	3
34.		Transportation Economics and Finance	PE	3	0	0	3	3
35.		Intelligent Transportation Systems	PE	3	0	0	3	3
36.		Road Safety Engineering	PE	3	0	0	3	3
5. CONSTRUCTION ENGINEERING AND MANAGEMENT								
37.		Valuation of Immovable Properties	PE	3	0	0	3	3
38.		Engineering Economics	PE	3	0	0	3	3
39.		Maintenance Repair and Rehabilitation of Structures	PE	3	0	0	3	3
40.		Advanced Construction Technology	PE	3	0	0	3	3
41.		Contract Management	PE	3	0	0	3	3
42.		Formwork for Concrete Structures	PE	3	0	0	3	3

SI. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
43.		Entrepreneurship in Civil Engineering	PE	3	0	0	3	3
44.		Professional Practices for Civil Engineers	PE	3	0	0	3	3
45.		Building Information Modelling	PE	3	0	0	3	3

LIST OF COURSES FOR MAJOR/MINOR

SI. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1. STRUCTURAL ENGINEERING								
1.		Design of Concrete Structures	PE	3	0	0	3	3
2.		Advanced Concrete Structures	PE	3	0	0	3	3
3.		Design of Bridges	PE	3	0	0	3	3
4.		Advanced Steel Structures	PE	3	0	0	3	3
5.		Advanced Structural Analysis	PE	3	0	0	3	3
6.		Prefabricated Structures	PE	3	0	0	3	3
7.		Finite Element Method	PE	3	0	0	3	3
8.		Industrial Structures	PE	3	0	0	3	3
9.		Smart Materials and Structures	PE	3	0	0	3	3
10.		Offshore Structures	PE	3	0	0	3	3
11.		Advanced Concrete Technology	PE	3	0	0	3	3
12.		Design of Steel Concrete Composite Structures	PE	3	0	0	3	3
13.		Theory of Plates	PE	3	0	0	3	3
2. GEOTECHNICAL ENGINEERING								
14.		Ground Improvement Techniques	PE	3	0	0	3	3
15.		Design of Deep Foundation	PE	3	0	0	3	3
16.		Geo Environmental Engineering	PE	3	0	0	3	3

Sl. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
17.		Slope Stability and Landslides	PE	3	0	0	3	3
18.		Earth retaining Structures	PE	3	0	0	3	3
19.		Foundations in Expansive Soils	PE	3	0	0	3	3
20.		Advanced Foundation Engineering	PE	3	0	0	3	3
21.		Reinforced Soil Structures	PE	3	0	0	3	3
22.		Strength and Deformation Behaviour of Soils	PE	3	0	0	3	3
23.		Subsurface Investigation and Instrumentation	PE	3	0	0	3	3
24.		Shallow Foundation	PE	3	0	0	3	3
25.		Earth and Rock Fill Dams	PE	3	0	0	3	3
3. ENVIRONMENTAL ENGINEERING								
26.		Solid and Hazardous Waste Management	PE	3	0	0	3	3
27.		Environmental Impact Assessment	PE	3	0	0	3	3
28.		Air and Water Quality Modelling	PE	3	0	0	3	3
29.		Air Pollution and Control	PE	3	0	0	3	3
30.		Industrial Wastewater Treatment and Management	PE	3	0	0	3	3
31.		Design of Physico-chemical Treatment Systems	PE	3	0	0	3	3
32.		Design of Biological Treatment Systems	PE	3	0	0	3	3
33.		Sustainable Development and Cleaner Production	PE	3	0	0	3	3
34.		Occupational Health, Safety and Risk Assessment	PE	3	0	0	3	3
35.		Biodegradation and Bioremediation Techniques	PE	3	0	0	3	3

Sl. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
36.		Energy Management	PE	3	0	0	3	3
37.		Environment, Health and Safety in Industries	PE	3	0	0	3	3
38.		Landfill Engineering and Remediation Technology	PE	3	0	0	3	3
4. TRANSPORTATION ENGINEERING								
39.		Pavement Engineering	PE	3	0	0	3	3
40.		Remote Sensing and GIS	PE	3	0	0	3	3
41.		Traffic Engineering	PE	3	0	0	3	3
42.		Urban Transportation Planning	PE	3	0	0	3	3
43.		Transportation Systems Planning and Management	PE	3	0	0	3	3
44.		Transportation Economics and Finance	PE	3	0	0	3	3
45.		Intelligent Transport System	PE	3	0	0	3	3
46.		Road safety Engineering	PE	3	0	0	3	3
47.		Town Planning and Architecture	PE	3	0	0	3	3
48.		Metro Systems and Engineering	PE	3	0	0	3	3
49.		Airport and Harbour Engineering	PE	3	0	0	3	3
50.		Theory of Traffic flow	PE	3	0	0	3	3
5. CONSTRUCTION ENGINEERING AND MANAGEMENT								
51.		Project Management for Construction	PE	3	0	0	3	3
52.		Project Formulation and Appraisal	PE	3	0	0	3	3
53.		Planning, Scheduling and Control of Construction Projects	PE	3	0	0	3	3
54.		Contract Management	PE	3	0	0	3	3
55.		Functional Planning, Building Services and Maintenance Management	PE	3	0	0	3	3
56.		Advanced Construction Methods and Techniques	PE	3	0	0	3	3

Sl. No	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
57.		Construction Risk Management	PE	3	0	0	3	3
58.		Shoring, Scaffolding and Formwork	PE	3	0	0	3	3
59.		Valuation of Immovable Properties	PE	3	0	0	3	3
60.		Construction Safety and Health Management systems	PE	3	0	0	3	3
61.		Environmental Impact Assessment for Construction Engineers	PE	3	0	0	3	3
62.		Design of Energy Efficient Buildings	PE	3	0	0	3	3

LIST OF OPEN ELECTIVE COURSES OFFERED FOR THE STUDENTS OF OTHER UG PROGRAMMES:

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C	UG PROGRAMME
1.		Town Planning and Architecture	**OE**	**3**	**0**	**0**	**3**	**3**	**COMMON TO ALL PROGRAMMES**
2.		Climate Change and Adaptation	**OE**	**3**	**0**	**0**	**3**	**3**	
3.		Metro Systems and Engineering	**OE**	**3**	**0**	**0**	**3**	**3**	
4.		Renewable Energy Resources	**OE**	**3**	**0**	**0**	**3**	**3**	
5.		Principles of Sustainable Development	**OE**	**3**	**0**	**0**	**3**	**3**	
6.		Disaster Management	**OE**	**3**	**0**	**0**	**3**	**3**	
7.		Public Administration	**OE**	**3**	**0**	**0**	**3**	**3**	
8.		Elementary Earthquake Engineering	**OE**	**3**	**0**	**0**	**3**	**3**	
9.		Green Building	**OE**	**3**	**0**	**0**	**3**	**3**	

LIST OF VALUE-ADDED COURSES:

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.		Building Construction Process- an Overview	OC	1	0	0	1	-
2.		Applications of IoT in Civil Engineering	OC	1	0	0	1	-
3.		Certification and Career Roadmap in Civil Engineering	OC	1	0	0	1	-
4.		Environmental Monitoring	OC	1	0	0	1	-
5.		Python for Civil Engineers	OC	1	0	0	1	-
6.		3D Printing of Civil Engineering Structures	OC	1	0	0	1	-
7.		Alternative Building Materials from Waste	OC	1	0	0	1	-
8.		Sustainability in Construction	OC	1	0	0	1	-
9.		Detailing of Steel Structures Using TEKLA	OC	1	0	0	1	-
10.		Pre – Engineered Building Detailing	OC	1	0	0	1	-
11.		Basic Plumbing	OC	1	0	0	1	-
12.		Green Building Rating	OC	1	0	0	1	-
13.		Drone Surveying	OC	1	0	0	1	-
14.		Archaeology of India	OC	1	0	0	1	-
15.		Retrofitting and Rehabilitation of Heritage Structures	OC	1	0	0	1	-

SUMMARY

Category; BSC – Basic sciences, HSC– Humanities and Social Sciences, ESC–Engineering sciences, PCC –Professional Core, PEC- Professional Elective, OEC-Open Elective Course, EEC –Employability Enhancement Course, MC – Mandatory Course

B.E. CIVIL ENGINEERING										
Sl. No.	**Subject Area**	**Credits per Semester**								**Credits Total**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HSC	4	5		3					**12**
2	BSC	10	4	4						**18**
3	ESC	5	10	7	4			1		**27**
4	PCC	3	3	11	13	15	12	13		**70**
5	PEC					3	3	6	6	**18**
6	OEC					3	3			**6**
7	EEC/PROJECT					1	4		6	**11**
8	MC			2			1			3
9	OC	1	3							4
									TOTAL CREDITS	**169**

SEMESTER I

23FYH111	TECHNICALENGLISH	L	T	P	C
		2	2	0	4

MODULE I FOCUS ON LANGUAGE: GRAMMAR & VOCABULARY 6

Embedded Sentence – Numerical Adjectives - Subject Verb Agreement – If Conditionals – Active Passive Voice – Reported Speech - Idiomatic Expressions - Business and Job Related Vocabulary - Relative Clause – Pronouns – Adjectives - Degrees of Comparison - Technical Vocabulary – Avoidance of Jargon - Collocations - Formal and Informal Vocabulary – Verbal Analogy - Tenses - Prepositions – Articles – Homophones and Homonyms - One Word Substitutes –Linking Words

MODULE II TECHNICAL COMMUNICATION 6

Importance of Technical Communication - Objective & Characteristics of Technical Communication – General and Technical Communication – Process of Communication - Levels of Communication – Flow of Communication –Visual Aids in Technical Communication - Barriers to Communication: Noise – Classification of Barriers –Non-verbal Communication: Kinesics – Proxemics- Chronemics.

MODULE III READING& LISTENING 6

Reading Comprehension Techniques: Understanding Technical Articles – Skimming and Scanning – Summarizing–- Intensive & Extensive Reading- Note Making – SQ3R Reading Technique - Meaning and Art of Listening-Importance of Listening & Empathy in Communication – Reasons for Poor Listening – Traits of a good listener – Listening to Technical Talks – Listening to TED/INK Talks

MODULE IV WRITING 6

. Paragraph Writing – Interpreting Charts and Graphs – Instructions – Checklists – Recommendations – Describing a Process – Extended Definitions – Essay Writing – Report Writing – Minutes of the Meetings -Email Writing - Essay Writing - Job Application Letters

MODULE V SPEAKING 6

Introducing Oneself- Asking for and Giving Directions – Seeking Clarification – Speaking about a Process – Introduction to Technical Presentation – Mechanics of Presentation – Achieving Confidence, Clarity & Fluency – Vocal Cues - Barriers to Speaking – Types of Speaking – Persuasive Speaking – Public Speaking

Tutorials and Practical Sessions based on the above syllabus 30 Hours

COURSEOUTCOMES

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

CO1: Apply the rules of the Grammar and construct grammatically correct sentences

CO2: Categorize the barriers to communication and formulate solutions.

CO3: Identify the nuances of Technical Communication

CO4: Interpret texts using reading and listening strategies

CO5: Demonstrate effective business writing and Presentation Skills

CO6: Use effective LSRW strategies to communicate at workplace

TOTAL: 60 PERIODS

TEXTBOOKS:

1. “A Course in Technical English” by Praveen Sam D &Shoba K N, CUP, 2020.
2. “Technical Communication – Principles and Practice” by Meenakshi Raman, Sangeeta Sharma, Oxford University Press, New Delhi, 2015.

REFERENCES:

1. “English for Engineers” by Sudharshana N. P &Savitha C, CUP, 2018.
2. “Embark – English for Undergraduates” by Steve Hart, Aravind R. Nair &VeenaBhambhani, CUP, 2016.
3. “Interchange - 2” by Jack C Richerds, CUP, Fourth Edition, Chennai, 2015.
4. “Communicative English” by Lourdes JoavaniRayen&Shoba K N, , CUP, 2018.

ONLINE RESOURCES:

1. Technical English for Engineers - NPTEL course

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1									2	3		1			
2									2	3		1			
3									2	3		1			
4									2	3		1			
5									2	3		1			
AVg.									2	3		1			

1-low, 2-medium,3-high

23FYM111	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

MODULE I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix –Characteristic equation – Properties of Eigenvalues and Eigenvectors (without proof) – Cayley-Hamilton Theorem (only statement) – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation

MODULE II DIFFERENTIAL CALCULUS 9+3

Representation of functions - Limit of a function - Continuity - Derivatives – Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

MODULE III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial derivatives –Total derivative – Taylor’s series for functions of two variables– Maxima and minima of functions of two variables -Lagrange’s method of undetermined multipliers

MODULE IV INTEGRAL CALCULUS 9+3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals- Beta and Gamma functions - Properties –Simple problems

MODULE V MULTIPLE INTEGRALS 9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals in Cartesian coordinates – Volume of solids.

COURSEOUTCOMES

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

CO1: Use the matrix algebra methods for solving practical problems

CO2: Apply differential calculus tools in solving various application problems.

CO3: Compute partial derivatives of multivariate functions and determine maxima and minima of functions of two or three variables

CO4: Apply different methods of integration in solving engineering problems

CO5: Apply multiple integral ideas in solving area of regions and volume of solids

TOTAL: 60 PERIODS

TEXTBOOKS:

1. “Thomos Calculus” by Joel R.Hass, Christopher E.Heil, Maurice D.Weir, 15th Edition, Pearson, 2022.
2. "Calculus: Early Transcendentals" by James Stewart, Cengage Learning, 7th Edition, New Delhi, 2015
3. “Higher Engineering Mathematics” by Grewal, B.S., 44th Edition, Khanna Publishers, New Delhi 2022.

REFERENCES:

1. "Calculus" by Anton, H, Bivens, I and Davis, S, Wiley, 10th Edition, 2016.
2. “Advanced Engineering Mathematics” by Erwin Kreyszig, 10th Edition, John Wiley & Sons, 2019.
3. “Advanced Engineering Mathematics” by Jain R.K. and Iyengar S.R.K., 5th Edition, Narosa Publications, New Delhi, 2016.
4. “Engineering Mathematics” by SivaramakrishnaDas P., Vijayakumari C., 1st Edition, Pearson Education, Delhi, 2017.
5. "Thomas Calculus" by Weir, M.D and Joel Hass, 12th Edition, Pearson India, 2016.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1		1								1	2		
2	3	1		1								1	2		
3	3	1		1								1	2		
4	3	1		1								1	2		
5	3	1		1								1	2		
AVg.	3	1		1								1	2		

1-low, 2-medium,3-high

23FYP111	PHYSICS FOR CIVIL ENGINEERS	L	T	P	C
		3	0	0	3

MODULE I ACOUSTICS AND ULTRASONICS **9**

Reverberation - Reverberation time - Sabine's formula (no derivation) - Absorption coefficient and its determination - Factors affecting the acoustics of the buildings and their remedies- Production of ultrasonic waves- Piezoelectric method - Properties -Detection - Thermal and Piezoelectric methods, Determination of velocity of ultrasonic waves in liquids using acoustic grating - applications-SONAR, Nondestructive testing

MODULE II LASERS **9**

Absorption and emission - Spontaneous emission - Stimulated emission - Population inversion - Sources of excitation - Active medium - Resonant cavity – Einstein's theory of stimulated emission - Nd-YAG laser - CO2 laser - Semiconductor laser – Applications – 3D profiling, laser drilling and laser welding.

MODULE III FIBER OPTICS **9**

Optical fiber - Advantages of optical fiber as wave guide and propagation of light in optical fibers - Numerical aperture and acceptance angle - Structure of optical fiber - Fiber optical materials - Types of optical fibers - Single and multimode fibers -Step index and graded index fibers – Applications - Fiber optic communication system, Fiber endoscope

MODULE IV QUANTUM PHYSICS **9**

Compton effect - Expression for Compton shift - Concept of matter waves - Physical significance of wave function - Schrödinger's wave equation - Time independent and time dependent equation - Eigen values and eigen function - Particle in a box (one dimension)- Scanning electron microscope (SEM)- Transmission electron microscope

MODULE V NANO TECHNOLOGY AND NEW ENGINEERING MATERIALS **9**

Nanomaterials - Preparation of nano materials - Physical vapour deposition – sol gel method - properties of nano particles – applications - Shape memory alloys – characteristics and applications shape memory alloy - Liquid crystal display - Twisted nematic display - metallic glasses - preparation, properties and applications.

COURSEOUTCOMES

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

CO1: Demonstrate basic knowledge about acoustics of buildings and ultrasonic waves

CO2: Gain knowledge and understanding of lasers and their applications in various fields

CO3: Gain knowledge and understanding of optical fibers and their uses in civil engineering

CO4: Gain knowledge and understanding of quantum mechanics and their principles in civil engineering field.

CO5: Conceptual understanding of nanomaterials and their importance in shape memory alloys, liquid crystal, metallic crystals

TOTAL: 45 PERIODS

TEXTBOOKS:

1. “Engineering Physics” by V.Rajendran., Tata McGraw Hill, Publishing Company, New Delhi, 2017.
2. “Engineering Physics” by Gaur R K and Gupta S L, DhanpatRai Publications Pvt. Ltd, New Delhi, 2017.

REFERENCES:

1. “A Textbook of Engineering Physics” by Avadhanulu M. N, Kshirsagar P.G, Arun Murthy. T.V.S, S.Chand& Company Ltd., New Delhi, 2018.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1						2						2		
2	1			1	1								1		
3	1			1	1								1		
4	1			1	1								1		
5	1			1	1								1		
AVg.	1			1	1		2						1		

1-low, 2-medium,3-high

23FYC111	ENGINEERING CHEMISTRY FOR CIVIL ENGINEERS	L	T	P	C
		3	0	0	3

MODULE I FUELS AND COMBUSTION 9

Classification of fuels –calorific value, units of heat, Gross and Net calorific values. Determination of calorific value by Bomb calorimeter - Dulong's formula –theoretical calculation of calorific value. Coal- types of coal-Analysis of coal-Proximate analysis and ultimate analysis – Metallurgical coke - carbonization, Manufacture – Otto Hoffmann's by-product oven method. Petroleum – Refining of crude oil. Knocking –Octane number and Cetane number. Manufacture of synthetic petrol – Bergius process. Flue gas analysis –Orsat method

MODULE II CORROSION AND ITS PREVENTION 9

Corrosion - Definition - Classifications: Chemical corrosion and Electro chemical corrosion-mechanism-Pilling Bed worth rule. Galvanic corrosion, differential aeration corrosion, pitting corrosion, waterline corrosion and soil corrosion. Factors influencing corrosion. Corrosion control-cathodic protection, selection of materials and proper designing. Protective Coatings – Inorganic coating – surface preparation –Electroplating method applied to C_r and N_i

MODULE III ENGINEERING MATERIALS 9

Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Refractories – classification – acidic, basic and neutral refractories – properties [refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling] – Manufacture of Alumina, magnesite and Zirconia bricks. Lubricants – Mechanism of lubrication, classification of lubricants: liquid lubricants – properties [viscosity index, flash and fire points, cloud and pour points, oiliness] – solid lubricants – graphite and molybdenum sulphide, semi–solid lubricants.

MODULE IV ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus – mass defect, binding energy, nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells – Principle and applications of silicon solar cell. Batteries-Types of batteries–primary battery (dry cell) secondary battery (lead acid battery, lithium – ion-battery) fuel cells–H2-O2fuelcell.Supercapacitors-principle, types and examples.

MODULE V NANO CHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size dependent properties. Nanoparticles: nano cluster, nano rod, nanotube (CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapourdeposition, laserablation; Nanomaterials-Properties and applications

COURSEOUTCOMES

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

CO1: Develop suitable fuels for engineering processes and applications

CO2: Apply suitable methods for controlling corrosion

CO3: Apply the different engineering materials such as refractories, abrasives, lubricants for various engineering applications

CO4: Recognize different forms of energy resources and apply them for suitable applications

CO5: Implement the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technological applications

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Engineering Chemistry" by Jain P. C. & Monica Jain., 16th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015.
2. "A text book of Engineering Chemistry" by S.S.Dara, , Chand Publications, 2014
3. "Nanotechnology A Chemical Approach to Nanomaterials" by G.A. Ozin & A.C. Arsenault, RSC Publishing,2005
4. "Corrosion Engineering" by M.G. Fontana, N.D. Greene, McGraw Hill Publications, New York, 3rd Edition, 1996.

REFERENCES:

1. "Engineering Chemistry" by Sharma, B.K, Krishna Prakashan Media (P) Ltd (2011).
2. "Nanoscale Science and Technology "by Robert.W.Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005
3. "Nano: The Essentials: understanding Nanoscience and Nanotechnology", by T.Pradeep, Tata McGraw- Hill Publishing Company Limited, New Delhi,2008
4. "A Text book of Engineering Chemistry" by Chawla. S., Dhanpat Rai & Co, 2008

ONLINE RESOURCES:

1. "A Textbook of Engineering Chemistry" by Syamala Sundar Dara- Google Böcker

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2											2		
2	3		3										3		
3	3		3										3		
4	2						3						2		
5	3				2								1		
AVg.	3	2	3		2		3						2		

1-low, 2-medium,3-high

23CE111	CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3

MODULE I STONES **9**

Classification of Rock - Common Building Stone - Selection - Application of stone in buildings - Requirement and testing of stones - Deterioration and preservation of stone work.

MODULE II BRICKS AND BUILDING BLOCKS- **9**

Manufacture of bricks - Classification - Qualities - Test on bricks - Tiles - Types - Tests - Lightweight concrete blocks.

MODULE III MORTAR - CEMENT – CONCRETE- **9**

Classification of mortar - Preparation - Selection for mortar – Tests for mortar - Manufacture of cement - Types of cement -Characteristics - Aggregates - Basic characteristics - Types of aggregates - admixtures - Types of concrete- acceptance criteria for concrete.

MODULE IV TIMBER, STEEL AND OTHER MATERIALS- **9**

Timber - Market forms - Industrial timber - Plywood - Veneer -Seasoning, preservation and defects. Steel - Composition uses - Market forms. Terminology, Specifications and Uses - Paints - Varnishes - Distempers - Emulsions - Plaster of Paris Asphalt, Bitumen and Tar.

MODULE V SPECIAL MATERIALS **9**

Glass and its applications - Sheets for pitched roof coverings – False ceiling – Expanded Polystyrene (EPS) panels - Geo textiles - Mats and pads for earth reinforcement - Aluminum wall panels – Energy Efficient Materials-CSEB blocks – Construction and Demolition waste materials.

COURSEOUTCOMES

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

CO1: Identify the types of rocks and their application in civil engineering construction

CO2: Identify and characterize the building materials such as bricks tiles and blocks

CO3: Assess the properties of Mortar and describe the characteristics of cement and aggregates as well as types of aggregates, admixtures and concrete

CO4: Describe the market forms of timber, steel and the finishing materials such as paints, varnish, bitumen and tar

CO5: Describe the application of the special construction materials like glass, EPS, geotextiles and aluminium wall panels.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Building Materials" by Duggal SK., New Age International (P) Ltd., New Delhi, 2019
2. “Construction materials” by Subhash Chander and Sanjay Mahajan, Tech India Publication series, New Delhi, 2019
3. "Building Materials" by Varghese PC, Prentice Hall India Pvt. Ltd, New Delhi, 2015.

4. "Engineering Materials" by Rangwala, SC., Charotar Publishing House, Anand, 2019

REFERENCES:

1. “Civil engineering Materials and Construction Practices” by R.K. Gupta and Jain Brothers, New Delhi, 2019
2. "Civil Engineering Materials" by Neil Jackson and Dhir, R.K., McMillan Publishers Ltd, New Delhi,1997
3. "Building Materials" by Surendra Singh, Vikas Publishing Company, New Delhi, 1996.
4. “Civil Engineering Materials” by Ttti Chandigarh, McGraw-Hill Education (India) Pvt Limited, 2001.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105102088/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2												3	2	
2	2												3	2	
3	2												3	2	
4	2												3	2	
5	2														
AVg.	2												3	2	

1-low, 2-medium,3-high

23CE121	ENGINEERING GRAPHICS I	L	T	P	C
		0	0	4	2

MODULE I INTRODUCTION TO ENGINEERING DRAWING 6

Principles of Engineering Graphics and their significance, usage of drawing instruments and Lettering, dimensioning and Scales

MODULE II ORTHOGRAPHIC PROJECTIONS 12

Principles of Orthographic Projections-Conventions-Projections of Points and Lines inclined to both the Planes, Projection of Planes

MODULE III PROJECTION OF REGULAR SOLIDS 14

Projection of solids inclined to both the planes- Draw Simple Annotations

MODULE IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 14

Sections- Prism, Cylinder, Pyramid, Cone; Development of Surfaces of Right regular Solids-Prism, Pyramid, Cylinder and Cone

MODULE V ISOMETRIC PROJECTIONS 14

Principles of Isometric Projections-Isometric Scale, Isometric Views, Conventions

TOTAL: 60 PERIODS

COURSEOUTCOMES

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

CO1: Familiarize with the fundamentals and standards of Engineering graphics.

CO2: Freehand sketching of basic geometrical constructions and multiple views of objects.

CO3: Orthographic projections of lines and plane surfaces.

CO4: Draw the projections of solids and development of surfaces

CO5: Project isometric and perspective sections of simple solids

TEXTBOOKS:

1. “A text book of Engineering Graphics” by Natrajan K.V., Dhanalakshmi Publishers, Chennai, 2009
2. “Engineering Graphics” by Venugopal K. and Prabhu Raja V., New Age International (P) Limited, 2008
3. “Engineering Graphics” by N S Parthasarathy and Vela Murali, Oxford University, Press, New Delhi,2015
4. “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production” by Luzzader, Warren.J. and Duff, John M., Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005

REFERENCES:

1. “Engineering Drawing” by Bhatt N.D. and Panchal V.M., Charotar Publishing House, 2010
2. “Engineering Drawing” by Basant Agarwal and Agarwal C.M., Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. “Engineering Drawing” (Vol. I&II combined),” by Gopalakrishna K.R., Subhas Stores, Bangalore, 2007.
4. “Engineering Drawing” by Shah M.B., and Rana B.C., Pearson, 2nd Edition, 2009
5. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
6. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
7. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
8. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
9. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. Special points applicable to University Examinations on Engineering Graphics:

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1				2					3			2	3	
2	1				2					3			2	3	
3	1				2					3			2	3	
4	1				2					3			2	3	
5	1				2					3			2	3	
AVg.	1				2					3			2	3	

1-low, 2-medium,3-high

23CE122	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

CARPENTRY **6**

1. Planning and marking practice
2. Chiseling practice
3. Making a half-lap joint
4. Making a dove-tail joint

FITTING **6**

1. Making a square joint
2. Making a dove-tail joint
3. Making a V-joint
4. Making a L and single dove-tail joint

SHEET METAL **6**

1. Making of single seam panned-down joint
2. Making of double seam knocked-up joint
3. Making of dove-tail seam double-grooved joint
4. Fabrication of dust pan
5. Fabrication of rectangular box with base

PLUMBING **6**

1. Practice of external threading on PVC pipe
2. Practice of saddle connection to a house service line
3. Study of valve and tap repairs
4. Laying of pipe connections for wash basin/sink

ELECTRICAL WIRING **6**

1. BIS symbols used in electrical circuits and precautions to be observed
2. Preparation of a wiring circuit for a single lamp controlled by a single switch
3. Dim and bright connection method
4. Preparation of wiring circuit to control one lamp by two switches at different places (Staircase wiring)
5. Measurement of power and energy

LIST OF EQUIPMENTS

Carpentry tools, 15 sets

Fitting tools, 15 sets

Sheet Metal tools, 15 sets

Plumbing tools, 15 sets

Electrical Wiring tools, 15 sets

COURSEOUTCOMES

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

CO1: Acquire “Hands on” training and practice for use of various tools in carpentry

CO2: Apply the knowledge of fitting to household fittings and industrial buildings

CO3: Develop simple sheet metal components using tools

CO4: Apply the knowledge of pipeline connections to household fittings and industrial buildings

CO5: Apply the skills of basic electrical engineering for house wiring practice

CO6: Acquire skills in basic engineering practice for creating objects from raw materials

TOTAL: 30 PERIODS

REFERENCES:

1. “Engineering Practices Laboratory Manual”, Department of Mechanical Engineering, CIT, 2019

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1				3				2				2	1	
2	1				3				2				2	1	
3	1				3				2				2	1	
4	1				3				2				2	1	
5	2				2								1	1	
6	2		2						2				1	1	
AVg.	1		2		3				2				2	1	

1-low, 2-medium,3-high

		L	T	P	C
23CE123	**C PROGRAMMING LABORATORY**	**0**	**0**	**4**	**2**

LIST OF EXPERIMENTS:

1. Operators
2. Decision Statements
3. Control Statements
4. Functions
5. Arrays
6. Pointers
7. Strings
8. Structures
9. Macros
10. Files

COURSEOUTCOMES

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

CO1: Write, compile and debug C programs

CO2: Develop simple programs using decision making statements and looping constructs

CO3: Practice operations on arrays, strings and pointer

CO4: Practice modularization of the given problem using functions

CO5: Write programs using structures and files

TOTAL: 60 PERIODS

TEXTBOOKS:

1. "The C Programming Language" by Kernighan B W. and Ritchie D., Pearson Education India; 2nd edition, 2015
2. "Programming in C" by Kamthane A., Pearson Education India; 3rd edition, 2015
3. "Computing Fundamentals and C Programming" by Balagurusamy E., McGraw Hill Education; Second Edition, 2017

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				3				2				2	1	
2	2				3				2				2	1	
3	2				3				2				2	1	
4	2				3				2				2	1	
5	2				3				2				2	1	
AVg.	2				3				2				2	1	

1-low, 2-medium,3-high

SEMESTER II

23FYH211	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

MODULE I FOCUS ON LANGUAGE: ENGLISH GRAMMAR & VOCABULARY 9

Word Formation: Prefixes &Suffixes - Modal Verbs – Verb Preposition Combinations – Confusing Words – Abbreviations and Acronyms – Relative Clause – Pronouns – Cause and Effect Expressions – Purpose and Function – Conjunction - Common Errors and Redundancies- Contracted form of Verbs- Sentence Types and Clauses

MODULE II READING 9

Sequencing of Sentences – Cloze Reading – Reading Charts, Tables, Schedules and Graphs – Reading Newspaper Reports – Reading Advertisements – Reading Online content – Reading Official Letters and Profiles

MODULE III WRITING 9

Types of Paragraphs – Description – Describing Structures –Paragraph Construction - Paragraph Patterns – Kinds of Paragraph - Business Letters – Describing a Product– Proposal Writing – Memos –Gadget Review - Steps to Effective Précis Writing - Dialogue Writing – Writing Blogs.

MODULE IV LISTENING 9

Types of Listening – Barriers of Effective Listening – Intensive Listening- Listening to Public Announcements – Listening to News Bulletins and Weather Forecasts – Listening to Speeches.

MODULE V SPEAKING 9

Meetings - Negotiations: Types of Negotiation –Six Basic Steps of Negotiations – Informal and formal Negotiations - Expressing Preferences - Retelling an Incident – Controlling Nervousness & Stage Fright- Visual Aids in Presentation -Small Talk& Social Conversations - Making Enquires – Expressing Gratitude and Apologizing - Making Suggestions – Making Requests and Seeking Permission

COURSEOUTCOMES

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

CO1: Interpret the passage and construct grammatically correct sentences.

CO2: Use correct vocabulary and communicate effectively

CO3: Categorize information presented in a technical text and answer the questions

CO4: Apply professional writing techniques and compose passages

CO5: Identify the barrier to listening and provide solutions

CO6: Demonstrate appropriate professional writing, listening and speaking skills

TOTAL: 45 PERIODS

TEXTBOOKS:

1. “Embark – English for Undergraduates” by Steve Hart, Aravind R. Nair &Veena Bhambhani, CUP, 2016.
2. “Technical Communication – Principles and Practice” by Meenakshi Raman, Sangeeta

Sharma, Oxford University Press, New Delhi, 2015.

REFERENCES:

1. “A Course in Technical English” by Praveen Sam D & Shoba K N, CUP, 2020.
2. “English for Engineers” by Sudharshana N. P & Savitha C, CUP, 2018.
3. “Communicative English” by Lourdes Joavani Rayen & Shoba K N, CUP, 2018.
4. “Interchange - 2” by Jack C Richerds, CUP, Fourth Edition, Chennai, 2015.

ONLINE RESOURCES:

1. https://www.investopedia.com>term
2. https://sg.indeed.com.career.advice

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1									2	3		1			
2									2	3		1			
3									2	3		1			
4									2	3		1			
5									2	3		1			
AVg.									2	3		1			

1-low, 2-medium,3-high

23FYM211	FOURIER SERIES AND TRANSFORMS	L	T	P	C
		3	1	0	4

MODULE I FOURIER SERIES 9+3

Dirichlet's conditions – Fourier series – Odd and even functions – Half range sine series and cosine series– Complex form of Fourier series – Parseval's identity – Harmonic analysis

MODULE II LAPLACE TRANSFORMS 9+3

Transform of elementary functions – Transform of unit step, Dirac delta and periodic functions – Initial and final value theorems – Inverse Laplace transforms – Convolution theorem – Solution of linear second order ordinary differential equations with constant coefficients

MODULE III FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity

MODULE IV $\mathcal{Z}$ – TRANSFORMS 9+3

$\mathcal{Z}$ -transforms - Elementary properties – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using $\mathcal{Z}$ – transforms

MODULE V VECTOR CALCULUS 9+3

Vector differentiation – Gradient, divergence and curl – Directional derivative – Solenoidal and Irrotational vector fields – Vector integration – Line, surface and volume integrals – Green's, Gauss and Stoke's theorems (without proof) – Simple applications involving cube and rectangular parallelopiped

COURSEOUTCOMES

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

CO1: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications

CO2: Solve initial and boundary value problems in ordinary differential equations using Laplace transforms

CO3: Understand the mathematical principles on transforms that would provide them the ability to formulate and solve some of the physical problems of engineering

CO4: Use the effective mathematical tools for the solutions of difference equations by using $\mathcal{Z}$ transform techniques for discrete time systems

CO5: Apply the concepts of vector calculus in the study of surface and volume integrals along with the classical theorem involving them

TOTAL: 60 PERIODS

TEXTBOOKS:

1. "Higher Engineering Mathematics" by Grewal, B.S., 44^{th} Edition, Khanna Publishers, New Delhi 2022.

2. “Advanced Engineering Mathematics” by Erwin Kreyszig, 10th Edition, John Wiley & Sons, 2019.
3. "Higher Engineering Mathematics" by Ramana. B.V., McGraw Hill Education Pvt. Ltd, New Delhi, 2017

REFERENCES:

1. "A Textbook of Engineering Mathematics" by Bali. N.P and Manish Goyal, 9th Edition, Laxmi Publications Pvt. Ltd, 2014
2. “Advanced Engineering Mathematics” by Jain R.K. and Iyengar S.R.K., Narosa Publications, New Delhi, 5th Edition, 2016.
3. “Engineering Mathematics” by Sivaramakrishnadas. P, Vijayakumari. C, 1st Edition, Pearson Education, 2017.
4. “Engineering Mathematics” Vol. I & II by Sastry, S.S, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014
5. “Transforms and Partial Differential Equations” by Veerarajan. T, Mc Graw Hill Education, 2016.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2		1								1	2		
2	3	2		1								1	2		
3	3	2		1								1	2		
4	3	2		1								1	2		
5	3	2		1								1	2		
AVg.	3	2		1								1	2		

1-low, 2-medium,3-high

23CE211	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO MECHANICS AND STATICS OF PARTICLES 9

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces - Forces in a Plane- Force on a Particle, Resultant of Two Forces - Resultant of Several Concurrent Forces - Resolution of a Force into Components Rectangular Components of a Force - Forces in Space – Rectangular Components of a Force in Space - Force defined by its magnitude and two points on its line of action - Addition of Concurrent Forces in Space, Equilibrium of a Particle in Space.

MODULE II EQUILIBRIUM OF RIGID BODIES 9

Introduction, Free-Body Diagram, Equilibrium in Two Dimensions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples.

MODULE III FRICTION 9

Frictional resistance – classification of friction- laws of friction –coefficient of friction-angle of friction – angle of repose – cone of friction – free body diagram - equilibrium of a body on a rough horizontal and inclined plane –ladder friction – rope friction – wedge friction – screw jack.

MODULE IV BASICS OF DYNAMICS 9

Kinematics and kinetics definition – displacements, velocity and acceleration- Equations of motion - Types of motion –Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves –motion under gravity – relative motion – curvilinear motion of a particle – projectiles – angle of projection – range – time of flight and maximum height – law of conservation of energy – principle of work and energy – Simple Harmonic Motion - Newton's second law - Dynamic equilibrium.

MODULE V IMPULSE - MOMENTUM AND IMPACT OF ELASTIC BODIES 9

Impulse – Momentum approach – linear impulse and momentum – Equations of momentum – impulse and momentum principle – impulsive motion – conservation of momentum - Time of compression, restitution, collision – law of conservation of momentum – Impact - Types of impact – Co-efficient of restitution - collision of elastic bodies by direct central impact and oblique impact.

COURSEOUTCOMES

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

CO1: Familiarize the basic principles of engineering mechanics to analyze and solve practical engineering problems.

CO2: Evaluate the magnitude and behavior of frictional forces under static conditions.

CO3: Determine the motion parameters (displacement, velocity, and Acceleration) of bodies undergoing rectilinear, curvilinear, and general plane motion.

CO4: Apply fundamental principles of kinematics and dynamics to effectively analyze and solve simple practical problems.

CO5: Explain Newton's law and coefficient of restitution for elastic bodies

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Vector Mechanics for Engineers" by F.B. Beer and E.R. Johnson, Tata McGraw Hill Pvt. Ltd., 12th Edition, 2022.
2. "A Text Book of Engineering Mechanics" by R. S. Khurmi and N. Khurmi, S. Chand & Co., 22nd Edition, 2018.

REFERENCES:

1. "Engineering Mechanics" by S. Timoshenko and Young, McGraw Hill, 5th Edition, 2020.
2. "Engineering Mechanics, Volume I - Statics, Volume II – Dynamics" by Meriam J.L and Kraige L. G., John Wiley & Sons, New York, 9th Edition, 2018.
3. "Engineering Mechanics: Statics and Dynamics" by Russell C Hibbeler and Ashok Gupta, Pearson Education Inc., Prentice Hall, 14th Edition, 2016.
4. "Fundamentals of Engineering Mechanics" by Rajasekaran S and Sankara Subramanian G, Vikas Publishing House Pvt. Ltd., India, 3rd Edition, 2013.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112106286
2. https://onlinecourses.nptel.ac.in/noc19_me41/preview

CO-PO&PSOMAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3				2				2				3	1	
2	3				2				2				3	1	
3	3				2				2				3	1	
4	3				2				2				3	1	
5	3				2				2				3	1	
AVg.	3				2				2				3	1	

1-low, 2-medium,3-high

23CE212	ENGINEERING GEOLOGY	L	T	P	C
		3	0	0	3

MODULE I PHYSICAL GEOLOGY AND GEOMORPHOLOGY 9

Applications of earth science in civil engineering practices - understanding internal structure – composition and age of the earth. Rock weathering – types and effects in civil engineering- soil – soil profile - types - mode of formation –process of mass wasting- landslides and related phenomenon- causes and control - geomorphological features developed by river, ground water, wind. Earthquake-theory-terminology - causes-seismic waves-measurements, Richter scale - Tsunami - impacts on civil engineering works.

MODULE II STRUCTURAL GEOLOGY 9

Dip and strike-apparent dip and true dip- folds- parts of fold- types of fold- mechanism of fold-recognition of fold. Fault- fault terminology- classification of fault- effects of fault on out crop-significance of folds and fault- unconformities- types- recognition of unconformities- joints-classification of joints- structures due to denudation- outlier- Inlier- off lap- on lap.

MODULE III MINERALOGY & CRYSTALLOGRAPHY 9

Physical properties of mineral - its composition - system of crystallization - ore forming and rock forming minerals – origin - uses –distribution in India. Quartz group- Feldspar group - Feldspathoid group - Silica group - Pyroxene group - Mica group - Olivine group - Chlorite group - Serpentine group - Clay mineral group- Alumino silicate group- Calcic Minerals - Carbonate group

MODULE IV PETROLOGY 9

Rock cycle - Igneous, sedimentary and metamorphic rocks- mineralogical composition, texture and structure, classification, engineering properties of Igneous rocks - granite, gabbro, dolerite and basalt. Sedimentary Sandstone, Shale, Limestone, Laterite. Metamorphic Rock - Gneiss, Quartzite, Slate, Charnokite, Decorative Stones-Porphyries- Marble.

MODULE V APPLIED GEOLOGY 9

Rocks as building stones-properties of building stones-road metals-geology of dam sites-dams terminology-types-problems associated with dam sites- geology of reservoirs-tunnels-bridges constructional features-stability of bridges- foundation of bridges and coastal protection – geophysical survey-magnetic survey-electrical survey-seismic survey and radiometric survey-principles and applications.

COURSEOUTCOMES

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

CO1: Describe the importance of geology in civil engineering, weathering, geological work of various geological agents with geological surface and subsurface features

CO2: Identify the elements of crystallography to classify minerals based on their system

CO3: Identify minerals based on their physical properties and its distribution in India.

CO4: Identify rocks based on mineralogy, texture, structure and mode of occurrence with its application in civil engineering purposes.

CO5: Employ the geological knowledge for projects of dams & reservoirs, tunnels, coastal protection.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. “A textbook of Engineering and General Geology’’ by Parbin Singh., S.K. Kataria & Sons Publications, New Delhi, 2022.
2. “Principles of Engineering Geology” by K. M. Bangar., Standard Publishers distributors. NAI SARAK Delhi2021
3. “Principles of Geomorphology” by W.D. Thornbury., Second Edition - CBS-Publications, New Delhi; December 2019

REFERENCES:

1. "Textbook of Engineering Geology" by Chenna Kesavulu N., Laxmi Publications, New Delhi, Second Edition, 2016
2. “Physical Geography” by Dr. Savindra Singh, Pravalika Publications, Allahabad, India; 2015
3. “Engineering Geology” by Venkatareddy. D., Vikas Publishing House Pvt. Ltd. 2010.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105106: Engineering Geology, IIT Kharagpur. Dr. Debasis Roy

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				1				2				2	1	
2	2				1				2				2	1	
3	2				1				2				2	1	
4	2				1				2				2	1	
5	3				2				2				3	2	
AVg.	2				1				2				2	1	

1-low, 2-medium,3-high

23CE213	CONSTRUCTION TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I FOUNDATIONS **9**

Introduction - Building components - Site selection - Functions of foundation -Requirements of good foundation - Types of foundations- Selection, Description and Construction of Spread footing - Combined footing - Strap footing - Raft foundation - Grillage foundation - Types of piles - Pile driving - Under reamed pile foundation for black cotton soils - Setting out foundation- Excavation of foundation trenches -Timbering of trenches - Excavation in ground with sub-soil-Water - Anti-termite treatment - Pre-construction & Post-Construction treatment.

MODULE II MASONRY **9**

Definition and terms used in masonry- Brick masonry- characteristics and requirements of good brick masonry- Bonds in brick work, Header, Stretcher, English, Flemish bond-Stone masonry-Requirements of good stone masonry- Classification-characteristics of different stone masonry-Joints in stone masonry. Types of walls; load bearing, partition walls, cavity walls-Concrete block walls - Types of Building blocks.

MODULE III ROOF AND FLOORS **9**

Types of roofs - Flat, slope and curved - Types of roof truss - Wooden and Steel-Erection Methods-Purlins - Types of roof coverings- aluminum, steel sheets, corrugated iron and tiles -Market sizes. Drainage in roofs- slope and diameter - Flooring - Ground level flooring in poor Soils and Normal Soils. Floor- Different types of flooring materials- advantages and disadvantages - Construction methods of different types of floors. Causes and effect of dampness - Methods of damp proofing - Materials used for damp proofing course.

MODULE IV STAIRS, DOORS, WINDOWS AND FORM WORK **9**

Staircase -Terminology and Specification- classification of staircase and its details -Construction details - Vertical movement - Staircase, Ramps, Elevators and Escalators - Types of doors and windows and ventilators - drawings - Materials for Doors and Windows - Standard sizes of Doors and Windows - Door and Window Fixtures- Formwork - Requirements - shuttering for columns - Shuttering for beam and slab floor - Formwork for Stairs & Walls. Shoring - Underpinning - various types of Scaffolding.

MODULE V PLASTERING, PAINTING AND INSULATION **9**

Plastering and pointing - Methods of plastering - Types of plastering- External wall cladding-Defects in Plastering - Treatment and repair techniques for defects in plastering - Different types of pointing - Paints -Types of paints - Paintings of Interior & Exterior walls, wooden and steel members-Fire protection - Fire resisting properties of common building materials - Fire safety equipment for buildings - Thermal Insulation and sound insulations

COURSEOUTCOMES

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

CO1: Propose suitable type of foundation for building structures.

CO2: Demonstrate the types of brick and stone masonry.

CO3: Describe types of roofs and floors.

CO4: Classify the different types of staircases based on geometrical configurations, doors and windows.

CO5: Describe the requirements for fire safety, thermal and sound insulation in a building.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "Building Construction" by Punmia. B.C., Ashok. K.Jain & Arun.K.Jain, Laxmi Publications (P) Ltd, New Delhi, 2023.
2. "Building Construction" by S. C. Rangwala, Charotar Publishing House(P) Ltd, Gujarat, 2022.
3. "Building Construction" by P.C Varghese, Prentice-Hall of India, New Delhi, 2017

REFERENCES:

1. "Building Construction" by Sharma S.K. and Kaul B.K., S.Chand & Company Ltd., New Delhi, 2013.
2. "Building Construction" by Sushil Kumar., Standard Publishers distributors, New Delhi, 2016.
3. "Building Construction" by S.P.Arora and S.P.Bindra, Dhanpat Rai publications,2014.
4. “Construction Technology” by Subir K. Sarkar and Subhajit Saraswati, Oxford University Press, 2008.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105106206

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				1				2				2	2	
2	2				1				2				2	2	
3	2				1				2				2	2	
4	2				1				2				2	2	
5	2				1				2				2	3	
AVg.	2				1				2				2	2	

1-low, 2-medium,3-high

23FYH221	ENGLISH COMMUNICATION COMPETENCY LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. Speech Sounds
2. Vocabulary
3. Reading Comprehension
4. Listening Practice - I
5. Dialogue Writing
6. Conversational Exercise - I
7. Focus on Language
8. Creative Writing
9. Conversational Exercise –II
10. Listening Practice - II
11. Greeting & Thanking
12. Complaining, Apologizing & Congratulating
13. Asking & Giving Directions
14. Alphabet Series & Letter Series Word Formation
15. Para Jumbles
16. Synonyms and Antonyms
17. Sentence Completion & Correction
18. Presentation Skills
19. Group Discussion
20. Interview Skills

COURSEOUTCOMES

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

CO1: Solve objective questions on verbal ability.

CO2: Apply reading and listening strategies to comprehend text.

CO3: Use appropriate language structures and converse effectively.

CO4: Compose appropriate structures for creative writing.

CO5: Demonstrate presentation, Interview and Group Discussion.

TOTAL: 60 PERIODS

REFERENCES:

1. “Touchstone – Level 2” by Michael Mccarthy et al., Second Edition, CUP, 2014

CO-PO&PSOMAPPING

CO	PO	PSO

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1									2	3		1			
2									2	3		1			
3									2	3		1			
4									2	3		1			
5									2	3		1			
AVg.									2	3		1			

1-low, 2-medium,3-high

23CE221	ENGINEERING GRAPHICS II	L	T	P	C
		0	0	4	2

INTRODUCTION TO CAD **15**

Demonstrating Knowledge of theory of CAD Software. Menu bars and its Uses, Tool bars and its Uses-Different Function Keys and its Uses –Basic Shapes and Commands-Modification Tools-Annotations-Dimensioning-Layer Creation.

ISOMETRIC PROJECTIONS OF REGULAR SOLIDS USING CAD **10**

Isometric Views of Simple Solids-Conversion of Isometric Views to orthographic Views and Vice Versa. Drafting of Isometric Projections Using Drafting Tool

ORTHOGRAPHIC PROJECTIONS& PROJECTION OF REGULAR SOLIDS USING CAD **10**

Principles of Orthographic Projections-Conventions-Projections of Points and Lines inclined to both the Planes, Projection of Planes-Projection of solids inclined to both the planes- Draw Simple Annotations. Using Drafting Tool.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES USING CAD **10**

Sections- Prism, Cylinder, Pyramid, Cone; Development of Surfaces of Right regular Solids-Prism, Pyramid, Cylinder and Cone Using Drafting Tool.

BASIC PREPARATION OF DRAWINGS USING CAD **15**

Types of Doors, Windows - Detailed drawings of different types of doors, windows with specifications. Preparations of interiors positions of utilities like study table, chair, dining table, sofa, Kitchen sink, Fridge, washing machine etc.

COURSEOUTCOMES

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

CO1: Familiarize with the fundamentals and standards of Engineering graphics

CO2: Use Computer Aided drafting in the respective Engineering Fields

CO3: Imagine and visualize the geometric details of engineering objects

CO4: Communicate ideas through technical drawings

CO5: Interpret Orthographic and Isometric Views of objects

TOTAL: 60 PERIODS

TEXT BOOKS:

1. “A Hand Book on Autocad Tools Practice” by Azhar Wahab., Notion Press, 2020Jain P H., “Text book of Engineering Graphics”, Soham Publications, 2018
2. “A text book of Engineering Graphics” by Natrajan K.V., Dhanalakshmi Publishers, Chennai, 2009.
3. “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, by Luzzader, Warren.J. and Duff,John M., Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. “AutoCAD 2019 For Beginners” by Cadfolks., Kishore; Illustrated edition, 2018

REFERENCES:

1. "Engineering Drawing" by Bhatt N.D. and Panchal V.M., Charotar Publishing House, 2010.
2. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
3. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
4. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
5. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
6. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. Special points applicable to University Examinations on Engineering Graphics.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				3				2	3			2	3	1
2	2				3				2	3			2	3	1
3	2				3				2	3			2	3	1
4	2				3				2	3			2	3	1
5	2				3				2	3			2	3	1
AVg.	2				3				2	3			2	3	1

1-low, 2-medium,3-high

23FPC221	BASIC SCIENCES LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

Physics Laboratory

1. Determination of the Young’s modulus of the material of a given beam using uniform bending method.
2. Determination of the rigidity modulus of the material of a given wire using torsional pendulum.
3. Determination of the particle size of given powder using a Laser.
4. Determination of surface tension of water using capillary tube.
5. Calibration of ammeter and voltmeter using potentiometer
6. Determination of magnetic field around along the axis of a current carrying circular coil
7. Determination of efficiency of solar cell
8. Study of logic gates

Chemistry Laboratory

1. Determination of strength of given HCl using NaOH by pH measurement.
2. Determination of Alkalinity of water.
3. Determination of equivalent conductance of a strong electrolyte.
4. Estimation of Dissolved Oxygen in water sample.
5. Determination of sodium in water sample by flame photometry.
6. Estimation of iron in water sample by spectrophotometry.
7. Determination of corrosion rate of steel in acid media by weight loss method
8. Estimation of ferrous ion by potentiometric titration.

COURSEOUTCOMES

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

CO1: Determine Rigidity modulus of a wire, Young’s modulus of wooden beam, Surface tension of water and Earth’s magnetic field

CO2: Determine the particle size using LASER, and efficiency of solar cell

CO3: Implement all the basic gates using the universal gates and calibrate Ammeter and Voltmeter

CO4: Apply the knowledge of detecting dissolved oxygen, alkalinity and metal ions in water sample

CO5: Implement different types of elemental analysis through titrations like volumetric, potentiometric and conductometric.

CO6: Handle analytical tools such as spectrophotometer, flame photometer, and potentiometer and use the same for engineering analysis.

TOTAL: 60 PERIODS

REFERENCES:

1. “Physics Laboratory Manual”, Department of Physics, CIT, 2023
2. “Chemistry Laboratory Manual”, Department of Chemistry, CIT, 2023

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2				2								1	1	1
2	2				2								1	1	1
3	2				1				2				1	1	1
4	2				2								1	1	1
5	2				2								1	1	1
6	2				2								1	1	1
AVg.	2				2				2				1	1	1

1-low, 2-medium,3-high

23FYC221	ENVIRONMENTAL SCIENCE & ENGINEERING	L	T	P	C
		1	0	0	1

NATURAL RESOURCES **3**

Forest resources: Use and over-exploitation and deforestation. Water resources: Use and over-utilization of surface and ground water. Dams - benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

ENVIRONMENTAL POLLUTION **3**

Sources, causes, effects and management of air pollution, water pollution, soil pollution and radioactive pollution. Solid waste management

ECOSYSTEM AND BIODIVERSITY **3**

Concept of an ecosystem- structure and functions- food chain and food webs Biodiversity-types, Importance and values of biodiversity, India as a mega diversity nation, hot spots of biodiversity, Threats to biodiversity, conservation of biodiversity

GREEN CHEMISTRY **3**

Significance of green chemistry - basic components of green chemistry. Industrial applications of green chemistry-green fuels-e-green propellants and bio catalysts

GLOBAL ENVIRONMENTAL ISSUES AND MANAGEMENT **3**

Water conservation, Rain water harvesting, Climate change, Ozone depletion, Acid rain, Greenhouse effect and global warming. Disaster management- Earthquakes, Floods, Landsides and cyclones

COURSEOUTCOMES

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

CO1: Apply the concept of natural resources.

CO2: Implement the remedial measures to control environmental pollution

CO3: Use the concept of conserve the biodiversity

CO4: Apply the components of green chemistry in environment

CO5: Develop remedy for global environmental issues

TOTAL: 15 PERIODS

TEXT BOOKS:

1. “Text book of Environmental chemistry and Pollution Control” by S.S.Dara, , S.Chand & Company Ltd, New Delhi, 2011
2. “Environmental Studies” by R.Rajagopalan, Oxford University Press New Delhi, 2015

REFERENCES:

1. “A Basic course in Environmental Studies” by Surinder Deswal & Dr.Anupama Deswal, Dhanpat Rai & Co (P) Ltd, New Delhi, 2013.
2. “Environmental Studies” by Benny joseph, Tata McGraw-Hill Publishing company Limited, New Delhi, 2018.

3. “Environmental Science and Engineering” by Anubha Kaushik &C.P,Kaushik, New Age International Publishers, 2nd Edition, 2006.
4. “Introduction to Environmental Science and Technology” by Dr.S.Amalraj, Laxmi publications (P) Ltd, New Delhi , New Edition, 2005.
5. “A Text book of Environmental Science” by Vidhya Thakur, Scientific Publishers (India) 2019.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				1	3	3						2	2	2
2	2				1	3	3						2	2	2
3	2				1	3	3						2	2	2
4	2				1	3	3						2	2	2
5			2			3	3						2	3	3
AVg.	2		2		1	3	3						2	2	2

1-low, 2-medium,3-high

SEMESTER III

23M311	DIFFERENTIAL EQUATIONS AND RANDOM VARIABLES	L	T	P	C
		3	1	0	4

MODULE I ORDINARY DIFFERENTIAL EQUATIONS 9+3

Second and higher order linear differential equations with constant coefficients – Homogenous equation of Legendre type- Method of variation of parameters – System of simultaneous linear first order differential equations with constant coefficients.

MODULE II PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations –Solutions of second and higher order homogenous linear equations with constant coefficients-Nonlinear partial differential equations with standard types only-Lagrange's linear equation – Solution of linear partial differential equations of higher order with constant coefficients.

MODULE III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of partial differential equations –Method of separation of variables-Solution of one-dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation in Cartesian coordinates

MODULE IV PROABAILITY AND RANDOM VARIABLES 9+3

Probability Concepts - Axioms of probability – Conditional probability – Bayes theorem – Random variables- Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions

MODULE V TWO DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Expectation of two-dimensional random variables – Covariance – Correlation and linear regression- Transformation of random variables

COURSEOUTCOMES

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

CO1: Apply the concepts of ordinary differential equations in modeling and solving physical problems.

CO2: Explain the partial differential equations that emerge in practical application scenarios

CO3: Compute solutions for partial differential equations utilizing Fourier series.

CO4: Explain the fundamental concepts of one-dimensional random variables and distribution functions, and their applications in engineering domains

CO5: Apply the concept of two-dimensional random variables in engineering disciplines.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. "Higher Engineering Mathematics" by Grewal B. S., 44th Edition, Khanna Publishers, New Delhi, 2022.
2. "Introduction to Probability and Statistics for Engineers and Scientists" by Ross. S.M., 5th Edition, Elsevier, 2014.

3. “Probability and Statistics for Engineers" by R.A., Miller, I and Freund J., Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. "Higher Engineering Mathematics" by Ramana. B.V., McGraw Hill Education Pvt. Ltd, New Delhi, 2017.
2. “Advanced Engineering Mathematics” by Jain R.K. and Iyengar S.R.K., Narosa Publications, 5th Edition, New Delhi, 2016.
3. “Engineering Mathematics” by Srimanta Pal and Suboth. C. Bhunia, Oxford University Press, New Delhi, 2015.
4. "Probability and Statistics for Engineering and the Sciences” by Devore. J.L., Cengage Learning, New Delhi, 9th Edition, 2020.
5. Schaum’s Outlines on Probability and Statistics " by Spiegel. M.R., Schiller. J. and Srinivasan. R.A., Tata McGraw Hill Edition, 4th Edition, 2012.

CO-PO&PSOMAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2		1								1	2		
2	3	2		1								1	2		
3	3	2		1								1	2		
4	3	2		1								1	2		
5	3	2		1								1	2		
AVg.	3	2		1								1	2		

1-low, 2-medium,3-high

23CE311	MECHANICS OF SOLIDS I	L	T	P	C
		3	0	0	3

MODULE I CENTROID AND MOMENT OF INERTIA 9

Centroid of areas, compound areas – Determination of moment of inertia of plane figures- principal moment of inertia – Radius of gyration

MODULE II CONCEPT OF STRESS AND STRAIN 9

Simple stresses and strains at a point -Normal and shear Stresses - Hooke's Law - Young's modulus - Bars subjected to axial Forces - simple problems - Thermal stresses - Simple statically Indeterminate problems - compound bars. Changes in dimensions and volume - Poisson's ratio - Modulus of Rigidity - Surface and volume strains - Bulk modulus - Relation between Elastic constants - Simple Tension Test on a Mild Steel rod - Stress-strain diagram - Concept of Factor of Safety and permissible stresses.

MODULE III STRAIN ENERGY PRINCIPLES AND COMPLEX STRESSES 9

Strain energy -Resilience - Stresses due to suddenly applied loads and impact loads. Complex stresses - Components of stress on inclined planes - Expression for stressed element subjected to two normal stresses with shear - Principal stresses and Principal planes - Mohr's circle of stress.

MODULE IV BENDING OF BEAMS 9

Types of Beams - Types of loads - Shear force and Bending Moment -Relationship between loading intensity, shear force and bending moment - Shear force and bending moment diagrams for statically determinate beams. Theory of simple bending -Stress distribution due to bending moment and shear force - Design of beams - Beams of uniform strength - Flitched beams.

MODULE V TORSION AND SPRINGS 9

Torsion of solid and hollow circular shafts - Power transmitted through shafts - Strain energy due to torsion - Combined bending and torsion – close coiled helical springs.

COURSEOUTCOMES

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

CO1: Apply the concepts of centroid and moment of inertia to solve engineering problems for a given plane section.

CO2: Apply elastic principles to calculate stress, strain, and dimensional changes in solids under loading along Cartesian axis.

CO3: Apply the concepts of complex stresses and strain energy in two dimensional solid systems.

CO4: Construct the shear force and bending moment variations for determinate beams subjected to possible shear loads and the analysis for bending and shear stresses in the determinate beams.

CO5: Compute shear stress of a hollow and solid circular shaft, the combined effect of bending and torsion and analyse the springs.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Essentials of Strength of Materials" by Rajput,R.K., S.Chand & Company Ltd., NewDelhi,2015
2. "Strength of Materials" by Bansal R.K., Laxmi Publications, NewDelhi, 2018.

REFERENCES:

1. "Strength of Materials" by Negi L.S., Tata Mc Graw Hill Education Pvt. Ltd,2017.
2. “Engineering Mechanics: Statics and Dynamics” by Shames, Irving H. 7th Ed., Pearson, 2018.
3. "Mechanics of Materials" by Beer F.P.,Johnston E.R.,DeWolf J.T. and Mazurek D., McGraw-Hill Higher Education,6th Edition,2011.
4. "Strength of Materials" by Lehri R.S.,Lehri A.S., S K Kotaria & Press, NewDelhi,2012.
5. “Mechanics of Materials” by Punmia B.C, Ashok jain and Arun jain, Lakshmi Publications, NewDelhi, 2017
6. "Strength of Materials" by Sadhu Singh,Khanna Publishers, NewDelhi,2016
7. “Mechanics of Materials” by Beer, Ferdinand P., and Russell Johnston Jr. 8th Ed., McGraw-Hill Education, 2018.
8. “Mechanics of Materials” by Hibbeler, Russell C. 10th ed., Pearson, 2023.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105108/
2. https://nptel.ac.in/courses/112106141/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		3										3		
2	3		3										3		
3	3		3										3		
4	3		3										3		
5	3		3										3		
AVg.	3		3										3		

1-low, 2-medium,3-high

23CE312	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I CEMENT AND AGGREGATES 9

Types of cement - properties and specific uses of various cements - Tests on cement -Fineness – Setting time - Consistency -Soundness - compressive strength. Properties of aggregates - shape, texture, bond, strength, soundness and thermal properties - grading - bulking of sand – Characterization of aggregates – toughness, strength, hardness, soundness

MODULE II WATER, ADMIXTURES AND CONCRETE MIX DESIGN 9

Quality of water for mixing and curing - use of Sea water for mixing concrete. Air-entraining agents - Accelerators - Retarders - Pozzolona - Water proofing agents - workability agents - plasticizers – super plasticizers. Factors affecting mix proportion - Water cement ratio - Aggregate cement ratio - Mix design by I.S. method and ACI method

MODULE III MANUFACTURE OF CONCRETE 9

Measurement of materials - Volume batching and weigh batching - Mixing of concrete - Types of mixers-Transporting of concrete - Placing of concrete - Compaction of concrete - Methods of compacting concrete- Tamping - Vibration – Vibro processing - Jolting - Rolling - Centrifugation - Curing of concrete – Different methods of curing.

MODULE IV PROPERTIES AND TESTS ON FRESH AND HARDENED CONCRETE 9

FRESH CONCRETE

Factors affecting fresh concrete properties - Workability Tests - Slump Test - Compacting factor Test - Flow test - Kelly Ball test - Vee Bee consistometer test - Segregation and Bleeding.

HARDENED CONCRETE

Introduction to types of testing – Destructive, Semi-Destructive, Non-Destructive - Compressive Strength - Tensile Strength - Modulus of Rupture - Modulus of Elasticity – Bond stress - Shrinkage – Creep – Permeability of concrete - Factors affecting shrinkage, creep & permeability - Thermal properties

MODULE V QUALITY CONTROL AND SPECIAL CONCRETES 9

Sampling - Frequency of sampling - Standard deviation - acceptance criteria as per IS 456 - 2000. Light weight concrete - Fibre Reinforced Concrete - High density Concrete - Polymer Concrete - Ferrocement-Shotcreting - Hot weather concreting - Cold weather concreting - High strength concrete - High performance concrete - Self compacting concrete - Ready mixed Concrete.

COURSEOUTCOMES

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

CO1: Summarize the cement and aggregates, including properties, uses, tests, and characterization methods for quality assessment.

CO2: Explain water quality, admixtures, and mix design parameters, considering IS and ACI methods for manufacturing of concrete.

CO3: Demonstrate the concrete manufacturing processes, encompassing material measurement, mixing, transportation, placement, compaction, and curing methods for quality assurance.

CO4: Demonstrate fresh and hardened concrete properties, conducting workability tests and various types of testing for quality evaluation

CO5: Summarize the important types of concrete used in the field application and apply sampling methods, frequency, standard deviation, and adherence to IS 456-2000 criteria

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Concrete Technology" by Shetty M.S., S.Chand and Company Ltd, New Delhi, 2019.
2. "Properties of Concrete" by Neville.A.M., Pearson Education Limited, 2017.

REFERENCES:

1. "Concrete Technology" by Santhakumar A.R., Oxford University Press, New Delhi, 2018
2. "Concrete Technology" by Krishnasamy K.T., Dhanpat Rai, New Delhi, 2014.
3. "Concrete Technology" by Gambhir M.L., Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
4. IS 456- 2000: Indian Standard Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi.
5. IS 10262-2019: Guidelines for Concrete Mix Design proportioning.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105102012
2. https://nptel.ac.in/courses/105106176

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3												2		
2	3		3										3	2	
3	3												2	1	
4															
5	3		3										3		
AVg.	3		3										3	2	

1-low, 2-medium,3-high

23CE313	MECHANICS OF FLUIDS	L	T	P	C
		3	0	0	3

MODULE I PROPERTIES OF FLUIDS & HYDROSTATICS 9

Introduction of basic properties – Viscosity - real and ideal fluids – compressibility – surface tension –Concept of Fluid pressure – Pressure head – Manometers - Total pressure and centre of pressure on plane and curved submerged surfaces – Buoyancy – stability of floating body.

MODULE II CONCEPTS OF FLUID FLOW 9

Classification of fluid flow – velocity and acceleration – velocity potential and stream function-Application of control volume to continuity, energy and momentum equation – Euler's equation of motion – Bernoulli's equation – applications – venturimeter, orifice meter, pitot tube.

MODULE III FLOW THROUGH PIPES 9

Laminar flow in circular pipes – Hagen – Poisueills's equation – Turbulent flow – Darcy–Weisbach equation – major and minor losses – transmission of power through pipes – flow through parallel, series pipes – flow through siphon pipes

MODULE IV DIMENSIONAL ANALYSIS AND MODEL STUDIES 9

Fundamental dimensions - dimensional homogeneity – Dimensional analysis by Rayleigh's method and Buckingham Pi-Theorem - Dimensionless parameters - Similitude and model studies – Distorted Models

MODULE V BOUNDARY LAYERS 9

Boundary layer thickness – Laminar and turbulent boundary layers – Displacement, momentum and energy thickness – Boundary Layer Separation and its Control – Drag force on a flat plate due to boundary layer.

COURSEOUTCOMES

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

CO1: Apply fundamental principles and concepts of fluid mechanics to analyze and solve problems related to fluid behavior, flow, and boundary layers.

CO2: Demonstrate the fluid properties, pressure acting on fluids and hydrostatic conditions

CO3: Illustrate conservation equation of mass, energy and momentum and applications in fluid kinematics and dynamics.

CO4: Analyze fundamental dimensions, dimensional homogeneity, dimensional analysis using Rayleigh's method and Buckingham Pi-Theorem, and similitude in model studies.

CO5: Apply the concept of boundary layer and its application to find the drag force.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Text Book of Fluid Mechanics and Hydraulic Machines" by Bansal.R.K., Lakshmi Publications, Madras, 2017
2. "Fluid Mechanics and Hydraulic Machines" by Rajput.R.K., S.Chand and Co, New Delhi, 2016.

REFERENCES:

1. “Hydraulics and Fluid Mechanics Including Hydraulic Machines” by Modi.P.N, & Seth.S.M., Standard Book House, 21^{st} edition, New Delhi, 2017.
2. “Hydraulics Fluid Mechanics and Fluid Machines” by Ramamrutham. S, Dhanpat Rai Publishing Company (P) Ltd, 9th Edition, New Delhi, 2018.
3. “Fluid Mechanics” by Streeter, V.L., and Wylie, E.B., Bedford. K.W., McGraw Hill education, 9^{th} Edition 2017.
4. “Fluid Mechanics” by Frank.M. White, Henry Xue, Tata McGraw Hill education, 9^{th} Edition, New Delhi, 2022.
5. “Introduction to Fluid Mechanics and Fluid Machines” by S K Som; Gautam Biswas and S Chakraborty, Tata McGraw Hill Education Pvt. Ltd., 2021.
6. “Principles of Fluid Mechanics and Fluid Machines” by Narayana Pillai N., 3^{rd} edition, University Press (India) Pvt. Ltd. 2009.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112104118

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3		3									3		
2	3				3								3		
3	3		3	3									3		
4	3			3	3								3	3	
5	2		2		2								2		
AVg.	3	3	3	3	3								3	3	

1-low, 2-medium,3-high

23CE314	SURVEYING	L	T	P	C
		3	0	0	3

MODULE I MEASUREMENT OF DISTANCES AND DIRECTIONS 9

Importance of surveying to engineers, plane and geodetic surveying, principles of surveying, classification of surveys, Linear Measurements using chain, measuring tape, hypotenuse allowance. Measurement of angles, bearings and included angles using Compass, Measurement of angles by Vernier theodolite, Application of Electronic Theodolites.

MODULE II LEVELLING AND COMPUTATION OF AREAS AND VOLUMES 9

Levelling- Basics definitions, types of levels and levelling staff, methods of levelling, Determination of levels- Height of Instrument Method - Rise and Fall method, Contouring- Characteristics and uses of Contours, Direct & Indirect methods of contour surveying, Areas - Determination of areas consisting of irregular boundary and regular boundary. Volumes - determination of volume of earth work in cutting and embankments, capacity of reservoirs.

MODULE III THEODOLITE TRAVERSING AND TRIANGULATION 9

Theodolite Surveying - Types of Theodolites, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Traversing -Methods of traversing, traverse computations and adjustments, Gale’s traverse table, Omitted measurements. Tachometric Surveying - Principles of Tachometry, stadia and tangential methods of Tachometry. Triangulation - baseline – satellite stations – reduction to centre- trigonometrical levelling – single and reciprocal observations

MODULE IV CURVES AND ADVANCED TOPICS IN SURVEYING 9

Curves: Types of curves and their necessity, elements of simple curve and setting out of simple curve, Introduction to compound, reverse, transition and vertical curves. Hydro graphic Surveying- methods, applications and uses – Tides – MSL – Sounding methods – Three-point problem – Strength of fix, Introduction to photogrammetry

MODULE V MODERN SURVEYING METHODS 9

Total Station and Global Positioning System- Basic principles, classifications, applications, comparison with conventional surveying. Electromagnetic distance measuring system - principle of working and EDM instruments, Components of GPS – space segment, control segment and user segment, reference systems, satellite orbits, GPS observations. Applications of GPS, GIS and remote sensing, Introduction to Drone Surveying

COURSEOUTCOMES

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

CO1: Summarize surveying's significance to engineers, covering plane and geodetic surveying principles, survey classification and appropriate measurement techniques.

CO2: Explain levelling basics, including definitions, types of levels, methods of levels, contouring techniques and compute areas and volumes.

CO3: Describe theodolite surveying, traversing, and tachometric principles, including triangulation methods and computations for accurate measurements.

CO4: Explain curve types and setting, hydrographic surveying and photogrammetry principles for precise measurements and applications in engineering.

CO5: Understand Total Station, GPS, and EDM principles, applications, comparisons with conventional methods and introduction to drone surveying.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. “Surveying and Levelling Parts 1 & 2” by Kanetkar.T.P and Kulkarni.S.V, Pune Vidyarthi Griha Prakashan, Pune, 2014
2. “Surveying (Vol – 1, 2 & 3)” by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) ltd., New Delhi. 2016
3. “Higher Surveying” by Chandra A M, New Age Publishers; New Delhi, 2015

REFERENCES:

1. “Global Positioning System - Theory and Practice” by Hoffman. B, H. Lichtenegga and J. Collins, Springer -Verlag Publishers, 2001
2. “Surveying and Levelling” by R. Subramanian, Oxford university press, New Delhi. 2013
3. ” Surveying (Vol – 1 & 2)” by Duggal S K, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2016.
4. “Surveying and levelling” by R. Agor, Khanna Publishers 2015.

ONLINE RESOURCES:

1. http://www.nptelvideos.in/2012/11/surveying.html

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2			2								2	2	
2				2	2								2		
3	3												3		
4	2			2	2								2	2	
5	1						1						1		
AVg.	2	2		2	2		1						2	2	

1-low, 2-medium,3-high

23CE321	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. Tension test on steel bars
2. Shear test on steel bars
3. Tests on bricks
4. Hardness test - Brinell hardness number
5. Hardness test - Rockwell hardness number
6. Impact flexure test on metals
7. Test on wood
8. Test on helical spring
9. Bending test on beams (simply supported, cantilever, fixed)
10. Torsion test on mild steel.

COURSEOUTCOMES

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

CO1: Conduct tension and shear tests on steel bars to assess their mechanical properties and structural performance and analyse the hardness number and impact strength of metal pieces

CO2: Perform tests on bricks to evaluate their quality and suitability for construction purposes.

CO3: Assess the stiffness of helical spring and assess the shear strength on circular bars

CO4: Assess the compressive strength and hardness properties of wooden specimens.

CO5: Assess the flexural rigidity and modulus of elasticity of beams with different support conditions and cross sections.

TOTAL: 60 PERIODS

REFERENCES:

1. "Essentials of Strength of Materials" by Rajput, R.K., S.Chand & Company Ltd., New Delhi, 2015.
2. IS 432 Part I- 1982, “Specification for Mild Steel and Medium Steel bars and hard-drawn steel wire for Concrete Reinforcement”, Bureau of Indian Standards, New Delhi.
3. IS 3495 Part I to IV- 1992, "Methods of Tests of Burnt Clay Building Bricks", Bureau of Indian Standards, New Delhi.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1			1					1		1	3		
2	2	2		1	1					1		1	3		
3	2	2		1						1		1	3		
4	2	2		1						1		1	3		
5	2	2	1	2	1		1			1		1	2	2	
AVg.	2	2	1	1	1		1			1		1	3	2	

1-low, 2-medium,3-high

23CE322	SURVEY LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

Chain Survey

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset
2. Setting out works – Foundation marking using tapes single Room and Double Room
3. Setting out works – Curve marking using tape – offset method

Compass Survey

4. Compass Traversing – Measuring Bearings & arriving included angles

Levelling – Study of levels and levelling staff

5. Fly levelling using Dumpy level & Auto level
6. Check leveling, Measurement of L/S and C/S of Road - Differential Levelling

Theodolite – Study of Theodolite

7. Measurements of horizontal angles by reiteration and repetition and vertical angles
8. Determination of elevation of an object using single plane method when base is accessible/inaccessible.
9. Setting out works – Foundation marking using electronic theodolite

Tacheometry – Tangential system – Stadia system

10. Determination of Tacheometric Constants
11. Heights and distances by stadia Tacheometry

Total Station – Study of Total Station, Measuring Horizontal and vertical angles

12. Traverse using Total station and Area of Traverse
13. Determination of distance and difference in elevation between two inaccessible points using Total station
14. Setting out works – Foundation marking using electronic total station

COURSEOUTCOMES

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

CO1: Conduct chain survey techniques including studying chains, aligning, ranging, chaining, marking, and perpendicular offset for accurate measurements.

CO2: Comprehend compass traversing methodologies, encompassing the measurement of bearings and calculation of included angles.

CO3: Perform levelling techniques, including the study of levels, levelling staff, fly levelling, differential levelling, and road measurement.

CO4: Experiment theodolite operations, including measurements of horizontal and vertical angles, elevation determination, and foundation marking procedures and understand tacheometry principles, including tangential and stadia systems, and apply them to determine constants, heights, and distances.

CO5: Explain the operation of Total Station, including measuring horizontal and vertical angles, traversing, and setting out works.

TOTAL: 60 PERIODS

REFERENCES:

1. “Surveying, Theory and Practice” by James M. Anderson and Edward M. Mikhail, 7th Edition, McGraw Hill, 2001.
2. “Surveying” by Bannister and S. Raymond, 7th Edition, Longman 2004.
3. “Fundamentals of Surveying” by Roy S.K., 2nd Edition, Prentice Hall of India, 2004
4. “Surveying Vol I & II” by Arora K.R., Standard Book house, 10th Edition 2008

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2		2	3				1	1		2	3	1	
2	2	2		2	3				1	1		2	3	1	
3	2	2	1	2	3				1	1		2	3	2	
4	2	2	1	2	3				1	1		2	3	2	
5	2	2	1	2	3				1	1		2	3	3	
AVg.	2	2	1	2	3				1	1		2	3	2	

1-low, 2-medium,3-high

23CE323	BUILDING PLANNING AND DRAWING	L	T	P	C
		0	0	4	2

INTRODUCTION TO REVIT

Introduction to Revit Architecture – Preparation of Plan, Elevation, 3D – Modification Tools – Fixing Building Components – Super Structure and Sub Structure – Fixing Architectural, Electrical and Plumbing fixtures - Rendering

BASIC HOUSE DESIGN

Concept of one and two storey - Split level design. Study of Function, location, shape and size and planning of the following building areas.

Living areas - living rooms, dining room entry way, foyer, patios and porches.
Sleeping areas - bedrooms with and without attached toilets.

Service areas - Kitchen, cabinets, Toilets, washing places, garages.
Fixing the size of doors, windows and sunshades.

PREPARATION OF DRAWINGS

Detailed drawings of floor plans, elevations and sections to show various features in a building.

Preparation of plot plans with a study of property lines - location of building on the site – Key Plan- Landscape plot plans

PREPARATION OF WORKING DRAWINGS

Detailed layout design and drawing of different types of staircases.

Detailed planning and drawing of electrification and Plumbing layout in buildings.
Detailed drawings of septic tank and soak pit with specifications

List of Experiments:

1. DRAFTING TECHNIQUES
2. BASIC HOUSE DESIGN
3. PREPARATION OF DRAWINGS
4. PREPARATION OF WORKING DRAWINGS

COURSEOUTCOMES

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

CO1: Demonstrate proficiency in utilizing Revit Architecture software for the preparation of plans, elevations, and 3D models & Build site plan, landscape design as per NBC.

CO2: Develop detailed drawings of plan, elevation and section of Buildings by computer aided drawing

CO3: Prepare detailed drawings for different types of staircases.

CO4: Develop the plumbing and electrical layout for the buildings.

CO5: Sketch the drawings for septic tank and soak pit

TOTAL: 60 PERIODS

REFERENCES:

1. "Building Drawing" by Shah. M.G, Kale. C.M and Patki. S.Y, Tata McGraw Hill Book Co., 2007.
2. "Architecture, Residential Drawing and Design" by Clois E.Kicklighter., The Good Heart - Willcox Company Inc., 2000.
3. "Architecture, Drafting and Design" by Donald E. Hepler and Paul I. Wallach., Tata McGraw Hill Book Co., New Delhi, 1998.
4. “A Course in Civil Engineering Drawing” by Sikka V.B., 4th Edition, S.K.Kataria and Sons, 2015.
5. “Civil Engineering Drawing and House Planning” by Verma.B.P., Khanna Publishers, 2010.
6. “Building Design and Drawing” by J.S Layal and Dr.Asish Dongre, 2015.
7. “Civil Engineering Drawing” by J.S Layal 2014.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	3		3	1		1	1	1		2	2	3	
2	2	2	3		3			1	1	1		2	3	3	
3	2	2	3		2				1	1		2	3	3	
4	2	1	2		2				1	1		2	2	3	
5	1	1	1							1		1	1	1	
AVg.	2	1	2		3	1		1	1	1		2	2	3	

1-low, 2-medium,3-high

SEMESTER IV

23CE411	MECHANICS OF SOLIDS II	L	T	P	C
		3	0	0	3

MODULE I DEFLECTION OF DETERMINATE BEAMS **9**

Governing differential equation - slope and deflection of beams - Double Integration method - Macaulay's method - Moment area method - Conjugate beam method

MODULE II STATICALLY INDETERMINATE BEAMS **9**

Analysis of propped cantilevers and fixed beams - Analysis of Continuous beams using Theorem of Three moments

MODULE III THEORY OF COLUMNS **9**

Short columns -Stresses due to combined bending and axial Force - core of section - unsymmetrical sections - Elastic buckling of long columns - Euler's theory for long Columns - Critical loads with different end conditions - limitations of Euler's theory - Rankine's formula**.**

MODULE IV THICK CYLINDER AND MEMBER FORCES IN TRUSS **9**

Stresses in thin-walled cylindrical shells - Wire wound cylindrical Vessels - Thick cylinder - Lame's equations. Plane roof trusses – Forces in the member - Method of Joints and method of sections

MODULE V UNSYMMETRICAL BENDING AND SHEAR CENTRE **9**

Analysis of stresses and deflections due to unsymmetrical Bending - Significance of shear centre - Location of shear centre for Thin-walled open sections with one axis of symmetry

COURSEOUTCOMES

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

CO1: Analyze the statically determinate beams subjected to Point load and uniformly distributed load for slope and deflection

CO2: Analyze the statically indeterminate beams subjected to point load and uniformly distributed load for shear force and bending moment.

CO3: Compute the stresses due to combined bending and axial load for short column and critical load calculation for long columns

CO4: Analyze stresses in thin, thick cylinders subjected to fluid pressure and find the member forces for a given plane section.

CO5: Calculate stresses and deflections in thin-walled open sections subjected to unsymmetrical bending, accurately incorporating the location of the shear center.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Essentials of Strength of Materials" by Rajput,R.K., S.Chand & Company Ltd., NewDelhi,2015
2. "Strength of Materials" by Bansal R.K., Laxmi Publications, NewDelhi, 2018.

REFERENCES:

1. “Computational Mechanics of Solids” by Carlos de Sa, by John Wiley & Sons 2020:
2. “Introduction to Continuum Mechanics” by David J. Inman, John Wiley & Sons 2018
3. “Mechanics of Materials” by Punmia B.C, Ashok Jain and Arun Jain, Lakshmi Publications, NewDelhi, 2017
4. ,"Strength of Materials" by Sadhu Singh, Khanna Publishers, NewDelhi,2016

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105108/
2. https://nptel.ac.in/courses/112106141/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	2			1								3		
3	3	2											3		
4	3	2											3		
5	3	3			2								3		
AVg.	3	2			2								3		

1-low, 2-medium,3-high

23CE412	HIGHWAY AND RAILWAY ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I HIGHWAY PLANNING **9**

History of road development in India - IRC, CRRI and NHAI- Importance of roads in India - Classification of roads-Road patterns- New Highway alignment - Factors - Engineering surveys for Highway alignment- Planning Surveys-Master Plan – drawings and reports –Highway Projects in India - Scope of highway Engineering - Passenger Car Unit - Highway Capacity.

MODULE II HIGHWAY GEOMETRIC DESIGN **9**

Highway Cross section elements - IRC standards- Right of way- Sight distance- Simple problems - Design of Horizontal Alignments- Super elevation- Widening of pavement on horizontal curves- Transition Curves-Types- Length-Examples. Design of vertical alignment-Gradient-Types- Vertical curves-Summit curves, Valley curves - Examples – Simple problems.

MODULE III HIGHWAY PAVEMENTS AND MATERIALS **9**

Highway Pavements – flexible – rigid – comparison – soil subgrade, sub base and base course, wearing course – Materials - Properties of aggregates along with their laboratory tests used in road/rail works- Bituminous materials - Types- Requirements – Tests to determine the properties of Bitumen - Various Bituminous mixes - Highway drainage – Significance and requirements

MODULE IV ELEMENTS OF RAILWAY ENGINEERING **9**

Comparison of Railway and Highway transport – organization of Indian railways – Railway board – Zonal railways, Permanent way – Gauges – Railway Track cross section – coning of wheels – Rails, Rail joints – Creep – effects- remedies – Sleepers – Ballast – Sub grade and Embankment –Track alignment- Surveys. Gradients – super elevation and cant deficiency – Negative super elevation-Curves – points and crossings –necessity –Turnouts – Switches – components - types of switches.

MODULE V RAILWAY STATIONS AND SIGNALS **9**

Stations and yards – requirements, classification – operational - functional, layout of station – Platform – Loops, siding and level crossing – Loco sheds – Derailing switches, Fouling marks, Buffer stop – Sand hump – rolling stock- Signalling –Object engineering principles – classification and types - Level crossings – Interlocking - Safety in Railways

COURSEOUTCOMES

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

CO1: Interpret the factors influencing highway design and planning to propose strategic solutions for efficient and sustainable road development in India.

CO2: Apply IRC standards to design safe highway elements with proper horizontal and vertical alignments, sight distances, super elevation, and transition curves.

CO3: Apply appropriate materials and design principles for flexible and rigid pavements, based on material properties and laboratory investigations.

CO4: Apply principles of track alignment, gradients, and signaling to illustrate safe and efficient railway track elements.

CO5: Apply expertise to design railway stations and signaling, emphasizing efficiency, and safety.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Highway Engineering" by Khanna and Justo, by McGraw Hill Education 2020.
2. "Railway Engineering" by Satish Chandra, by Oxford University Press, 2022.

REFERENCES:

1. "Principles, Practice and Highway Engineering" by Kadayali., Khanna Publishers, New Delhi, 2018.
2. "Railway Track Design for High-Speed Trains" by Alejandro S. Garcia, CRC Press, 2019.
3. "Handbook of Highway Engineering" by Kenneth B. Johns, 4th Edition McGraw-Hill, 2019.
4. IRC Codes 15-2002, 37-2001, 38-1988, 52-1988, 62-1976, 66-1976, 73-1980, 58-2002 & IRC SP 23-1993.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105108/
2. https://nptel.ac.in/courses/112106141/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2			2	2						3	2	
2	3	2			1								3	3	
3	3	2			1								3	2	
4	3	2											3	2	
5	3	2	2										3	3	
AVg.	3	2	2		1	2	2						3	2	

1-low, 2-medium,3-high

23CE413	APPLIED HYDRAULICS AND HYDRAULIC MACHINERY	L	T	P	C
		3	0	0	3

MODULE I UNIFORM FLOW IN OPEN CHANNELS 9

Uniform flow - Chezy's equation - Manning's equation - hydraulically best section for circular, rectangular and trapezoidal channels - Flow over notches and weirs

MODULE II NON-UNIFORM FLOW IN OPEN CHANNELS 9

Non-uniform flow - critical depth - specific energy - flow characteristics –application of momentum equation for rapidly varied flow - hydraulic jump – Dynamic equations of gradually varied flow – flow profile classification - surges in channel.

MODULE III IMPACT OF JETS 9

Impulse momentum principle - its applications on impact of liquid jets on plates and vanes at rest and in motion - moment of Momentum equation - its applications on plates and vanes mounted on wheels.

MODULE IV TURBINES 9

Classifications - velocity triangles - work done and efficiencies - Study of Pelton wheel, Franci's turbine and Kaplan turbine - performance of turbines - specific speed – unit quantities - selection of turbines.

MODULE V PUMPS 9

Classification - Centrifugal pumps - work done – multistage pump - minimum starting speed - - specific speed - characteristic curves - Reciprocating pump - work done - effect of acceleration and friction on pressure head – indicator diagram - maximum speed of the pump – air vessels.

COURSEOUTCOMES

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

CO1: Analyse open channels under uniform flow conditions using Chezy's and Manning's equations, and assess the effectiveness of different channel shapes.

CO2: Analyze open channels under non uniform flow characteristics.

CO3: Apply impulse-momentum principles to assess liquid jets interacting with plates and vanes.

CO4: Interpret velocity triangles and choose turbines based on performance criteria.

CO5: Analyze pumps suitability of Centrifugal and Reciprocating Pumps by specifications, principles, and performance for applications

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Hydraulics Fluid Mechanics and Fluid Machines" by Ramamrutham. S, Dhanpat Rai Publishing Company (P) Ltd, 10th Edition, New Delhi, 2022.
2. "Fluid Mechanics, Hydraulics and Hydraulic Machines" by Arora K.R., Standard Publishers & Distributors, 2020.

REFERENCES:

1. "Hydraulics And Fluid Mechanics Including Hydraulic Machines" by Modi.P.N, & Seth.S.M., Standard Book House,22nd edition, New Delhi, 2019.
2. "Text Book of Fluid Mechanics and Hydraulic Machines" by Bansal. R.K., Lakshmi Publications, Madras, 2017
3. "Fluid Mechanics and Hydraulic Machines" by Rajput.R.K., S.Chand and Co, New Delhi, 2016.
4. "Fluid Mechanics" by R. C. Hibbeler, Pearson, 2017.
5. "Introduction to Fluid Mechanics and Fluid Machines" by S K Som; Gautam Biswas and S Chakraborty, Tata McGraw Hill Education Pvt. Ltd., 2021.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103021/

CO-PO&PSOMAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2											3		
2	3	3			1								3		
3	3	2											3		
4	3	2	1										3	2	
5	3	2	2										3	1	
AVg.	3	2	2		1								3	2	

1-low, 2-medium,3-high

23CE414	WATER SUPPLY ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I SOURCES OF WATER 9

Importance and need for planned water supply scheme –Design period- Population forecasting methods -Water demand-types and per capita demand, factors affecting per capita demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir: Mass in-flow curve and analytical methods –Water characterization-physical, chemical and biological – Significance – Drinking Water quality standards (IS, CPHEEO and WHO)

MODULE II CONVEYANCE FROM THE SOURCE 9

Intake structures, need and its types –Pipe materials, pipe appurtenances and valves used in transmission of water- laying, jointing and testing of pipes – Hydraulics design of pressure pipes – Pumps, pumping station and capacity of pumps – Selection of pumps.

MODULE III WATER TREATMENT 9

Screening - Sedimentation – theory, types of settling, Stokes law - Coagulation – theory, chemicals used, flocculation - Jar test – design of sedimentation tank - Filtration – removal mechanisms, filter media, types, slow sand, rapid sand and pressure filters, filter design - Disinfection – methods. Chlorination – action, factors influencing, free chlorination, combined chlorination.

MODULE IV TERTIARY WATER TREATMENT 9

Water softening – Desalination – demineralization – Adsorption - Ion exchange– Membrane Systems – Reverse osmosis - Iron and Manganese removal - Defluoridation - Construction and Operation & Maintenance aspects – Recent advances - MBR process

MODULE V WATER DISTRIBUTION 9

Requirements of water distribution and its method – Components – Service reservoirs – Analysis and design of distribution network by equivalent pipe method and Hardy-Cross method of balancing– Leak detection – Corrosion and its control- Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing - Langelier saturation index (LSI).

COURSEOUTCOMES

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

CO1: Interpret the factors affecting water demand and source selection, design using mass-inflow curves, and find water quality based on relevant standards

CO2: Illustrate the need and economic feasibility in the conveyance of potable water from the source using pipes and pumps.

CO3: Identify the effective water treatment processes for sedimentation, filtration, and disinfection, considering theory, jar tests, and design parameters.

CO4: Interpret advanced water treatment system available in current scenario to provide quality drinking water and specific requirements.

CO5: Apply the Hardy-Cross method to build a water distribution network, assess its performance, including plumbing systems.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. “Water Supply Engineering” by Santhosh Kumar. Garg, Khanna Publishers, 2022
2. “Environmental Engineering” by Joseph Reynolds & Richard Perkins, McGraw-Hill Education, 2019.

REFERENCES:

1. “Handbook of Water Resources Management” by James McWhorter & David Maidment, Springer, 2019.
2. “Water Supply Engineering” by Modi, P.N., Vol.I, Standard Book House, New Delhi, 2019.
3. IS10500:2012, Water Quality Standards, New Delhi 2012.
4. “Environmental Engineering” by Peavy, Rowe, Tchobanoglous, McGraw Hill Publishers, New Delhi, 2017.
5. “Water Treatment Principles and Design” by James M. Montgomery & David B. Russell, John Wiley & Sons, 2nd Edition, 2020.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105104102/
2. https://nptel.ac.in/courses/105106119/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1			1	1						3	2	
2	3	2	2								1		3	3	
3	3	2	3										3		
4	3	2			1								3		
5	3	2	3		1								3	3	
AVg.	3	2	2		1	1	1				1		3	3	

1-low, 2-medium,3-high

23CE415	CONSTRUCTION MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I CONSTRUCTION PROJECT AND ORGANIZATION MANAGEMENT 9

Introduction to Construction projects -Types and its features, Phases of a project - Importance, scope and functions of construction management - Project Organization - Forms of business organization - Structure of construction organization -Management levels - Construction team-Roles, Responsibilities and Skills of construction team - Factors behind the success of a construction projects.

MODULE II TENDERING AND CONTRACTING 9

Tender - Types, Terms and Conditions, Notice Inviting Tender, E-Tender, Transparency, opening, Scrutiny, Acceptance, Rejecting tender- Tender documents - Technical terms - Administrative approval, Technical Sanction, Earnest money deposit (EMD) and Security deposit (SD) - Construction Contract - Introduction, Requirement, Types - Contract documents and Conditions of Contract - Contract agreement, Estimates

MODULE III CONSTRUCTION PLANNING AND SCHEDULING 9

Construction project planning: Objectives, principles and steps in planning - Stages of project planning: Pre-tender planning, Preconstruction planning, Detailed construction planning - Collection of field data, Mobilization Concepts Scheduling techniques: Network analysis - Basic terminologies, Work Breakdown Structure, Computation of project duration, critical path, floats. Critical Path Method (CPM), Program Evaluation and Review Technique (PERT) .

MODULE IV CONSTRUCTION RESOURCE MANAGEMENT 9

Planning and organizing construction site and resources - Site layout including enabling structures, developing site organization, Documentation at site - Measurement book, Muster roll, types of bills and recording - Cash book -Work register - imprest account. Planning for materials, labour and equipment. Resource allocation- resource smoothing and resource leveling- Interface Management Concepts

MODULE V PROJECT MONITORING AND CONTROL 9

Project Monitoring & Control - Supervision, record keeping, periodic progress reports and updation. Common causes of time and cost overruns. Direct and indirect cost related to time.

Costs associated with constructed facilities - Activity crashing - Normal and crashed duration and corresponding cost - Cost slope- Crashing of network to optimize cost and duration of a project. Modern Project management systems: Lean Construction, Use of Building Information Modelling (BIM) in project management.

COURSEOUTCOMES

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

CO1: Identify the factors contributing to a successful construction project by applying knowledge of management functions, team roles, and organizational structures

CO2: Apply tendering procedures to select contractors effectively.

CO3: Understand and craft realistic schedules to optimize construction resource utilization.

CO4: Apply managerial skills to plan efficient resource management for projects.

CO5: Analyze and implement monitoring and control mechanisms for project progress

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Fundamentals of Construction Planning and Management" by Dr.M.R.Sharma, , Kataria and Sons, New Delhi, 2015.
2. "Construction Engineering and Management" by Seetharaman S., Umesh publications, New Delhi, 1997
3. “Construction Project Management” by K. K. Chitkara, Tata McGraw-Hill Publishing Company, 2016.
4. "Construction Project Management: Theory and Practices" by Kumar Neeraj Jha, Pearsons Education India, 2015

REFERENCES:

1. "Project Management for Construction" by Chris Hendrickson, Prentice Hall, 2000.
2. “Implementing Lean in construction- Lean and the sustainability agenda” by C Corfe, CIRIA, C726. London, 2013.
3. “Project Planning and Control with PERT and CPM” by B.C. Punmia, K.K. Khandelwal, Lakshmi Publications, 2022.
4. “Construction Planning, Equipment and Methods” by Robert Peurifoy, Clifford J. Schexnayder and Aviad Shapira, Tata McGraw-Hill Publishing Company, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105104161
2. https://nptel.ac.in/courses/105103093
3. https://nptel.ac.in/courses/105106149

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		1			1			1					2	
2	2		2							1				3	
3	2		3								1			3	
4	2	3							1					3	
5	2	3									2			3	
AVg.	2	3	2			1			1	1	2			3	

1-low, 2-medium,3-high

23CE421	ENVIRONMENTAL ENGINEERING LABORATORY - I	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Determination of Acidity of the given Water/Wastewater Sample.
2. Determination of Alkalinity of the given Water/Wastewater Sample.
3. Determination of Hardness of the given Water/Wastewater Sample.
4. Estimation of Chlorides in the given Water/Wastewater Sample.
5. Determination of Dissolved Oxygen Content in the given Water/ Wastewater Sample.
6. Assessment of Settleable, Total, Volatile, Fixed, Dissolved and Suspended Solids in Water/Wastewater Sample.
7. Determination of pH of the given water sample
8. Assessment of Optimum Coagulant Dose (OCD) to treat the given Water/Wastewater sample.

COURSEOUTCOMES

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

CO1: Understand the chemical and physical properties of water and wastewater samples using laboratory techniques.

CO2: Apply appropriate standard methods to determine alkalinity, acidity, hardness, chloride content, dissolved oxygen, pH, and solids content in water and wastewater samples.

CO3: Interpret dissolved oxygen concentration accurately using appropriate techniques and its significance for water quality.

CO4: Identify the pH of water samples using a calibrated pH meter and assess its impact on water chemistry, aquatic life, and treatment processes.

CO5: Understand water and wastewater treatment processes to identify optimal coagulant doses.

TOTAL: 30 PERIODS

REFERENCES:

1. “Environmental Engineering: Fundamentals, Design, Sustainability” by Richard G. Bauman and Benjamin J. Franklin, John Wiley & Sons, 2023
2. IS 10500, Drinking water Specification, Bureau of Indian Standards, New Delhi, 2023 (Fourth Edition).
3. IS 3025, Methods of sampling and test (physical and chemical) for water and wastewater. Bureau of Indian Standards, New Delhi, 2022(Revised).

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/103107084/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2			1							1	3		
2	3	2			2							1	3		
3	3	2			1		1						3		
4	3	2			1		2						3		
5	3	3	2				2						3		
AVg.	3	2	2		1		2					1	3		

1-low, 2-medium,3-high

23CE422	HYDRAULICS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. Calibration of flow meters
2. Flow through pipes - Major & Minor losses
3. Flow through Orifices & Mouthpieces
4. Flow over Notches
5. Verification of Bernoulli's Theorem
6. Metacentric Height
7. Impact of Jets.

COURSEOUTCOMES

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

CO1: Demonstrate the pressure measurements and flow rates through venturimeter and orifice meter configurations in piping systems.

CO2: Infer the rate of flow of water from a tank and in an open channel.

CO3: Interpret the limitations of Bernoulli's theorem in pipe flow scenarios, accounting for viscosity and friction effects.

CO4: Analyze the metacentric height of the ship model in hydrostatic condition.

CO5: Apply the principles to assess the performance of pumps and turbines using characteristics curves.

TOTAL: 60 PERIODS

REFERENCES:

1. “Practical Hydraulics and Water Resources Engineering” by M. Kay, 3rd Edition, 2020.
2. “Fundamentals of Fluid Mechanics” by Munson, Young, and Okiishi, Latest Edition: 8th Edition, 2023.
3. “Fluid Mechanics” by Frank M. White, Latest Edition: 9th Edition, 2022.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106311/
2. https://archive.nptel.ac.in/content/storage2/courses/112104117/ui/Course_home-7.htm

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2			1					1			3		
2	3	2								1			3		
3	3	3										1	3		
4	3	2								1			3		
5	3	2			1					1					
AVg.	3	2			1					1		1	3		

1-low, 2-medium,3-high

23CE423	CONCRETE LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1 **Study of Equipment & Mix Design**

1. Study of Concrete Mixer, Needle Vibrator, Table vibrator, Moulds, Proving ring, Jacks and Dial gauges
2. Concrete Mix Design as per IS: 10262 - 2019

2, **II. Tests on Cement & Cement Mortar**

3. Normal Consistency and Setting Time of Cement
4. Soundness Test on Cement
5. Compressive Strength Test for Cement
6. Flow Test on Mortar
7. Setting Time of Cement Mortar

3, **III. Tests on Fresh Concrete**

8. Slump Test
9. Compacting Factor Test
10. Vee - Bee Consistometer test
11. Kelly Ball Test

4, **IV. Tests on Hardened Concrete**

12. Compressive Strength of Concrete on Cube and Cylinder
13. Split Tensile Strength of Concrete on Cylinder
14. Modulus of Rupture of concrete

5, **V. Non - Destructive Testing**

15. Ultrasonic Pulse Velocity Test
16. Rebound Hammer Test
17. Windsor Pin System
18. Demo of Core Cutting Machine

COURSEOUTCOMES

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

CO1: Identify and perform Quality Control tests on cement, mortar and concrete as per Indian Standards

CO2: Apply mix proportion principles to design a concrete mix and evaluate the strength of the concrete as per Indian Standard for field applications.

CO3: Apply Indian Standards to determine fresh concrete properties via workability tests.

CO4: Analyze the hardened properties of concrete under tension, compression and transverse loading as per Indian Standards.

CO5: Experiment with the strength of existing concrete structures by performing Non-Destructive Test as per Indian Standards

TOTAL: 60 PERIODS

REFERENCES:

1. "Concrete Technology" by Santhakumar A.R., Oxford University Press, New Delhi, 2023
2. "Concrete Technology" by Krishnasamy K.T., Dhanpat Rai, New Delhi, 2020(14th Edition).
3. "Concrete Technology" by Gambhir M.L., Tata McGraw Hill Publishing Company Limited, New Delhi, 2022(5th Edition).
4. Indian Standards (IS 456-2000, IS 269-2015, IS 516-2019, IS 1786-2018, IS 1893-2016, IS 12269-2015, IS 9103-2020, IS 8112-2013)

ONLINE RESOURCES:

1. http://www.nptel.iitm.ac.in
2. https://freevideolectures.com/course/3357/concrete-technology
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2			2			2	1	1		1	3	2	
2	3	3	3									1	3	3	
3	3	2			2							1	3		
4	3	2			2							1	3		
5	3	2										1	3	1	
AVg.	3	2	3		2			2	1	1		1	3	2	

1-low, 2-medium,3-high

SEMESTER V

		L	T	P	C
23CE511	**STRUCTURAL ANALYSIS I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

MODULE I FUNDAMENTALS OF STRUCTURAL ANALYSIS AND ANALYSIS OF PIN JOINTED SPACE TRUSSES 9

Determination of static and kinematic indeterminacy- Principle of superposition- Analysis of Pin-jointed plane and space trusses by Method of Tension coefficient.

MODULE II ENERGY CONCEPTS 9

Strain energy and Complementary energy - Deflection by strain energy method for statically determinate beams. Virtual work- principle of virtual work for deformable bodies- unit load method - Deflection of determinate beams and plane trusses. Castigliano's theorems - deflection calculation for simple determinate beams - Maxwell's reciprocal theorem for deflection.

MODULE III ANALYSIS OF STATICALLY INDETERMINATE BEAMS AND PLANE TRUSSES 9

Analysis of statically indeterminate beams - Consistent deformation method - Theorem of least work (beams upto 2 degrees of freedom only). Analysis of statically indeterminate plane trusses by Consistent deformation method - Lack of fit - settlement and temperature effects.

MODULE IV ANALYSIS OF ARCHES 9

Analysis of three hinged arches of parabolic and circular profiles - Analysis of two hinged symmetric parabolic and circular arches. Settlement and temperature effects.

MODULE V MOVING LOADS AND INFLUENCE LINES 9

Influence lines for shear force, bending moment and reactions in statically determinate beams - Calculation of shear force and bending moment due to concentrated and distributed moving loads - Influence lines for forces in members of statically determinate plane trusses. Influence lines for reactions, shear force and bending moment in statically indeterminate beams by Muller-Breslau principle - Application of Muller Breslau principle to beams with degree of static indeterminacy not exceeding one.

COURSEOUTCOMES

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

CO1: Identify static and kinematic indeterminacy of structures and calculate the forces of pin jointed structures by method of tension coefficient.

CO2: Apply energy concepts and theorems to find the deflection of statically determinate structures.

CO3: Analyze statically indeterminate beams and trusses by consistent deformation method.

CO4: Analyze two hinged and three hinged parabolic and circular arches to determine bending moment, axial thrust and radial shear force

CO5: Develop ILD and analyze for moving loads in determinate and indeterminate beams

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Structural Analysis" Vol. I & II, by Bhavikatti S.S, Vikas Publishing House (P) Ltd., New Delhi,

2019.
2. “Structural Analysis” by Aslam Kassimali and C. S. Krishna Murthy., 11th Edition, 2022

REFERENCES:

1. “Theory of Structures” by Ramamrutham. S. and Narayan R., Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2016.
2. “Mechanics of Materials” by James M. Gere, Barry J. Goodno, and Stephen P. Timoshenko, 2020.
3. “Advanced Mechanics of Materials and Applied Elasticity” by Ansel C. Ugural., 6th Edition, 2021.
4. "Theory of Structures, Vol. I & II" by Gupta S.P and Pandit G.S, Tata McGraw Hill, New Delhi, 2012.
5. "Computational Structural Mechanics" by Rajasekaran S. and Sankarasubramanian G., Prentice Hall of India, New Delhi, 2012.

ONLINE RESOURCES:

1. https://nptel.ac.in

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2		1	1					1		2	3	1	
2	3	2		1	1					1		2	3	1	
3	3	2	1	1	1					1		2	3	1	
4	3	2		1	1					1		2	3	1	
5	3	2	1	1	1					1		2	3	1	
AVg.	3	2	1	1	1					1		2	3	1	

1-low, 2-medium,3-high

23CE512	DESIGN OF REINFORCED CONCRETE STRUCTURAL ELEMENTS	L	T	P	C
		3	0	0	3

MODULE I MATERIALS FOR CONCRETE AND CONCEPT OF LIMIT STATE DESIGN 9

IS code regulations - Materials for concrete - Stress - Strain curve for concrete in compression – Concrete Grades, Types, Mix proportioning - Types of reinforcement, Grades - Plain and deformed bars - Stress - strain curve for reinforcing steel. Concept of LSD - Characteristic loads and strengths - Partial safety factor. Design of singly reinforced rectangular beams for flexure, shear and torsion.

MODULE II LIMIT STATE DESIGN OF BEAMS 9

Design of doubly reinforced rectangular, lintel and flanged beams for flexure, shear and torsion. Design of continuous beams using B.M. and S.F. coefficients as per IS code - Detailing as per SP34.

MODULE III LIMIT STATE DESIGN OF SLABS 9

Types of slabs - Design of one-way simply supported and continuous slab using BM and SF co-efficient as per IS code - Design of two way, simply supported and continuous slab as per IS code Detailing. Staircase, Loads and types, Design of dog legged staircase slab - Detailing as per SP34.

MODULE IV LIMIT STATE DESIGN OF COLUMNS 9

Design of short rectangular and circular columns subjected to axial compressive load - Design of short columns subjected to combined axial compressive load, uni-axial and biaxial bending moments using Interaction Charts from SP-16- Detailing as per SP34.

MODULE V LIMIT STATE DESIGN OF FOOTINGS 9

Design of wall footings - Design of isolated square and rectangular footings – Design of combined rectangular footings – Detailing as per SP34.

COURSEOUTCOMES

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

CO1: Identify the material properties of concrete and steel, evaluate the strength parameters as per LSM and IS 456-2000 for computing member capacity.

CO2: Analyze and design the beams for flexure, shear, and torsion.

CO3: Design the solid slabs to assess ultimate and serviceability limit states using IS 456 - 2000.

CO4: Design the columns for axial load and bending load using SP16 interaction charts as per LSM and IS 456-2000

CO5: Analysis and design of footings using IS 456-2000 guidelines

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Reinforced Concrete Design" by S. Ramakrishnan, Tata McGraw-Hill Education Co, New Delhi, 2018.
2. "Limit State Design of Reinforced Concrete" by Varghese PC., Prentice Hall of India Pvt. Ltd., 2017.

REFERENCES:

1. "Fundamentals of Reinforced Concrete" by Sinha N.C., and Roy S.K., S.Chand and Company, New Delhi, 2013.
2. IS: 456 - 2000, Indian Standard Code of Practice for Reinforced Concrete, Bureau of Indian Standards, New Delhi.
3. SP- 16 - 2016, Design Aids for reinforced Concrete (Third Revision), Bureau of Indian Standards, New Delhi.
4. SP-34: 2016, Detailing of Reinforcement in Concrete (Second Revision), Bureau of Indian Standards New Delhi
5. "Reinforced Concrete Limit State Design" by Ashok K Jain, New Chand Bros, Roorkee, 2012.
6. “Reinforced Concrete Design” by S.N Sinha, Tata McGraw Hill Publishing Co, New Delhi, 2011.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/105/105105105/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2			1					1		2	3		
2	3	2	1		1					1		2	3		
3	3	2	1		1					1		2	3		
4	3	2	1		1					1		2	3	2	
5	3	2	3							1		2	3	3	
AVg.	3	2	2		1					1		2	3	3	

1-low, 2-medium,3-high

23CE513	MECHANICS OF SOILS	L	T	P	C
		3	0	0	3

MODULE I BASIC SOIL PROPERTIES **9**

Soil formation and soil types – Civil engineering problems related to soils – Nature of soil-Simple definitions – Phase relationships – Classification – IS Classification system. Compaction – Factors affecting compaction – Laboratory and field compaction methods

MODULE II SOIL WATER **9**

Principles of water flow - Darcy's law – Permeability – Laboratory Methods – Field measurement of permeability – Effective stress concept - Dry and saturated soils.

MODULE III STRESS DISTRIBUTION AND CONSOLIDATION **9**

Stress distribution in soil media - Boussinesq's Analysis - Westergaard's Analysis – Intensity of vertical stress using influence charts. Consolidation - measurement of compressibility - e-log P curves - Terzaghi's one dimensional consolidation theory - Determination of coefficient of consolidation.

MODULE IV SHEAR STRENGTH **9**

Shear at a point – Mechanism of shear resistance – Mohr – Coulomb failure criterion – measurement of shear strength - Direct shear test - Triaxial shear test - Unconfined compression strength test - Vane shear test - Shear strength of clay soil - Shear strength of sand.

MODULE V STABILITY OF SLOPES **9**

Types of slopes - Stability of infinite slope - Stability of Finite slope - Total stress Analysis - Swedish circle method – Use of Taylor's stability number – Slope failure mechanism – Effect of Tension cracks.

COURSEOUTCOMES

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

CO1: Understand soil composition, properties, classification, and compaction methods in laboratory and field.

CO2: Apply the concepts of soil permeability, interpreting data from laboratory and field tests.

CO3: Understand the concept of effective stress in soil mechanics and its importance in analyzing stress distribution and deformation behaviour of soils

CO4: Understand the concepts of consolidation including Terzaghi's one-dimensional consolidation theory and computing the settlement of soils under applied loads

CO5: Demonstrate proficiency in analyzing and measuring the shear parameters of soil and apply the same in stability analysis of different type of slopes

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Basic and Applied Soil Mechanics" by Gopalranjan and Rao, ASR, New Age International (P) Limited Publication, New Delhi, Fifth Edition,2023.
2. "Soil Mechanics and Foundation Engineering" by K.R. Arora, Standard Publisher Dist., Standard,

2020.

REFERENCES:

1. "Craig's Soil Mechanics and Foundation Engineering: Principles and Applications (9th ed.)" by Craig, R.F., Taylor & Francis, 2023.
2. "Fundamentals of Soil Mechanics (4th ed.)" by Das, B.M., Pearson Education India,2020.
3. "Textbook of Soil Mechanics and Foundation Engineering: Geotechnical Engineering Series" by Murthy V. N. S., CBS, 2018
4. "Principles of Geotechnical Engineering" by Braja M.Dass and Khaled Sobhan, , Cengagelearning, 2017
5. "Geotechnical Engineering" by Venkatramaiah C., New Age International, Sixth Edition, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103097

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2		1	1					1		2	3		
2	3	2		1	1					1		2	3		
3	3	2		1	1					1		2	3		
4	3	2		1	1					1		2	3	1	
5	3	2	1	1	1					1		2	3	2	
AVg.	3	2	1	1	1					1		2	3	2	

1-low, 2-medium,3-high

23CE521	HIGHWAY ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

TESTS ON COARSE AGGREGATE MATERIALS

1. Calculation of Abrasion value using Los Angeles Abrasion Test
2. Calculation of Toughness value using Aggregate Impact Test
3. Calculation of Crushing Value using Aggregate Crushing Test
4. Calculation of Elongation Index
5. Calculation of Flakiness Index
6. Water Absorption Test.
7. Sieve Analysis Test
8. Bulk Density Test
9. Moisture Content Test
10. Specific Gravity Test

TESTS ON BITUMEN

1. Ductility Test
2. Viscosity Test
3. Softening Point Test
4. Penetration Test

COURSEOUTCOMES

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

CO1: Conduct tests on coarse aggregates, including abrasion, toughness, crushing, and moisture.

CO2: Interpret the tests on bitumen, including ductility, viscosity, softening point, and penetration tests, ensuring quality and performance standards are met.

CO3: Assess the properties of coarse aggregates and bitumen and their suitability for construction applications.

CO4: Apply relevant testing standards and procedures to ensure accurate and reliable results in evaluating coarse aggregates and bitumen for construction projects.

CO5: Interpret test results, identify potential issues or defects, and make informed decisions to maintain material quality and performance standards in highway projects.

TOTAL: 60 PERIODS

REFERENCES:

1. ” Highway Engineering” by Khanna & Justo, 9th Edition, McGraw-Hill Education, 2023.
2. "Highway Engineering" by Khanna.S.K and Justo.C.E.G., A Veeraragavan, Khanna Publishers, Nem Chand & Brothers , 2014.
3. “Highway Material Testing” by S.K.Khanna & C.E.G. Justo, Nem Chand & Bros, Roorkee, 2007.
4. IRC: 94-1986 – Dense Bituminous Macadam.
5. “Quality Assurance Hand book for Rural Roads Vol.1”, National Rural Road Department Agency, May 2007

6. “MORTH Specifications for Road and Bridge works (5th revision)” – IRC, New Delhi, 2013
7. “Highway Material Testing” by S.K.Khanna & C.E.G. Justo, Nem Chand & Bros, Roorkee, 2007.
8. Bureau of Indian Standard Code of Practice for
   Particle Size and Shape IS 2386 – Part I
   Specific gravity, Density, Voids, Adsorption and Bulking IS 2386 – Part III
   Mechanical Properties IS 2386 – 1963 Part IV

ONLINE RESOURCES:
1. https://www.vlab.co.in/broad-area-civil-engineering
2. https://www.ni.com/en/shop/labview/virtual-instrumentation-for-test-control-and-design.html

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1		1	2					1		2	3		
2	3	1		1	2					1		2	3		
3	3	1								1		2	3		
4	3	1		1	2			1		1		2	3		
5	3	2	1	1	1			1		2		2	3	1	
AVg.	3	1	1	1	2			1		1		2	3	1	

1-low, 2-medium,3-high

23CE522	QUANTITY SURVEYING LABORATORY	L	T	P	C
		0	0	4	2

INTRODUCTION AND METHODS OF BUILDING ESTIMATE

General-Units of measurements-Requirements of estimation-Types of estimates – Long wall & Short wall method- Centre Line method – simple problems- Estimate of different foundations, steps and boundary walls-Lump Sum items.

DETAILED ESTIMATE (MANUAL & EXCEL)

Detailed estimate of all items of work – Residential Building – Industrial Building – Staircase – Estimate of R.C.C works

SPECIFICATIONS

Object of specifications – General and detailed specifications for various items of work – Earthwork Excavation – Lime mortar – Cement Concrete – Damp Proof course – Form work – Brick masonry – Stone masonry – Flooring – Painting and wood work.

RATE ANALYSIS

Purpose – Requirements – Schedule of rates and data book – Procedure of rate analysis-Requirement of labour and materials for different works – Obtaining rates for various items of work namely Cement mortar- Cement concrete – R.C.C.- R.R. Masonry – Brick work – Damp proof course – Plastering – Flooring – Weathering course – Pointing – Painting.

VALUATION

Objects of Valuation – Definition of various terms namely free hold property – Lease hold property – Market value – Book value – Assessed value – Replacement value – Gross income – Net income – Capital cost – Dinking fund – Depreciation – Determination of Depreciation – Depreciation methods of Valuation – Fixation of rent – Calculation of standard rent of Government Building.

COURSEOUTCOMES

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

CO1: Apply construction estimating methods for buildings.

CO2: Prepare detailed estimates for residential, industrial buildings & staircases.

CO3: Apply specifications for building construction elements.

CO4: Analyze construction work & determine material, labor and cost requirements.

CO5: Apply the concept of types of valuation to buildings and calculate the cost and rent for the buildings.

TOTAL: 60 PERIODS

REFERENCES:

1. “Introduction to Valuation of Immovable Properties (Basics for Beginners)” by Dr.K.Divakar Star Colour Park India Ltd, Coimbatore, 2020.
2. “Estimating and Costing in Civil Engineering” by B.N Dutta, CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.

3. “Civil Engineering Contracts and Estimates” by B.S.Patil, , 7th Edition, University Press, 2015
4. “Getting more at less cost - The value Engineering way" by Jagannathan, G., Tata McGraw Hill Publishing Company, New Delhi, 2000.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		3										3	3	
2			3										3	3	
3		2												3	
4	1		3										2	3	
5			2											2	
AVg.	2	2	3										3	3	

1-low, 2-medium,3-high

23CE523	GEO-INFORMATICS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. Starting up a GIS map and layer editing & exploring
2. Using tools: Hyperlink, identify and navigate
3. Exploring feature- attribute relationship
4. Exploring benefits of the feature-attribute relationship
5. Creating a map layout
6. Reversing a map layout
7. Finding places by using coordinates
8. Determination of Measurements on maps using Mercator projection, Mollweide projection and Winkel Tripel projection
9. Implementation of Vector and Raster data in ArcMap
10. Working with geographic data and exploring
11. Exploration of Query data based on attributes and locations
12. Analyzing data using Buffer and Overlay
13. Analyzing the GIS analysis process using tools, query and combinations

COURSEOUTCOMES

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

CO1: Apply fundamental GIS functionalities to launch and manipulate GIS maps, edit layers, and utilize tools like hyperlink, identify, and navigate with accuracy

CO2: Analyze feature-attribute relationships and assess the connections between geospatial features and their attributes

CO3: Apply design principles to create visually appealing and informative map layouts.

CO4: Identify the dimensions and distances on maps using different projections

CO5: Integrate vector and raster data, perform attribute and location-based queries, and utilize buffer and overlay tools.

TOTAL: 60 PERIODS

TEXT BOOK:

1. ,"An Introduction to Remote Sensing" by Kevin Munett,2023.
2. "Remote Sensing and Image Interpretation" by John Jensen and John Chipman, 2015

REFERENCES:

1. "Geographic Information Systems and Science" by Paul Longley et al, 2019.
2. "Mastering ArcGIS Pro" by Alison Knapp, 2023.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1		1	3			1		1		2	2		
2	2	2		2	2					2		2	2		
3	1	1	2		1					3		2			
4	2	1			1					1		2	2		
5	2	2		1	3					1		2	2		
AVg.	2	1	2	1	2			1		2		2	2		

1-low, 2-medium,3-high

SEMESTER VI

23CE611	STRUCTURAL ANALYSIS II	L	T	P	C
		3	0	0	3

MODULE I SLOPE DEFLECTION METHOD 9

Application of slope deflection method to the analysis of statically indeterminate beams and rigid jointed plane frames - Effects of settlement of supports for beams only (Examples on structures having Kinematic indeterminacy not exceeding three).

MODULE II MOMENT DISTRIBUTION METHOD 9

Stiffness and carry over factors - Application of the method to the analysis of continuous beams and rigid jointed plane frames- effects of settlement of supports - Symmetric and skew symmetric loadings.

MODULE III MATRIX FLEXIBILITY METHOD 9

Element flexibility - Structure flexibility - Formulation of Structure flexibility matrix - Determination of forces - Application to simple indeterminate beams, frames and trusses.

MODULE IV MATRIX STIFFNESS METHOD 9

Element stiffness - Structure stiffness - Formulation of Structure stiffness matrix - Application to simple indeterminate beams, frames and trusses.

MODULE V FINITE ELEMENT METHOD 9

Basic steps - Concept of an element - Various element shapes - Application of Finite Element Method - Limitations - Element stiffness matrix for one dimensional member - Procedure of assembly and solving equations (No problems).

COURSEOUTCOMES

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

CO1: Examine deflections and internal forces in statically indeterminate beams and rigid jointed plane frames using the slope deflection method for structures, considering support settlement.

CO2: Analyze continuous beams and rigid jointed plane frames subjected to symmetric and skew-symmetric loadings using the moment distribution method, incorporating the effects of support settlement.

CO3: Apply the matrix flexibility method to indeterminate beams, frames, and trusses by formulating structure flexibility matrices, determining forces, and interpreting results.

CO4: Apply the concepts of matrix stiffness method to analyze indeterminate beams, frames, and trusses by constructing structure stiffness matrices and solve for deflections and forces at specified points.

CO5: Summarize the fundamental concepts of the finite element method, including element shapes, limitations, and application to one-dimensional elements.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Structural Analysis" Vol. I & II by Bhavikatti S.S, Vikas Publishing House (P) Ltd., New Delhi, 4th

edition, 2011.
2. "Structural Analysis" by Hibbeler, R.C., Pearson Education Ltd.,10th edition,2023.

REFERENCES:

1. "Mechanics of Materials" by James M. Gere and Stephen P. Timoshenko, 9th Edition ,2023.
2. " Analysis of Structures" by Vazirani V.N. and Ratwani M.M, (10th Edition), S. Chand & Company, 2022.
3. " Mechanics of Structures" by R.C. Hibbeler, (3rd Edition), Pearson, 2020.
4. " Structural Analysis in Theory and Practice" by Sergio Castillioni, (2nd Edition), Springer, 2022.
5. "Mechanics of Structures" Vol.II by Junnarkar and Shah., Charotar Publishing House, Anand, 2012.

ONLINE RESOURCES:

1. https://nptel.ac.in
2. MIT Open Courseware - Introduction to Structural Analysis: https://ocw.mit.edu/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	2			1		2		3	3		
2	3	3	2	1	2			1		2		3	3		
3	3	3	2	1	2			1		2		3	3		
4	3	3	2	1	2			1		2		3	3		
5	2	2			2					2		2	2		
AVg.	3	3	2	1	2			1		2		3	3		

1-low, 2-medium,3-high

23CE612	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I CONCEPTS OF STRUCTURAL STEEL DESIGN **9**

Working Stress Design - Limit State Design - Stress-strain relation of Mild steel - Modified stress-strain diagram - Assumptions in Plastic theory - Collapse load - load factor - plastic bending - Plastic hinge - Plastic moment of resistance - Plastic modulus - Shape factor –

Bolted and welded connections for axial forces- eccentric connections with bolt and weld.

MODULE II CONNECTIONS **9**

Beam to beam connection - framed connection. Beam to column connection - Unstiffened seat connection – stiffened seat connection - double stiffener angle. Moment resistant connections. column and column bases connections subjected to axial and eccentric loads.

MODULE III TENSION MEMBERS **9**

Design of tension members subjected to axial tension- tension member subjected to bending - lug angles. Design of Tension Splice - Concept of Shear lag.

MODULE IV COMPRESSION MEMBERS **9**

Design of compression members with single rolled steel sections - Angle struts. Design of built-up compression members - Design of lacings and battens - Eccentrically loaded column -column splices.

MODULE V BEAMS **9**

Design of laterally and unsupported supported beam for flexure, shear, web crippling and buckling and deflection. Built-up Beams - cross sections - beams with restrained and unrestrained compression flange.

COURSEOUTCOMES

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

CO1: Apply WSD & LSD methods, analyze steel behavior (stress-strain) & plastic design (hinges, moments) and design of bolted/welded connections (axial & eccentric).

CO2: Calculate the member capacities and connection requirements for different member forces of standard steel structural elements

CO3: Apply tension member design for axial & bending loads and analyze tension splices & shear lag effects.

CO4: Apply design methods for compression members with or without lacings/battens subjected to eccentric loads and design of column splices.

CO5: Apply beam design for flexure, shear, buckling, deflection and analysis for built-up sections and flange restraint effects

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Design of Steel Structures" by Subramanian.N, Oxford University Press, New Delhi, 2016.

2. "Limit State Design of Steel Structures" by Duggal.S.K, Tata McGraw Hill Publication, 2019.

REFERENCES:

1. ” Handbook of Steel Design” by Mark Ambrose, ,6th Edition, McGraw-Hill Education, New York, NY, 2024.
2. "Limit State Design of Steel Structures" by Ramachandra, Virendra Gehlot, Scientific Publishers, Jodhpur, 2017.
3. "Fundamentals of Structural Steel Design" by Gambir M.L., Tata McGraw Hill Publication, New Delhi, 2013
4. "Design of Steel Structures by Limit State Design" by Bhavikatti.S.S, , I.K International Pvt. Ltd., New Delhi 2011.
5. IS 800 - 2007, "Code of Practice for use of Structural Steel in General Building Construction" Bureau of Indian Standards, New Delhi

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105162
2. https://nptel.ac.in/courses/105106113

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3		1	1		2		2		3	3	2	
2	3	2	2		1			1		2		2	3	1	
3	3	2	3		1	1		2		2		3	3	3	
4	3	3	1		1	1		1		2		2	3	1	
5	3	1			2					3		2	3	3	
AVg.	3	2	2		1	1		2		2		2	3	2	

1-low, 2-medium,3-high

23CE613	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I SOIL INVESTIGATION AND CHOICE OF FOUNDATION 9

Methods of Soil Exploration - Boring - Sampling - Disturbed and undisturbed Sampling - Sampling techniques - Bore log and soil investigation report - Function and requirements of good foundation - Choice of foundation based on soil conditions.

MODULE II BEARING CAPACITY 9

Bearing capacity of shallow foundations on homogeneous deposit - Terzaghi's Theory - IS Code method - Field tests - Factors influencing Bearing Capacity - Settlement of foundations - Components of settlement - Allowable and maximum differential settlement - Methods of improving bearing capacity - Methods of minimizing settlements.

MODULE III SHALLOW FOUNDATIONS 9

Location and depth of foundations - Types of Isolated footing, Combined footing, Mat foundation - Proportioning of foundations for conventional rigid behaviour – Floating foundation – Applications

MODULE IV PILE FOUNDATIONS 9

Need for deep foundations -Types of piles - classification of piles - Load carrying capacity of piles in granular and cohesive soils-Static and Dynamic formulae - Pile carrying capacity by field tests - Pile load test - Group Capacity - Settlement of Pile groups- Negative skin friction.

MODULE V EARTH PRESSURE ON RETAINING WALLS 9

Earth pressure theory - Plastic equilibrium in soils - active and passive state - Rankine's theory - Coulomb's wedge theory - Earth pressure on retaining walls of simple configurations - Stability of retaining wall -Culmann's graphical method for determining earth pressure.

COURSEOUTCOMES

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

CO1: Understand soil exploration methods (boring, sampling), analyze disturbed/undisturbed samples & techniques

CO2: Apply Terzaghi & IS code methods to analyze bearing capacity & settlement.

CO3: Understand the type of shallow foundations and proportioning them for structural applications.

CO4: Understand the necessity for pile foundation and its types, estimating the load carrying capacity of single pile and group piles and their settlement.

CO5: Analyze retaining wall stability using graphical methods (Culmann) and concepts (active/passive pressure).

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Basic and Applied Soil Mechanics" by Gopal Ranjan and Rao, ASR, New Age International (P) Limited Publication, New Delhi, Fifth Edition,2023.
2. "Foundation Engineering"(9^{th} Edition)” by Varghese P.C., McGraw-Hill Education, New York,

2024.

REFERENCES:

1. “Soil Mechanics and Foundation Engineering” by K.R. Arora, Standard Publisher Dist., Standard, 2020
2. “Textbook of Soil Mechanics and Foundation Engineering: Geotechnical Engineering Series” by Murthy V. N. S., CBS, 2018
3. "Principles of Geotechnical Engineering" by Braja M. Dass and Khaled Sobhan, Cengage learning,2017
4. “Fundamentals of Geotechnical Engineering” by Das, Braja M and Nagaratnam Sivakugan. , Cengage Learning, 2017.
5. “Geotechnical Engineering” by Venkatramaiah, C. New Age International, Sixth Edition, 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105176/
2. National Geotechnical Engineering Society (NGES): https://www.ngs.org/: https://www.ngs.org/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2			2									2		
2	3		2										3		
3	2		3										3		
4	2		3										3		
5	2		3										3		
AVg.	2		3	2									3		

1-low, 2-medium,3-high

23CE621	SOIL MECHANICS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. Grain Size analysis of soil
2. Determination of Specific Gravity
3. Atterberg limits
4. Determination of coefficient of permeability
5. Determination of field density
6. Proctor Compaction Test
7. Direct Shear Test
8. Unconfined compression Test
9. CBR Test
10. Consolidation Test (Concept Only)
11. Triaxial Test (Concept Only)

COURSEOUTCOMES

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

CO1: Conduct soil tests & analyze data to determine engineering properties essential for geotechnical engineering applications.

CO2: Experiment grain size analysis, specific gravity, Atterberg limits, permeability, field density, and Proctor compaction tests.

CO3: Conduct and interpret direct shear and unconfined compression tests, essential for understanding soil strength characteristics.

CO4: Perform CBR tests to determine the load-bearing capacity of soil, critical for pavement design and construction

CO5: Conduct consolidation and triaxial tests to evaluate soil's compressibility and strength properties, essential for geotechnical engineering analysis

TOTAL: 60 PERIODS

REFERENCES:

1. ” Soil Mechanics Lab Manual” by Braja M. Das, (8^{th} Edition), Cengage Learning, 2023.
2. ” Principles of Geotechnical Engineering” by R.F. Craig, (10^{th} Edition), Thomas Telford Publishing, 2023.
3. ” Introduction to Soil Mechanics Laboratory Testing” Dante Fratta, (3^{rd} Edition), CRC Press, 2021.
4. IS Code of Practice 2720 – Indian Standard Code of Practice for Methods of Tests for soil.
5. "Soil Engineering Laboratory Instruction Manual", Published by the Department of Civil Engineering. CIT, Coimbatore, 2008

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105101160

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1		3	1		1	1	2	2		3	3		
2	2	2		3	1			1	2	2		3	3		
3	2	3		3	1			1	2	2		3	3		
4	2	2		3	1			1	2	2		3	3		
5	3	3		3	2			1	2	2		3	3		
AVg.	2	2		3	1		1	1	2	2		3	3		

1-low, 2-medium,3-high

23CE622	PROJECT PLANNING LABORATORY	L	T	P	C
		0	0	4	2

PROJECT PLANNING USING PRIMAVERA AND MS PROJECT

Preparation of Detailed Estimate and Abstract Estimate using Excel

Introduction to project planner and project management - defining administrative categories- - preparing activity areas and bar/Gantt chart areas

Overview about EPS and OBS, Calendars, creating a Project, creating a work breakdown structure, adding activities, creating relationships, scheduling, adding constraints, Maintaining the project documents library, Preparation of Planning stage program with planned stage duration and Planned cost.

Updating and tracking projects using base line producing reports of Actual Duration and Actual cost as per Actual site execution -layout- filter - formatting, printing layout and reports- Planning stage or tendering stage Programme – Tracking stage or monitoring stage Programme – Preparation of S curve of unit based and cost base.

COURSEOUTCOMES

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

CO1: Develop comprehensive project structures and schedules using industry-standard techniques and software.

CO2: Apply tracking, updating, and control methods to ensure projects meet quality, cost, and timeline goals.

CO3: Utilize industry-standard techniques (WBS, OBS, critical path analysis) to effectively manage project scope, resources, and timelines.

CO4: Demonstrate proficiency in project progress reporting, monitoring, control, and report creation.

CO5: Develop schedules considering potential risks and identify mitigation strategies.

TOTAL: 60 PERIODS

REFERENCES:

1. “Project Management for Construction” by Chrisopher R. Thomas, (5th Edition), Blackwell Publishing, 2020.
2. "Elements of Estimating and Costing" by Rangwala S.C., Charotar Publishing House, An and 388001
3. " Planning and managing Projects with P6 Project Planner" by Dr.P.Vinayagam and Dr.A.Vimala, , I.K. International Publishing House Pvt. Ltd., New Delhi, 2015.
4. ” Project Scheduling: Modeling, Planning & Control” by Joseph O’Brien, (6th Edition), McGraw-Hill Education, 2019.
5. ” Construction Project Management: Principles and Practices” by Daniel W. Liston, 7th Edition, John Wiley & Sons, 2023.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1			3		3						3			3	
2			2								3				
3			3							2	3				
4										2	3				
5			2								3				
AVg.			3		3					2	3			3	

1-low, 2-medium,3-high

23CE623	BUILDING INFORMATION MODELLING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Introduction to BIM
2. Level of Detail (LOD) BIM Concepts
3. Evolution and development of BIM & object-based parametric modeling
4. 2D and 3D Exercises
5. Infrastructure Modelling
6. Detailed Architectural BIM Modeling
7. Introduction to GEOBIM exercises
8. Project Scheduling with BIM
9. Generating Good for Construction (GFC) Documentation
10. Mini project

COURSEOUTCOMES

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

CO1: Apply the fundamental principles of Building Information Modeling (BIM)

CO2: Assess the construction processes through Building Information Modelling (BIM)

CO3: Analyze project delivery methods using BIM and related digital technologies

CO4: Prepare detailed architectural BIM models considering materials, spatial relationships, and Level of Detail (LOD)

CO5: Develop project schedules and project management documentation using BIM

TOTAL: 30 PERIODS

REFERENCES:

1. "Project Management using Primavera" by Harris P.E., Eastern Harris Publications, 2nd Edition,2008.
2. M.S. Project – Microsoft Press, 1st Edition, 2003
3. "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors" by Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston, John Wiley & Sons, 2008.
4. "BIM and Construction Management: Proven Tools, Methods, and Workflows" by Brad Hardin, Sybex, 2009.
5. "Building Information Modeling: BIM in Current and Future Practice" by Karen Kensek and Douglas Noble, First Edition, Wiley, 2014.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				3								2		
2			2		3								2		
3			3		3								2		
4	2		3											3	
5			3								3			3	
AVg.	2		3		3						3		2	3	

1-low, 2-medium,3-high

SEMESTER VII

23CE711	WASTE WATER ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I SEWERAGE SYSTEMS 9

Introduction - Necessity and objectives of sanitary engineering projects - Definitions - systems of Sanitation - Quantity of sanitary sewage - variation in quantity of sewage - quantity of storm sewage - Characteristics and composition of sewage - effluent standards - Sampling of sewage - Examination of sewage - DO, BOD, COD and their significance - Cycles of decomposition

MODULE II DESIGN OF SEWERS 9

Components and design period - Hydraulics of sewers - Self cleansing velocity, non-scouring velocity - Design of sewers - Sewer appurtenances - Sewer materials and sewer joints - Construction and maintenance of sewer - Pumping of sewage –House drainage - Sanitary fixtures / fittings - systems of plumbing - Septic tanks and effluent disposal system.

MODULE III PRIMARY TREATMENT OF SEWAGE 9

Objectives and basic principles of sewage treatment - Preliminary treatment - screens – Grit chamber - and Skimming tank - Design of Grit chamber - Primary treatment - Principles of sedimentations - Sedimentation tank types - Design of primary sedimentation tank.

MODULE IV SECONDARY TREATMENT PROCESSES 9

Basic principles of biological treatment - types - Activated sludge process (ASP) - flow diagram - Design of ASP - Oxidation ponds and Aeration lagoons - - Waste stabilization ponds - Trickling filters - types - operational problems - design of high rate and standard rate filters - Process description of Sequential batch reactor (SBR), Upflow anaerobic sludge blanket reactor (UASBR)

MODULE V SLUDGE DIGESTION AND DISPOSAL 9

Sludge disposal - Sludge characteristics - sludge digestion - Digestion process - stages - Design of sludge digesters - Disposal of digested sludge - Use of lagoons for disposal of raw sludge - Effluent disposal - Standards for disposal - Disposal methods – Dilution - zones of pollution in lakes - self-purification of streams - oxygen sag curve - Land disposal- sewage farming.

COURSEOUTCOMES

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

CO1: Explain the sanitation systems, quantify sewage flow and characteristics to evaluate their environmental impact.

CO2: Apply hydraulic principles to analyze and design sewer systems using appropriate materials and components.

CO3: Analyze the preliminary and primary treatment stages in sewage plants and estimate targeted removal efficiencies.

CO4: Analyze and compare various secondary biological treatment processes for sewage and select the most suitable option based on principles.

CO5: Apply sustainable sludge management strategies considering environmental, economic, and social factors.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Wastewater Engineering and Management" by B. C. Punmia and Ashok Jain, Laxmi Publications, 2023
2. “Water Supply and Sanitary Engineering” by Birdie G.S., and Birdie, Dhanpat Rai Publishing Company (P) Ltd. New Delhi, 2023

REFERENCES:

1. "Wastewater Engineering: Treatment and Reuse” by Metcalf & Eddy, McGraw-Hill Education, 2020.
2. "Manual on Sewerage and Sewage Treatment”, CPHEEO, 2013
3. "Sewage Treatment and Disposal” by K. V. S. Gopalakrishnan, Tata McGraw-Hill Education, 2022.
4. "Wastewater Treatment: Concepts, Design, and Approach" by C. L. Karia and R. A. Christian, PHII Learning Private Limited, 2023.
5. "Environmental Engineering-II" by Tata P. Henery and M. M. Elangovan, Tata McGraw-Hill Education, 2023

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/106/105106119/
2. https://nptel.ac.in/courses/105/105/105105048/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
2	3		3										2		
3	2		2										3		
4	3		3										3		
5			3				3						2		
AVg.	3		3				3						2		

1-low, 2-medium,3-high

23CE712	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I CONCEPTS OF PRESTRESSING AND LOSSES 9

Basic concepts, Advantage, Principles of prestressing, Material required-Methods and systems of prestressing - Classification of prestressed concrete structures-Materials-High strength concrete and High strength steel, Losses in prestress, Losses in pretensioned and post tensioned beams. Loss due to elastic shortening, creep, shrinkage, relaxation, friction - Approximate percentage of various losses in pretensioned and post tensioned beams.

MODULE II DESIGN OF FLEXURE MEMBERS 9

Theory and behaviour of prestressed concrete members in bending - Design of prismatic prestressed concrete members for bending for working loads by Magnel's graphical method - Check for ultimate load stage (Limit State Design), calculation of deflections, Design of beams for shear in working and ultimate loads

MODULE III END BLOCK DESIGN, TENSION AND COMPRESSION MEMBERS 9

Design of Anchorage Zone by Guyon's method (simple problems)-Concept of Magnel's method, IS1343 recommendations. Design of tension and compression members-Columns subjected to bending moment and axial compression.

MODULE IV COMPOSITE BEAMS 9

Composite prestressed concrete beams- Design Procedure-Calculation of stresses at important stages both for propped and unpropped constructions-Design of shear connectors- Differential Shrinkage stress.

MODULE V STATICALLY INDETERMINATE STRUCTURES 9

Statically indeterminate structures- continuous beams-Concept of concordant cable and linear transformations- Sketching of pressure lines (simple problems). Partial and circular prestressing (Principles only), prestressed concrete water tank-concept (no problem).

COURSEOUTCOMES

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

CO1: Analysis of prestressed concrete sections for flexure and calculate the losses

CO2: Analyze prestressed concrete beams for bending and shear, through application of analytical methods and graphical techniques.

CO3: Analyze anchorage zones, tension members, and compression members in prestressed concrete sections.

CO4: Apply and implement appropriate design strategies for composite prestressed concrete beams

CO5: Apply the principles of concordant cable, linear transformations, partial prestressing, and circular prestressing in the design of statically indeterminate prestressed structures.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Prestressed Concrete" by Krishna Raju.N, Tata McGraw Hill, New Delhi, 2022.
2. "Limit State Design of Prestressed Concrete" by V.N. Vazirani and M.M. Ratwani, Tata McGraw Hill Education, 2020

REFERENCES:

1. "Design of Prestressed Concrete Structures" by P.C. Varghese, PHI Learning Private Limited, 2021.
2. "Prestressed Concrete Design and Analysis" by P.L. Deodhar, Laxmi Publications, 2023.
3. ,"Handbook on Prestressed Concrete Structures" by V.K. Raina, Tata McGraw Hill Education, 2017.
4. IS 1343:2012 - Code of Practice for Prestressed Concrete, Bureaus of Indian Standards, New Delhi.
5. IS 456:2000 - Code of practice for Plain and Reinforced Concrete, Bureaus of Indian Standards, New Delhi.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/106/105106118/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3		2			1		2		2	3	3	
2	3	2	3	1	1			1		2		2	3	3	
3	3	2	3		1			1		2		2	3		
4	3	2	3		1			1		2		2	3	3	
5	3	3	3		2			1		2		2	3	3	
AVg.	3	2	3	1	1			1		2		2	3	3	

1-low, 2-medium,3-high

23CE713	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I STRUCTURAL DYNAMICS **9**

Basic Concepts of vibration - Equation of motion- D'Alemberts Principle- Single Degree of Freedom system - Idealization of structure as SDOF System - Free vibration - Forced vibration - Damping - Measurement of damping by logarithmic decrement method-Simple problems on SDOF System- Introduction to Multi Degree of Freedom system.

MODULE II ENGINEERING SEISMOLOGY **9**

Elements of Engineering seismology - Reid's Elastic rebound theory- Plate tectonics - Seismic waves - Behavior of RCC, steel and prestressed concrete structures under earthquake loading - Pinching Effect - Bouchinger Effect - Lessons learnt from past earthquakes - Seismograph and Accelerograph - Seismic Zoning map of India.

MODULE III SEISMIC ANALYSIS **9**

Response Spectrum - Modal response contribution - Modal participation factor. Calculation of base shear as per IS 1893-2016 and IS 4326 provisions - Static and Dynamic method - Equivalent Static Lateral force method and Response spectrum method- Seismic Design Concepts.

MODULE IV EARTHQUAKE RESISTANT DESIGN **9**

Design of Beams, Columns - Shear wall - Types of Shear wall - Design of Rectangular Shear wall with boundary elements (IS 13920 -2016) - Introduction to coupled shear wall system.

MODULE V DUCTILE DETAILING **9**

Ductility - Assessment of Ductility - Member / Element Ductility - Structural Ductility - Factors affecting Ductility- Ductile detailing of beams, column, joint and footings and special confining reinforcements as per IS 13920 - 2016. Behaviour of Masonry Structures as per IS 13827 and IS13828. Modern Concepts-Base isolation - Soil structure interaction.

COURSEOUTCOMES

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

CO1: Apply concepts of structural dynamics in determining response of free and forced vibration for a given SDOF and MDOF structural systems.

CO2: Interpret general concepts of earthquake seismology, and its link to society

CO3: Analyze a multi-storeyed structure using Equivalent Static Method and Response Spectrum methods as per IS1893.

CO4: Design and detail the RC structural elements and shear wall for seismic resistance as per IS13920.

CO5: Illustrate ductile detailing of structural elements and behaviour of masonry structures as per IS 13827 and IS 13828 and concept of base isolation.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. "Earthquake Resistant Design of Structures" by Pankaj Agarwal and Manish Shrikhande, PHI

Learning Pvt. Ltd., New Delhi, 2023
2. "Earthquake Resistant of Structures" by Duggal.S.K., Oxford University Press, New Delhi,2018.

REFERENCES:

1. "Dynamics of Structures - Theory and applications to Earthquake Engineering" by Anil K. Chopra, 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2021.
2. "Earthquake Resistant Design of Masonry Buildings" by Miha Tomazevic, 2nd Edition, Imperial College Press, 2020.
3. IS 1893:2016 Part I Criteria for earthquake resistant design of structures: Part 1: General Provisions and Buildings
4. IS 1893: 2014 Part II Criteria for earthquake resistant design of structures: Part 2: Liquid Retaining Tanks
5. IS 4326: 2013 Code of practice for earthquake resistant design and construction of buildings
6. IS 13920: 2016 Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
7. IS 13827: 1993 Improving earthquake resistance of earthen buildings - Guidelines.
8. IS 13828: 1993 Improving earthquake resistance of low strength masonry buildings - Guidelines.
9. IS 13935: 2009 Seismic Evaluation, Repair and Strengthening of Masonry Buildings - Guidelines

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/101/105101004/
2. https://nptel.ac.in/courses/105102016

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3		1	2			1		2		2	3		
2	2	2			1	3				2		2	2		
3	3	3	2		1					2		2	3	2	
4	3	2	3							2		2	3	3	
5	3	2	2							2		2	3	2	
AVg.	3	2	2	1	1	3		1		2		2	3	2	

1-low, 2-medium,3-high

23CE721	COMPUTER APPLICATIONS LABORATORY	L	T	P	C
		0	0	4	2

ANALYSIS AND DESIGN PACKAGES

Introduction to STAAD Pro - Need for computer analysis - Analysis of basic structural elements like simply supported beams, cantilever beams, propped cantilever beams, continuous beams, sinking of supports and fixed beams. Analysis and design of 2D and 3D frames.

Analysis and design of 2D and 3D steel trusses - Analysis and design of RCC 2D and 3D space frames subjected to wind load and seismic load - Analysis, design and modelling of 2D frames and bridge deck with moving load-Analysis and design of rectangular and circular- ground level, underground and elevated water tank with and without bracings.

Design of structural elements like slab, beams, columns and footings Using Excel.

COURSEOUTCOMES

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

CO1: Modeling, Analysis and Design of beams, frames and trusses using STAAD Pro

CO2: Modeling, Analysis and Design of bridge decks for moving loads using STAAD Pro

CO3: Modeling, Analysis and Design of circular and rectangular water tanks using STAAD Pro

CO4: Design of buildings under earthquake loads.

CO5: Design of slab, beams, columns & Footings using EXCEL

TOTAL: 60 PERIODS

REFERENCES:

1. “STAAD Pro – Manual”, volume 1 and 2 by Bentley Systems India private limited, New Delhi.
2. "Analysis and Design of Structures using STAAD Pro" by Dr.P.Vinayagam, Vaghai Publishers, Coimbatore, 2011

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3		3			1		2		2	3	3	
2	3	2	3		3			1		2		2	3	3	
3	3	2	3		3			1		2		2	3	3	
4	3	3	3			2		1		2		2	3	3	
5	2	1	2		1					1		2	2	2	
AVg.	3	2	3		3	2		1		2		2	3	3	

1-low, 2-medium,3-high

23CE722	DESIGN AND DRAWING (CONCRETE & STEEL)	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

CONCRETE

Detailed design and drawing of the following structure

1. One way floor slab and two way floor slab.
2. Continuous beams.
3. Column with footing
4. Dog legged staircase
5. Water tanks – Underground & On-ground (Rectangular & circular)
6. Retaining walls – (Cantilever & Counterfort)

STEEL

Detailed design and drawing of the following structure

1. Bolt Connections - framed, stiffened seat & unstiffened seat connections
2. Welded Connections - framed, stiffened seat & unstiffened seat connections
3. Tension and compression splices
4. Battened and Laced Columns
5. Column bases
6. Welded plate girders
7. Gantry girder

COURSEOUTCOMES

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

CO1: Outline the reinforcement sketch for the slabs, beams, columns, footings, joints, water tanks and retaining walls as per IS Provisions.

CO2: Calculate the bar bending schedule of steel elements and quantitate

CO3: Outline the details of connections, splices, columns, column bases and plate girders of steel structures

CO4: Apply the software tools for detailing the structural concrete and steel elements.

CO5: Apply the software tools for bar bending schedule for the structural concrete and steel elements.

TOTAL: 60 PERIODS

TEXT BOOK:

1. "Structural Design and Drawing" by Krishnamurthy,D., CBS Publishers and Distributors, Delhi, 2020.
2. "Design of Steel Structures" by Subramanian.N, Oxford University Press, New Delhi, 2022.
3. "Limit State Design of Steel Structures" by Duggal.S.K, Tata McGraw Hill Publication, 2018.
4. "Structural Design and Drawing" by Krishnaraju, N., Oxford University Press, 2022.

REFERENCES:

1. "Design of Steel Structures by Limit State Design" by Bhavikatti.S.S, I.K International Pvt. Ltd., New Delhi 2023.

2. "Limit State Design of Steel Structures" by Ramachandra, Virendra Gehlot, Scientific Publishers. Jodhpur, 2022.
3. "Limit State Design in Structural Steel" by Shiyekar.M.R., PHI learning Pvt. Ltd., Delhi, 2020.
4. IS 800 - 2007, "Code of Practice for use of Structural Steel in General Building Construction", Bureau of Indian Standards, New Delhi.
5. SP6: Part 1: 1964, Handbook for Structural Engineers - Structural Steel Sections
6. IS 801:1975, "Code of Practice for use of cold formed light gauge steel structural members in general construction," Bureaus of Indian Standards, New Delhi.
7. S. N. Sinha, "Reinforced Concrete Design", Tata McGraw Hill Edition, 2020.
8. "Design of Reinforced Concrete Structures" by M. L. Gambhir, PHI Learning Pvt. Ltd., 2023.
9. IS 456 - 2000, "Code of practice for Plain and Reinforced Concrete" Bureau of Indian Standards, New Delhi.
10. SP34 - 1987, "Handbook on Concrete Reinforcement and Detailing", Bureau of Indian Standards, New Delhi.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105105/
2. https://nptel.ac.in/courses/105105162

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	3		3			1		2		2	3	2	
2	2	1	2		2					2		2	2	1	
3	3	1	3					1		2		2	3	2	
4	2	1	1		3					1		2	2		
5	2	1	1		3					1		2	2		
AVg.	2	1	2		3			1		2		2	2	2	

1-low, 2-medium,3-high

23CE723	ENVIRONMENTAL ENGINEERING LABORATORY – II	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Assessment of Available Chlorine in the given Bleaching powder sample
2. Estimation of Residual Chlorine of the given Polluted Water/Wastewater Sample.
3. Assessment of Biochemical Oxygen Demand (BOD) of the given Water/Wastewater Sample.
4. Assessment of Chemical Oxygen Demand (COD) of the given Water/Wastewater Sample
5. Spectrophotometric determination of sulphates in a given Water Sample.
6. Air pollution assessment - PM10
7. Air pollution assessment - PM2.5
8. Air pollution assessment - gaseous pollutant
9. Determination of Lead in water sample using AAS

COURSEOUTCOMES

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

CO1: Outline the suitability of water samples for drinking and construction purpose.

CO2: Interpret the suitability of wastewater samples as per effluent standards.

CO3: Calculate the degree of treatment based on the results of water and wastewater samples.

CO4: Determine the ambient air quality of given study area in terms of Particulate and Gaseous Pollutants

CO5: Experiment water and wastewater treatment processes by determining the Chemical Oxygen Demand

TOTAL: 30 PERIODS

REFERENCES:

1. "Environmental Engineering Laboratory manual", Published by the Department of Civil Engineering, Coimbatore Institute of Technology, Coimbatore, 2018.
2. IS 3025, Methods of sampling and test (physical and chemical) for water and wastewater. Bureau of Indian Standards, New Delhi, 1986.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/103107084/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						2						2		
2	2						3						2		
3	3		2										3		
4	2						3						1		
5	2		1		2								3		
AVg.	2		2		2		3						2		

1-low, 2-medium,3-high

PROFESSIONAL ELECTIVES

COURSE CODE	DESIGN OF CONCRETE STURCTURES	L	T	P	C
		3	0	0	3

MODULE I YIELD LINE THEORY **9**

Introduction to yield line theory of slabs - Application to square, rectangular, triangular and circular slabs with simply supported or fixed boundary conditions subjected to uniformly distributed loads (by upper bound theorem).

MODULE II RETAINING WALLS **9**

Design of gravity and cantilever retaining walls for level surface filled with/without uniform surcharge-stability requirements - Description of inclined backfill (no problems)-Counterfort-Introduction and concepts only.

MODULE III BUILDING FRAMES **9**

Difference between multi-storeyed load bearing and framed structures-Elastic analysis using substitute frames for gravity loadings approximate analysis of single and two bay frames up to 3 storeys for lateral loads using portal and cantilever methods.

MODULE IV GROUND AND UNDER GROUND WATER TANK **9**

Classifications- Design of ground level square and rectangular tanks – IS code IS 3370 Pt IV coefficients. Design of underground rectangular tank.

MODULE V OVERHEAD WATER TANK AND BRIDGES **9**

Introduction to overhead rectangular, circular and Intze type tanks with staging. Design of circular water tank-Design of ring beam-staging- Types of bridges - IRC loadings - Design of single span slab bridges for class a loading only (Restricted to two lane).

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply the upper bound theorem to analyze and design square, rectangular, triangular, and circular slabs with various boundary conditions under uniform loads for optimized slab design.

CO2: Evaluate and design gravity counterfort and cantilever retaining walls for diverse scenarios (level surface with/without surcharge), adhering to stability requirements.

CO3: Analyses the substitute frames for gravity loads and portal/cantilever methods for lateral loads.

CO4: Design of ground-level and underground rectangular tanks, leveraging IS code provisions. Select and design suitable overhead tanks and their staging systems, considering diverse loading and functional requirements.

CO5: Apply IRC codes to design single-span slab bridges for A Class loading (two lanes).

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Reinforced Concrete Design", by Unnikrishna Pillai and Devados Menon, Tata Mc Graw Hill Publishing Co, New Delhi, 2021.

2. "Advanced Reinforced Concrete Design", Krishna Raju N., CBS Publishers and Distributors, Delhi, 2016.

REFERENCES:

1. "Seismic Design of Concrete structures" by Park, R., Paulay, T., & Priestley, M.J.N. (2nd edition), John Wiley & Sons, 2017.
2. "Reinforced Concrete Limit State Design" by Ashok K Jain, New Chand Brothers, Roorkee, 2012.
3. "Plain and Reinforced Concrete" Vol.I and Vol. II, by Jain, O.P and Jaikrishna Nemchand and Brothers, Roorkee, 2007.
4. "Structural Analysis in Theory and Practice" by Sergio Castillioni, (2nd Edition), Springer, 2022.
5. "IS 456 - 2000 Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.
6. "IS 3370 (Part I) - 1965 (Re-established: 1999) - Code of Practice for Concrete Structures for the Storage of Liquids", Bureau of Indian Standards, New Delhi.
7. "IS 3370 (Part III) - 1965 (Re-established: 1999) - Code of practice for Concrete Structures for the Storage of Liquids", Bureau of Indian Standards, New Delhi.
8. "IRC: 5 - 1998 - Standard Specification and Code of Practice for Road Bridges (Section I)", Bureau of Indian Standards, New Delhi.
9. "IRC: 6 - 1966 - Standard Specification and Code of Practice for Road Bridges (Section II)", Bureau of Indian Standards, New Delhi.
10. "IRC: 21 - 2000 - Standard Specification and Code of Practice for Road Bridges (Section III)", Bureau of Indian Standards, New Delhi.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105216/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		3		2								3		
2	3		3				2						3		
3	3		2										3		
4	3		3										3	2	
5	3		3												
Avg.	3		3		2		2						3	2	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I DESIGN OF LONG COLUMNS AND DEEP BEAMS 9

Design of long column subjected to biaxial bending moment and axial load, SP 16. Behavior of deep beams - Designs as per IS 456 - 2000.

MODULE II CHECK FOR SERVICEABILITY 9

Limit State of Serviceability - calculation of deflection and cracking - Check for deflection and cracking as per IS 456 - 2000.

MODULE III DESIGN OF FLAT SLAB AND GRID FLOOR 9

Grid and coffered floors, general features, rigorous and approximate method of analysis and design of grid floor - Design of flat slab with and without drop, column and middle strip, proportioning of flat slab element as per IS 456-2000

MODULE IV LIMIT ANALYSIS 9

Limit Analysis of RCC structures - Fundamental principles, concept of moment redistribution - moment rotation characteristics permissible rotation capacity - Cambridge method - A.L.L. Baker's method of Limit analysis.

MODULE V TALL STRUCTURES 9

Analysis of R.C. Chimneys by Elastic theory - Design by LSD. Design of square bunker using Rankine's theory. Design of circular Silo using Jansen's theory and Airy's theory (Derivation not required for both theories).

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Design long columns under biaxial bending and axial loads and deep beams, handling complex bending scenarios in concrete elements.

CO2: Assess deflection and cracking in concrete structures using Limit State of Serviceability principles. Effectively controlling deflection and cracking within permissible limits to ensure structural functionality.

CO3: Analysis and design of grid floors and flat slabs with/without drops, employing both rigorous and approximate methods.

CO4: Apply limit analysis principles to assess ultimate bearing capacity of RCC structures.

CO5: Evaluate and apply appropriate theories to design diverse tall structures in selecting and implementing suitable methods for each scenario. Apply IRC codes to design single-span slab bridges for A Class loading (two lanes).

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Limit State Design of Reinforced Concrete” by P.C. Varghese, PHI Learning Private
2. "Advanced Reinforced Concrete Design" by Krishna Raju N., CBS Publishers and Distributors, Delhi, 2016.

REFERENCES:

1. “Plain and Reinforced Concrete" by Jain and Jai Krishna., Nem Chand Brothers, Roorkee, 2010.
2. IS 456:2000 Plain and Reinforced Concrete, Bureau of Indian Standards (BIS).
3. SP 16 Design Aids for Wind Loading on Helical Piles, BIS.
4. “Limit State Design of Concrete Structures” by M.L. Gambhir, Macmillan India Ltd., Delhi, 2011.
5. “Design of Reinforced Concrete” by Structures,S. Ramamrutham, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2011.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105105/

CO - PO & PSO MAPPING

CO	PO												PSO		
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5	3		3										3		
Avg.	3		3										3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF BRIDGES	L	T	P	C
		3	0	0	3

MODULE I REINFORCED CONCRETE DECK SLAB BRIDGES 9

Introduction - Classification of Bridges - Types of IRC loadings - Design of solid deck slab bridges for IRC loading -Concept of design of skew slab bridges.

MODULE II REINFORCED CONCRETE TEE BEAM AND DECK SLAB BRIDGES 9

Design of tee beam and deck slab bridges- Courbon's theory - Pigeaud's curves -Concept of balanced cantilever and continuous bridges.

MODULE III PRESTRESSED CONCRETE BRIDGES 9

Design of prestressed concrete bridges -Design of girder section -Maximum and minimum prestressing forces -Eccentricity -Check for stresses at various sections -Design of End block.

MODULE IV STEEL BRIDGES 9

Design of through type and deck type steel highway bridges for IRC loading - Design of stringers, cross girders and main girders.

MODULE V BRIDGE BEARINGS 9

Types of bearings - Design of steel roller and rocker bearings - Design of RC rocker bearing - Design of elastomeric pad bearing

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply IRC codes and design principles to analyze and design solid deck slab bridges for various loading conditions, demonstrating comprehension of skew slab bridge design concepts.

CO2: Illustrate Courbon's theory and Pigeaud's curves to design tee beam and deck slab bridges, differentiating between balanced cantilever and continuous bridge behavior.

CO3: Design prestressed concrete bridge sections, calculating prestressing forces, eccentricity, stresses, and end block dimensions, ensuring structural integrity.

CO4: Analyze and design through and deck type steel highway bridges for IRC loadings, focusing on stringers, cross girders, and main girders.

CO5: Select and design appropriate bridge bearings based on loading and structural requirements.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Design of Bridges", by Krishna Raju, N., Oxford & IBH Publishing Co. Pvt. Ltd., 2018.
2. "Essentials of Bridge Engineering" by Johnson Victor, D, Oxford and IBH Publishing Co., 2019.

REFERENCES:

1. "Bridge Engineering" by Ponnuswamy S., Tata McGraw-Hill, 2019.
2. “Concrete Bridge Practice” by Raina.V.K, Tata McGraw Hill, 2007.
3. IRC 5:1998 Standard Specifications and code of practice for Road Bridges, Section I - General.
4. IRC 6:2014 Standard Specifications and code of practice for Road Bridges, Section I - Loadings.
5. IRC 83:2015 Standard Specifications and code of practice for Road Bridges, Bearings.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ce63/preview/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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5	3		2										3		
Avg.	3		3		2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED STEEL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PLASTIC ANALYSIS AND CONNECTIONS 9

Plastic Analysis - Kinematic theorem, Static theorem and Uniqueness theorem - Propped cantilevers - Fixed beams and Continuous beams - Portal Frames. Connections - flexible, semi-rigid and rigid or moment resisting connections. Column cap.

MODULE II STEEL TOWERS 9

Transmission line towers - Micro Wave Towers - Loads on Towers - Shape, Sag and Tension in Uniformly loaded conductors - Analysis of towers - Design of member in towers - Design of tower foundations.

MODULE III INDUSTRIAL BUILDINGS 9

Components of Industrial Structures - Design of Gantry Girder. Welded Plate Girder – Elements of Plate Girder. Design of roof truss - Analysis and Design of Single Bay Gable Frame with Knee Bent.

MODULE IV CHIMNEY 9

Analysis and Design of self-supporting steel Chimney – Design of Chimney base plate – Design of Chimney foundation.

MODULE V LIGHT GAUGE STEEL MEMBERS 9

Light gauge sections - types of sections, material - local buckling of thin elements - stiffened and multiple stiffened compression members - Unstiffened elements - Laterally supported and unsupported flexural members.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply plastic analysis theorems to optimize steel structures and design flexible, semi-rigid, and rigid connections.

CO2: Analyze and design transmission line and microwave towers, incorporating loads, conductor tension, and member design, while ensuring foundation stability.

CO3: Develop and optimize industrial structures like gantry girders, welded plate girders, roof trusses, and single-bay gable frames with knee bents.

CO4: Analyze and design self-supporting steel chimneys, including base plate and foundation, considering wind, seismic, and thermal loads for structural integrity.

CO5: Evaluate and implement appropriate light gauge steel members for compression and flexural applications, ensuring efficiency, safety, and consideration of local buckling.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Design of Steel Structures” by Subramanian. N, Oxford University Press (3rd edition). New Delhi, 2017.
2. “Limit State Design of Steel Structure” by Duggal. S. K, Tata McGraw Hill Publication, 2011.

REFERENCES:

1. "Design of Steel Structures" by Jayagopal. L. S., Tensing. D., Vikas Publications House Ltd, Noida.
2. "Design of Steel Structures by Limit State Design" by Bhavikatti. S. S, I.K International Pvt. Ltd., New Delhi 2011.
3. "Limit State Design in Structural Steel" by Shiyekar. M.R., PHI learning Pvt. Ltd., Delhi, 2013.
4. IS 800 - 2007, Code of Practice for use of Structural Steel in General Building Construction, Bureau of Indian Standards, New Delhi.
5. IS 801: 1975, Code of Practice for use of cold formed light gauge steel structural members in general construction, Bureau of Indian Standards, New Delhi.
6. IS 802: Part 1 Section - 1, Code for Practice for use of Structural Steel in Overhead Transmission line Towers, Materials and Loads and Permissible Stresses, Bureau of Indian Standards, New Delhi, 1995
7. IS 6533-2 (1989), Code of Practice for Design and Construction of Steel Chimney, Bureau of Indian Standards, New Delhi, 1989.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_oe02/preview/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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5	3		3		2										
Avg.	3		3		2		2						3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

MODULE I BASIC CONCEPTS **9**

Indeterminacy - Static, Kinematic - Generalized measurements - Degrees of Freedom - Constrained measurements - Behavior of Structures - Principle of Superposition - Equilibrium, Compatibility and Force displacement relations.

MODULE II ENERGY CONCEPTS **9**

Strain energy; stiffness and flexibility matrices for strain energy - Betti's law and its applications - Properties of stiffness and flexibility matrices - Contra gradient law- Coordinate transformations - Transformation of element matrices to structure matrices - orthogonal transformations.

MODULE III MATRIX STIFFNESS METHOD **9**

Transformation of element stiffness matrices from local to global coordinates – Application of direct stiffness method to two span continuous beams and pin-jointed plane frames (frames of maximum three members) - Advantages of direct stiffness method.

Element stiffness matrices for truss, beam and plane frame elements - Development of structure stiffness matrix by element approach Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by matrix stiffness approach.

MODULE IV MATRIX FLEXIBILITY METHOD **9**

Element flexibility matrices for truss, beam and plane frame elements - Development of structure flexibility matrix by element approach –Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by flexibility matrix approach.

MODULE V FINITE ELEMENT METHOD **9**

Introduction to finite element analysis – Concept of discretization of continuum - Finite element analysis procedure – Relevant basics of elasticity – Stress-strain relation (Constitutive relation) - Strain-displacement relation – Concept of strain-displacement matrix – Types of 1-D, 2-D and 3- D finite elements –Displacement function – Convergence and compatibility requirements - Development of shape functions for truss element (2-noded and 3-noded), beam element and CST element

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply fundamental principles of indeterminacy, degrees of freedom, structural behavior, and equilibrium to analyze and solve basic structural problems using superposition, compatibility, and force-displacement relations.

CO2: Apply energy principles to develop stiffness and flexibility matrices, understanding their properties and transformations.

CO3: Employ stiffness method to analyze two-span continuous beams and pin-jointed plane frames, understanding the advantages and limitations of this method.

CO4: Analyze statically indeterminate beams and plane frames using the flexibility matrix method, in both stiffness and flexibility approaches.

CO5: Develop finite element models for basic trusses, beams, and plates, employing discretization, stress-strain relations, and shape functions.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Advanced Structural Analysis" by Kasiraj B.M., Alpha Science International" (2nd edition)., New Delhi, 2014.
2. "Finite Element Analysis – Theory and Programming (Revised Edition)" by Krishnamoorthy, C. S. Tata McGraw Hill, New Delhi, 2022.

REFERENCES:

1. "Structural Analysis" by Pearson Education, Hibbeler R. C., New Delhi, 9th ed., 2017.
2. "A Unified Classical and Matrix Approach" by Ghali A., Neville A. M. And Brown T. G., Structural Analysis –Spoon Press, London and New York, 2017.
3. "Computational Structural Mechanics" by Rajasekharan S. and G. Sankarasubramanian, Prentice Hall of India, New Delhi, 2012.
4. "Elements of Matrix and Stability Analysis of Structures" by Manicka Selvam V.K., KhannaPublishers, Delhi, 2010.
5. "Advanced Structural Analysis" by Desayi, P., Krishnamurthy, C.S., Oxford University Press, Oxford, UK, 2017.

ONLINE RESOURCES:

1. https://nptel.ac.in

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2										3		
2	3				1								3		
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5	3				2								3		
Avg.	3	2	2		2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF PREFABRICATION 9

Types of prefabrication - Advantages and disadvantages of prefabrication-Economy of prefabrication - Modular coordination - Standardisation - Prefabrication system and structural schemes - Prefabricated elements - Beams - Columns - Slabs-Roof and floor panels - Wall panels – Staircase.

MODULE II PRECAST CONCRETE-MANUFACTURING AND ERECTION TECHNIQUES 9

Standard practices and techniques of precast concrete manufacturing and handling -Cycle of precasting - Reinforcement- Preparation of moulds -Preparation and transportation of concrete-Production tolerances -Transportation and erection of prefabricated elements - Equipments for handling precast elements.

MODULE III DESIGN PRINCIPLES 9

Disuniting of structures-Structural behaviour of precast structures - Handling and erection stresses - Design of cross section based on efficiency of material used- Problems in design because of joint flexibility-Allowance for joint deformation.

MODULE IV JOINTS AND CONNECTIONS 9

Types of precast element connections - Column to foundation connections -Column to column connections-Beam to column connections-Beam to beam connections-Floor to beam connections-Wall to wall connections- Joints for different structural connections - Dimensioning and detailing of joints for different structural connections - Construction and expansion joints in precast construction.

MODULE V DESIGN PRINCIPLES FOR ABNORMAL LOADS 9

Code provisions- Equivalent design loads for considering abnormal effects such as earthquakes, cyclones - Progressive collapse -Importance of avoidance of progressive collapse.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate and select appropriate prefabrication systems and elements based on economic, standardization, and structural considerations.

CO2: Plan and manage the precast concrete production process, including reinforcement, mold preparation, concrete handling, transportation, and erection, ensuring quality and safety.

CO3: Design precast concrete structures for efficient material use, considering handling and erection stresses, joint flexibility, and potential deformation issues.

CO4: Develop and detail efficient and structurally sound connections for precast elements, ensuring proper load transfer and stability.

CO5: Analyze robust design solutions for precast structures using relevant code provisions and methods, addressing abnormal loads and ensuring progressive collapse resistance.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Precast Concrete Handbook", by PCI Committee on Buildings, 9th Edition, Precast / Prestressed Concrete Institute, Chicago, 2017.
2. "Precast Concrete Construction", by Menn, C., Ernst & Sohn, Berlin, 2016.

REFERENCES:

1. "Precast concrete materials, Manufacture properties and usage", by Levit M., Applied Science Publishers, London, 2000.
2. "IS 15627:2008 Precast Concrete Blockwork for Load-Bearing Walls", Bureau of Indian Standards (BIS)
3. IS 15916-2010: "Indian Standard Code of Practice for Building Design and erection using Prefabricated Concrete", Bureau of Indian Standards, New Delhi.
4. "Precast concrete Connection Details", Structural Design Manual, Society for the Studies in the use of Precast Concrete, Netherland Behor Verlag, 2009.
5. "Precast Concrete Structures", by Nawy, E.G., John Wiley & Sons, Hoboken, NJ, 2013.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/124/105/124105013/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		2		1								3	2	
2			3		2	2							3	3	
3	3		3										3		
4	3		3										3		
5	3		3										3		
Avg.	3		3		2	2							3	3	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

MODULE I BASICS OF FINITE ELEMENT METHOD 9

General description - Basic element shapes - Discretization process - Node numbering – Mesh generation - Steps involved in finite element method - Application of finite element method - Advantages and disadvantages of finite element method.

MODULE II APPROXIMATE METHODS OF ANALYSIS 9

Energy principles - Variational methods - Rayleigh Ritz method - Method of collocation - Subdomain method - Galerkin Method - Least squares approach

MODULE III ANALYSIS OF TRUSSES 9

Stiffness matrix for an axial element - Direct stiffness approach - Element assembly into global stiffness matrix -two dimensional trusses - displacement of joints - forces in the members.

MODULE IV ANALYSIS OF BEAMS AND FRAMES 9

Beam stiffness - Direct stiffness approach - Element assembly into global stiffness matrix –solution for beam problems - Two-Dimensional beam element - rigid plane frames.

MODULE V PLANE STRESS AND PLANE STRAIN PROBLEMS 9

Basic concepts of plane stress and plane strain - derivation of stiffness matrix for constant - strain, linear strain triangular elements - rectangular elements - Iso-parametric elements - Lagrange and Serendipity elements - static condensation - axisymmetric elements.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply the fundamental principles of the finite element method (FEM) to discretize and analyze simple engineering problems, understanding its strengths and limitations.

CO2: Formulate and apply various approximate methods to solve simple engineering problems, comparing their strengths and weaknesses.

CO3: Develop and implement the direct stiffness method to analyze two-dimensional trusses, calculating joint displacements and member forces.

CO4: Apply the direct stiffness approach to analyze beams and rigid plane frames, formulating element stiffness matrices, assembling the global system, and solving for displacements and internal forces.

CO5: Analyze and evaluate the performance of different element stiffness matrices) for triangular, rectangular, and iso-parametric elements in solving plane stress and plane strain problems.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "A First Course in Finite Element Method", by Daryl L Logan, 6th Edition, CengageLearning, 2016.
2. "An Introduction to Finite Element Method", by Reddy J N, 3rd Edition, McGraw HillEducation, 2015

REFERENCES:

1. "Introduction to Finite Elements in Engineering", by Tirupathi R. Chandrupatla, Ashok D. Belegundu 4th Edition, Pearson, 2011.
2. "Finite Element Analysis", by Krishnamoorthy C.S, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. "Finite Element Analysis in Engineering Design", by Rajasekaran S, S.Chand and Company Ltd., 2003.
4. "Applied Finite Element Analysis", by Larry J.Segerlind, by John Wiley and Sons, New York, 2010.
5. "Concepts and Applications of Finite Element Analysis", by Robert D. Cook, David S. Malkus, John Wiley and Sons, India Edition, 2007.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_me43/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
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5	3				1								3		
Avg.	3		3		2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Planning of an industrial building based on the functional requirements, Lighting and ventilation – Fire safety norms – Protection against noise and vibration - factories act, Different types of loadings.

MODULE II INDUSTRIAL BUILDINGS 9

Roofs for industrial buildings – Steel and RCC - Design of Roof - Pre-Engineered Buildings - Design of multi storied deck slab, Steel platform.

MODULE III MATERIAL HANDLING SYSTEMS 9

Cranes -Types-design of EOT - Manual overhead cranes - Design of A-cranes, Monorails. Design of conveyers, conveyer towers.

MODULE IV INDUSTRIAL STORAGE STRUCTURES 9

Beam stiffness - Direct stiffness approach - Element assembly into global stiffness matrix –solution for beam problems - Two-Dimensional beam element - rigid plane frames.

MODULE V BEHAVIOUR OF LATERAL LOAD RESISTING SYSTMES 9

Lateral load resisting systems – structural walls – shear walls.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Develop and design industrial buildings considering functional needs, lighting, ventilation, fire safety, noise/vibration control, statutory requirements, and various loading types

CO2: Analyze and design roof systems (steel and RCC), pre-engineered buildings, multi-storied deck slabs, and steel platforms for industrial applications.

CO3: Apply engineering principles to design and analyze various material handling systems, including EOT cranes, manual overhead cranes, A-cranes, monorails, conveyors, and conveyor towers.

CO4: Perform structural design of silos and bunkers, including their supporting systems, considering specific storage requirements and loading conditions.

CO5: Evaluate and design efficient lateral load resisting systems (structural walls, shear walls) for industrial buildings, ensuring structural stability.

TOTAL: 45 PERIODS

TEXT BOOK:

1. ” Seismic Design of Industrial Buildings”, by Satyendra Gupta and Ajay Gupta, 2014.
2. “Design of Industrial Structures”, by David P. Billington, Charles O. Harris Jr, and JohnR. Hoemann, 2014.

REFERENCES:

1. “Foundations for Industrial Machines Handbook for Practising Engineers” by K.G. Bhatia, Taylor and Francis, 2009.
2. “Design of electrical transmission lines” by Sriram Kalga, Prasad Yenumala, CRC press, Taylor and Francis, 2016.
3. "Design of Steel Structures" by Punmia B.C., Ashokkumar Jain, Laxmi Publications, New Delhi-2004.
4. "Metal Building System - Design and specifications" by Alexander Newman, Second Edition, Mc Graw Hill, NewDelhi-2004.
5. “Transmission Line Structures” by Santhakumar A.R.and Murthy S.S., Tata McGraw Hill, 2004.
6. ,"Machine Foundation Design Handbook" by Prakash V. Varde 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/106/105106113/

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3			2							3	2	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SMART MATRIALS AND STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPALS OF SMART MATERIALS 9

Introduction to Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto - resistance effect.

MODULE II CHARACTERISTICS OF SMART MATERIALS 9

Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids.

MODULE III HIGH-BAND WIDTH AND LOW STRAIN SMART SENSORS 9

Piezeoelctric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magnetostrictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors.

MODULE IV SMART ACTUATORS 9

Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magnetovolume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.

MODULE V ADVANCES IN SMART STRUCTURES & MATERIALS 9

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Derive and explain the relationships between applied forces, electric fields, and magnetic fields in piezoelectric and magnetostrictive materials.

CO2: Compare and contrast different smart material types based on their actuation and sensing mechanisms and limitations.

CO3: Design a multi-sensor smart system for structural health monitoring, considering sensor placement, sensitivity, and data acquisition requirements, including a detailed diagram and rationale.

CO4: Calculate the required actuation force for a specific application using appropriate piezoelectric or magnetostrictive actuator models.

CO5: Evaluate and discuss emerging trends in smart materials and structures, including self-sensing, energy harvesting, and intelligent system design.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Smart Materials: Design Principles and Applications" by Bartosch, S., Springer, Cham, 2019.
2. "Smart materials and structures" by Newell, F. M., & Hubbard, G. M., John Wiley & Sons, 2022.

REFERENCES:

1. "Smart Materials and Structures" by Ahmad, A., & Devasia, M, CRC Press, 2021.
2. "Theoretical and Experimental Modal Analysis" (Mechanical Engineering Research Studies. Engineering Control Series, 9) by Maia, N.M.M and Silva, J.M.M., Research Studies Press, 2012.
3. "Smart Materials and Technology" by Michelle Addington and Daniel L. Schodeck, Elsevier, 2005.
4. "Mechanics of Composite Materials", by Jones, R.M., Taylor & Francis, Abingdon, 2013.
5. "Instrumentation – Devices and Systems", by Rangan C.S., Sarma G.R. and Mani V.S.V., Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 2010.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106068/

CO - PO & PSO MAPPING

CO	PO												PSO		
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3	3		3										2		
4	3		2									2	2		
5	3														
Avg.	3		3	1	2							2	2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	BASICS OF STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF VIBRATION ANALYSIS 9

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility.

MODULE II DYNAMIC RESPONSE OF TWO DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of two degree of freedom systems, Free and forced vibrations of two degree of freedom systems, Normal modes of vibration, Applications.

MODULE III DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of Multi-degree of freedom systems, Orthogonality of normal modes, Free and forced vibrations of multi degree of freedom systems, Mode superposition technique, Applications.

MODULE IV DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 9

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh - Ritz method - Formulation using Conservation of Energy - Formulation using Virtual Work, Applications.

MODULE V DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 9

Damping in MDOF systems, Nonlinear MDOF systems, Step-by-step numerical integration algorithms, Substructure technique. Variable - Probability density function - Moment generating function- Distributions: Binomial, Poisson, Normal and Exponential.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Develop and implement new analytical or computational techniques for SDOF vibration analysis.

CO2: Evaluate the limitations of the 2DOF model and its applicability to real-world engineering problems.

CO3: Evaluate the accuracy and limitations of the MDOF model and mode superposition results compared to analytical solutions.

CO4: Formulate the governing differential equation for free vibration of a specific beam or plate using Euler-Bernoulli theory or Kirchhoff plate theory.

CO5: Evaluate the accuracy and limitations of using PDFs and MGFs to characterize complex dynamic systems

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Dynamics of Structures" by Ray Clough and Joe Penzien, McGraw Hill Book Company, 2015.
2. "Dynamics of Structures - Theory and Applications to Earthquake Engineering" by “Anil K Chopra, Prentice Hall, New Delhi, 2019.

REFERENCES:

1. "Structural Dynamics - Theory of Computation" by Mario Paz, Kluwer Acadamic Publication, 2012.
2. "Vibration of Structures" by Smith.J.W, Chapman and Hall, 2004.
3. "Mechanical Vibrations" by Singiresu S. Rao, Pearson Education Inc., New Delhi, 2004.
4. "Fundamentals of Structural Dynamics", by Roy R. Craig, Jr., Andrew J. Kurdila, John Wiley & Sons, 2011.
5. "Basic Structural Dynamics", by FarzadNaeim and James C.Anderson, John Wiley & Sons, 2012.
6. "Structural Dynamics of Earthquake Engineering: Theory and Application Using Mathematica and Matlab" by Sanguthevar Rajasekaran, Woodhead Publishing, 2009.
7. "Structural Dynamics - An Introduction to Computer Methods" by Craig.R.R, John Wiley & Sons, 1995.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106068/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3				2								3		
2	3	2											3		
3	3			2									3		
4	3		1										3		
5	3				1								2		
Avg.	3	2	1	2	2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

MODULE I PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES **9**

Role of ground improvement in foundation engineering - Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils - Selection of suitable ground improvement techniques based on soil conditions.

MODULE II DEWATERING **9**

Dewatering Techniques - Well points - Vacuum and electro osmotic methods - Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits - Design for simple cases.

MODULE III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS **9**

In-situ densification of cohesion less soils - Dynamic compaction – Vibro - flotation, Sand compaction piles and deep compaction; Consolidation of cohesive soils - Preloading with sand drains and fabric drains, Stabilization of soft clay ground using stone columns and lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.

MODULE IV EARTH REINFORCEMENT **9**

Concept of reinforcement - Types of reinforcement material - Reinforced earth wall - Mechanism – Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

MODULE V GROUTING TECHNIQUES **9**

Types of grouts - Grouting equipments and machinery - Injection methods - Grout monitoring – Stabilization with cement, lime and chemicals - Stabilization of expansive soil.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze geotechnical challenges in alluvial, lateritic, and black cotton soils and recommend appropriate ground improvement techniques based on soil properties and project requirements.

CO2: Develop dewatering systems using wellpoints, vacuum, and electro-osmotic methods for efficient control of groundwater in construction projects, considering seepage analysis and practical limitations.

CO3: Select and design in situ densification consolidation techniques for cohesionless and cohesive soils, evaluating their relative merits and limitations.

CO4: Design and evaluate reinforced earth walls using various materials and mechanisms, considering applications in soil reinforcement and the functional roles of geotextiles in filtration, drainage, separation, road works, and containment.

CO5: Illustrate grouting procedures for soil stabilization with cement, lime, and chemicals, considering the treatment of expansive soils.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Soil Mechanics and Foundations (8th Edition)" by B. C. Punmia, Laxmi Publications, 2019.
2. "Dewatering in Building Construction (2nd Edition)" by Jacob Sandstedt, CRC Press, 2018.

REFERENCES:

1. "Principles of Foundation Engineering (7th Edition)" by D. P. Coduto, Prentice Hall, 2019.
2. "Grouting in Geotechnical Engineering (4th Edition)" by Paul I. Mayhew, ICE Publishing, 2019.
3. "Modern Ground Improvement Techniques (2nd Edition)" by Yoshitaka Ooi, CRC Press, 2019
4. "Ground Improvement Techniques (4th Edition)" by M. J. Tomlinson, CRC Press, 2018.
5. "Ground Improvement by Deep Mixing" by Yasushi Matsuda, Fumihiko Ohya, and Hideaki Igarashi, by John Wiley & Sons, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105108075

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3	1	
2	3	2	1										3	2	
3	3	2	2										3	2	
4	3	2											3	2	
5	3	2	3		2								3	2	
Avg.	**3**	**2**	**2**		**2**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF DEEP FOUNDATION	L	T	P	C
		3	0	0	3

MODULE I PILE CLASSIFICATIONS **9**

Function - classification of piles - Factors governing choice of pile foundation - Load transfer principles - piling equipment and methods - changes in soil condition during installation of piles - requirement of code of practice - responsibility of engineer and contractor.

MODULE II AXIALLY LOADED PILES AND PILE GROUPS **9**

Allowable load evaluation of piles and pile groups - Static method - cohesive - cohesion less soil – time effects - Dynamic method-pile driving formulae - Wave equation application – modelling – theoretical analysis - Interpretation of field test results and pile load test results - Settlement of Piles and Pile groups.

MODULE III LATERAL AND UPLIFT LOAD EVALUATION **9**

Piles subjected to Lateral loads - Broms method, elastic -p-y curve analyses - Batter piles - response to moment - pile subjected to uplift loads - load -deformation behavior - Lateral and uplift load test data interpretation. Foundation on week compressible-collapsible soil – case studies.

MODULE IV STRUCTURAL DESIGN OF PILE AND PILE GROUPS **9**

Pile foundation - structural design - pile cap analysis, pile - raft system basic interactive analysis - pile and pile groups subjected to vibrations - fundamental solutions.

MODULE V CAISSONS **9**

Caissons types - Stability of caissons - principles of analysis and design, seismic influences.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate and select suitable pile foundation types and installation methods based on site-specific conditions, load requirements, and code specifications.

CO2: Estimate and assess the axial load capacity of single piles and pile groups using both static and dynamic methods, interpreting field and test data to make informed design decisions.

CO3: Analyze and design piles subjected to lateral and uplift loads using appropriate methods by considering soil-pile interaction and interpreting test data for safe and reliable foundation design.

CO4: Apply structural design principles to analyze and design pile caps, pile-raft systems, and pile groups subjected to static and dynamic load.

CO5: Illustrate and design different types of caissons for stability under various loading conditions, considering seismic influences and relevant design codes.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Design of Shallow and Deep Foundations” by Frank, R., Cuira, F., & Burlon, S. CRC Press, Taylors & Francis Group, 1st Edition, Taylor & Francis Ltd, 2021.

2. “Ground Improvement Techniques and Geosynthetics” by Manfred R. Hausmann, 4th Edition”, 2019.

REFERENCES:

1. “Advanced Foundation Engineering” by Murthy V.N.S., 2023.
2. “Deep Foundations in Coarse-Grained Soils” by John P. Turner and Harry G. Poulos, 2021.
3. “Analysis and Design of Advanced Foundation Systems” by Charles W. Wissa, David B. Peck, and Hsai-Yang Fang, 2020.
4. “Numerical Modeling in Geomechanics with Applications in Foundation Engineering” by Paolo Utili and Michele Flora, 2019.
5. “Pile Foundations in Engineering Practice” by Shamsher Prakash and Gopal Ranjan, 2019.

ONLINE RESOURCES:

1. www.nptel.ac.in courses

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3	2	
2	3	3			1								3	2	
3	3	3											3	2	
4	3	2	3										3	3	
5	3	2	2										3	2	
Avg.	**3**	**2**	**3**		**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	GEO ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PERSPECTIVE IN GEOENVIRONMENTAL ENGINEERING 9

Scope in Geo-Environmental Engineering - role of soil in geo environmental applications-phase behaviour of soil – importance of hydrogeology- sources and type of soil contamination – case studies in soil failure.

MODULE II CONTAMINANT TRANSPORT 9

Transport of contaminant in subsurface flow - advection, diffusion, dispersion – chemical process - biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization, biodegradation - characterization of contaminated sites - soil and rock data - hydrological and chemical data - analysis and evaluation – risk assessment – case studies.

MODULE III REMEDIATION OF CONTAMINATED SITES 9

In-situ contaminant - vertical and horizontal barrier - surface cover - ground water pumping system on subsurface drain – soil remediation - soil vapour extraction, soil waste stabilization, solidification of soils, electro-kinetic remediation, soil heating, bio remediation, Phyto- remediation - ground water remediation - pump and treat, In-situ flushing, permeable reacting barrier, In-situ air sparing - case studies.

MODULE IV LANDFILLS AND SURFACE IMPOUNDMENTS 9

Source and characteristics of waste - site selection for landfills - components of landfills – liner system - soil, Geo-membrane, Geo-synthetic clay, Geo-composite liner system – leachate collection - final cover design - monitoring the geo liners in landfill.

MODULE V STABILISATION OF WASTE 9

Hazardous waste control and storage system - stabilization/ solidification of wastes - micro and macro encapsulation - absorption, adsorption, precipitation- detoxification – mechanism stabilization - organic and inorganic stabilization - utilization of solid waste for soil improvement Case studies.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate the role of soil and hydrogeology in environmental challenges, analyse case studies of soil failure, and identify potential sources and types of soil contamination.

CO2: Analyze the transport of contaminants in the subsurface and various chemical and biological processes, to characterize contaminated sites and conduct risk assessments.

CO3: Select appropriate remediation techniques for contaminated soil and groundwater, considering the environmental impact, and analyze case studies of remediation projects.

CO4: Enumerate landfill components by considering site selection, waste characteristics, and regulatory requirements, and evaluate monitoring methods for geo-liners.

CO5: Illustrate stabilization techniques for hazardous and non-hazardous waste, utilizing micro/macro encapsulation, other processes, and evaluate the utilization of stabilized waste for soil improvement.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Geo environmental Engineering" by Richard H. Giroud and David R. Bowders, 4th Edition, 2023.
2. "Recent Advances in Geo-Environmental Engineering, Geomechanics and Geotechnics, and Geohazards" by Springer International Publishing, Kallel, Amjad, etal.2019.

REFERENCES:

1. "Environmental Geotechnics: Innovative Solutions and Management Practices" by Subba Rao R. Pothini and N. Krishna Pillai, 2023.
2. "Geotechnical Aspects of Mine Site Closure" by John D. Barnhisel, 2022.
3. "Landfill Geotechnics: Design, Operation, and Closure" by Richard D. Rowe, 2019.
4. "Sustainable Remediation of Contaminated Sites" by Edward K. Nyer, 2018.
5. "Geoenvironmental Engineering Handbook" by Robert D. Holtz, William D. Kovacs, and Thomas C. Sheahan, 4th Edition, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103025

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2					1						3		
2	3	2		1									3		
3	3	2	2										3	1	
4	3	2				1	2						3	1	
5	3	2	1			1	2						3	1	
Avg.	**3**	**2**	**2**	**1**		**1**	**2**						**3**	**1**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SLOPE STABILITY AND LANDSLIDES	L	T	P	C
		3	0	0	3

MODULE I STABILITY OF SLOPES **9**

Introduction – Importance – General characteristics – Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

MODULE II STABILITY ANALYSIS **9**

Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations – Evaluation of pore water pressure.

MODULE III IRREGULAR SLOPES **9**

Non-uniform soils – Janbu's analysis – Taylor's analysis – Bishop's analysis – Total stress and effective stress approaches – Composite surfaces of sliding – Block sliding.

MODULE IV LAND SLIDES **9**

General Characteristics – Sources–Stability of Hill side slopes – Open cuts – Engineering problems involving the stability of slopes – Cuts in sand – Cuts in loess – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows – Clays containing pockets and sand masses – Slides in stiff clay slopes on shale – Slopes on weathered rock; talus slopes, slopes on over consolidated clays – Slides along coastal areas and tropically weathered residual soils – Long term stability of clay slopes.

MODULE V FIELD OBSERVATIONS AND SLOPE STABILIZATION **9**

Field instrumentation – Observation studies during construction – Post construction, piezometers – Settlement plates – Inclinometer – Case histories. Compaction of new embankments – Compaction of natural masses of soil and existing fills – Compaction of deep deposits of sand – Vibroflotation – Compaction of compressible soils – Drainage as a means of stabilization – Use of Geotextiles – Soil nailing.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Gain knowledge about the purpose of computing slope stability.

CO2: Ability to analyse stability of slopes in cohesive and cohesionless soils.

CO3: Familiar on the analysis of irregular slopes with different approaches.

CO4: Reasoning about causes of landslides in different soil conditions.

CO5: Understand the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Landslides: theory, practice and modelling" by Pradhan, Sarada Prasad, Vikram Vishal, and Trilok Nath Singh, eds. Springer International Publishing, 2019.

2. “Soil strength and slope stability” by Duncan, J. Michael, Stephen G. Wright, and Thomas L. Brandon, John Wiley & Sons, 2014.

REFERENCES:

1. “Slope analysis” by Chowdhury, D.F., Prentice Hall, 1988.
2. “Foundation Engineering Handbook” by Winterkorn, H.F. and Fang, H.Y., Van Nostrand Reinhold, 1994.
3. “The Stability of Slopes” by Bramhead, E.N., Blacky Academic and Professionals Publications, Glasgow 1986.
4. “Slope Stability” by Anderson, M.G., and Richards, K.S., John Wiley, 1987.
5. “Landslides and their contro” by Zaruba, Quido, and Vojtěch Mencl. Elsevier, 2014.
6. “Slope analysis” by Chowdury, R. Elsevier, 2012.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	3			1								3	2	
3	3	3											3		
4	3	2											3		
5	3	2		1									3	1	
Avg.	**3**	**2**		**1**	**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	EARTH RETAINING STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I EARTH PRESSURE THEORIES **9**

State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann's method) – Active and passive cases – Earth pressure due to external loads.

MODULE II STABILITY OF RETAINING STRUCTURES **9**

Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.

MODULE III SHEET PILE WALLS **9**

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.

MODULE IV SUPPORTED EXCAVATIONS **9**

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic design concepts - Slurry Supported Trenches-Basic principles – Slurry characteristics – Specifications – Diaphragm walls – stability Analysis.

MODULE V STABILITY OF SLOPES **9**

Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method etc. Special aspects of slope analysis, stability charts. Role of geosynthetics in stabilization of slopes.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Gain knowledge about the purpose of computing slope stability.

CO2: Ability to analyse stability of slopes in cohesive and cohesionless soils.

CO3: Familiar on the analysis of irregular slopes with different approaches.

CO4: Reasoning about causes of landslides in different soil conditions.

CO5: Understand the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Earth Retaining Structures, 7th Edition", Christopher J. Elias and Christopher R. I. Clayton, 2023.
2. "The engineering of foundations, slopes and retaining structures Salgado", Rodrigo. CRC Press, 2022.

REFERENCES:

1. "Gravity Retaining Walls" by David C. Onyemeluk, 2023.
2. "Ground Improvement Techniques and Geosynthetics" by Manfred R. Hausmann, 4th Edition, 2019.
3. "Design and Construction of MSE Walls and Reinforced Slopes" by David C. Bathurst and Ilan Juran, 2nd Edition, 2019.
4. "The Earthworks Handbook" by James Wright, 4th Edition 2018.
5. "Geosynthetic Engineering for Slopes" by Amarjit Singh, 2nd Edition, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105106052

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2											3		
2	3	2			1								3	2	
3	3	3	2										3	3	
4	3	2											3	1	
5	3	2		1									3	1	
Avg.	**3**	**2**	**2**	**1**	**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	FOUNDATIONS IN EXPANSIVE SOILS	L	T	P	C
		3	0	0	3

MODULE I GENERAL PRINCIPLES **9**

Origin of expansive soils – Physical properties of expansive soils –Mineralogical composition – Identification of expansive soils – Field conditions that favour swelling – Consequences of swelling.

MODULE II SWELLING CHARACTERISTICS **9**

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

MODULE III TECHNIQUES FOR CONTROLLING SWELLING **9**

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Pre wetting – Soil replacement – Sand cushion techniques – CNS layer technique.

MODULE IV FOUNDATIONS ON EXPANSIVE SOILS **9**

Belled piers – Bearing capacity and skin friction –Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

MODULE V MODIFICATION OF SWELLING CHARACTERISSTIC **9**

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze the behavior of expansive soils, predicting potential swelling and its consequences on structures.

CO2: Evaluate the swelling potential of expansive soils through laboratory testing and predict heave using appropriate methods.

CO3: Select appropriate techniques to control swelling potential based on site conditions and project requirements.

CO4: Design belled piers and under-reamed piles for expansive soils, considering their advantages, limitations, and specific design considerations.

CO5: Evaluate and select chemical stabilization techniques for expansive soils, considering their mechanisms, limitations, and construction methods.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Expansive Soils: Problems and Solutions” by M. Basarat Ali and V. Sivakumar, 2018.
2. “Soils and Geotechnology in Construction” by Lutenegger, Alan J’ CRC Press, 2019.

REFERENCES:

1. “Geotechnical Engineering in Expansive Soils” by D. Nelson and Der-Chung Donald Liu, 2019.

2. “Expansive Soils: Problems and Practice in Foundation Engineering” by Murthy V.N.S., 2021.
3. “Foundation Engineering in Expansive Soils” by B.B. Kale and S.N. Murthy, 2020.
4. “Expansive Soils: From Problem Child to Reliable Partner” by Prashant Nath and Manoj R. Dixit, 2018.
5. “Analysis and Design of Substructures: Limit State Design Saran” by Swami, Oxford and IBH Publishing, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103214

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	2			1								3		
3	3	2	2										3	1	
4	3	2	3										3	2	
5	3	2	2										3	1	
Avg.	**3**	**2**	**2**		**1**								**3**	**1**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PLANNING OF SOIL EXPLORATION 9

Exploration methods for different projects - methods of borings-penetration tests-pressure meter test, field vane shear test-field permeability test-rock boring, preservation, shipment and storage of samples.

MODULE II SHALLOW FOUNDATIONS 9

Requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes.

MODULE III PILE FOUNDATIONS 9

Methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

MODULE IV WELL FOUNDATION 9

Belled piers – Bearing capacity and skin friction –Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

MODULE V FOUNDATIONS ON PROBLEMATIC SOILS AND COFFERDAMS 9

Foundations for collapsible and expansive soil Cofferdams-various types, analysis and design Foundations under uplifting loads.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply an appropriate soil exploration program for different project types, selecting suitable methods for data acquisition, interpretation, and sample handling.

CO2: Analyze shallow foundations by considering bearing capacity, settlements, and code requirements, utilizing field test data for practical application.

CO3: Design pile foundations for axial and lateral loads, and load-settlement characteristics, implementing analytical methods.

CO4: Evaluate well foundations by considering Terzaghi's method, lateral stability, uplift, and design individual components, recognizing measures for rectification.

CO5: Select and design foundations for collapsible and expansive soils cofferdams, and evaluate foundations under uplifting loads, considering design strategies.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Advanced Foundation Engineering” by V. N. S. Murthy, 2023.
2. “Advanced Geotechnical Engineering: Soil, Rock, and Earthquake Engineering” by Donald P. Coduto, 2021.

REFERENCES:

1. "Deep Foundations in Coarse-Grained Soils" by John P. Turner and Harry G. Poulos, 2021.
2. "Analysis and Design of Advanced Foundation Systems" by Charles W. Wissa, David B. Peck, and Hsai-Yang Fang, 2020.
3. "Deep Foundations for Offshore Wind Turbines" by Brian L. Klosek and James R. Snedker, 2020.
4. "Micropile Design and Construction" by David P. Day, 2019.
5. "Ground Improvement Techniques and Geosynthetics", by Manfred R. Hausmann, 4th Edition, 2019.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105207

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2											3		
2	3	3			1								3	2	
3	3	3	2										3	2	
4	3	3	2										3	2	
5	3	3	3										3	2	
Avg.	**3**	**3**	**2**		**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	REINFORCED SOIL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT 9

Historical Background – Principles - Concepts and Mechanisms of reinforced earth – Soil – Geosynthetics interaction mechanism – interface resistance – Factors influencing interaction – Strain compatibility.

MODULE II REINFORCING MATERIALS AND THEIR PROPERTIES 9

Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibers - facing elements – Influence of environmental factors on the performance of Geosynthetic materials – Physical – Mechanical – Hydraulic and Endurance properties testing.

MODULE III DESIGN FOR SOIL REINFORCEMENT AND SEPARATION 9

Reinforcing the soil - Geotextiles and Geogrids –Retaining wall – embankment - unpaved roads – paved roads – railway tracks – Shallow foundations – seismic aspects.

MODULE IV DESIGN FOR FILTRATION, DRAINAGE AND CONTAINMENT 9

Geotextile filter – Filtration Mechanism – Factors affecting filter behaviour – Filtration design – Drains – Drainage in embankments – erosion control silt fences – Containment ponds – Reservoirs and Canals – Hydraulic tunnels – River bed and bank protection.

MODULE V DESIGN OF REINFORCED SLOPES 9

Type and orientation of Geosynthetics – Function of reinforcement against slope failure – Stability analysis – Design aspects – Embankments – Basal reinforcement – seismic aspects – General construction aspects.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze the interaction between soil and geosynthetics in reinforced soil structures, identifying factors influencing their performance and ensuring strain compatibility.

CO2: Select and evaluate appropriate geosynthetic materials for specific applications in reinforced soil structures, considering their properties, parameters and testing methods.

CO3: Design reinforced soil structures for various applications using geotextiles and geogrids, considering seismic aspects and construction guidelines.

CO4: Assess the geotextile filters, drainage systems, and containment structures, considering filtration mechanisms, hydraulic properties, and erosion control measures.

CO5: Develop and design reinforced slopes, selecting appropriate geosynthetics, evaluating their reinforcement function, and incorporating seismic considerations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Reinforced Soil and Mechanically Stabilized Earth” by Christopher J. Elias, Christopher R. I. Clayton, and Peter B. Flygare, 7^{th} Edition, 2019.

2. “Geosynthetic reinforced soil (GRS) walls” by Wu, Jonathan T H., John Wiley & Sons, 2019.

REFERENCES:

1. "Reinforced Soil Structures" by C.J.F.P. Jones & P.J. Zweifel, by CRC Press, 2019.
2. “Ground Improvement Techniques and Geosynthetics” by Manfred R. Hausmann, 2019.
3. “Design and Construction of MSE Walls and Reinforced Slopes” by David C. Bathurst and Ilan Juran, 2nd Edition, 2019.
4. "Ground Improvement Techniques" by M.J. Tomlinson, by CRC Press, 2018.
5. "Geosynthetics and their Applications" by Berndt, J.P., Adam, D., & Bell, J.R., by Wiley-Blackwell, 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/106/105106052/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	2											3		
3	3	2	2										3	1	
4	3	2	2										3	1	
5	3	3	3										3	2	
Avg.	**3**	**2**	**2**										**3**	**1**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I PERSPECTIVES OF SOLID WASTE 9

Definition, sources, and types of solid waste - Comparison of waste generation in India and other developed countries - Per capita generation rates - Sampling and characterization of solid waste - Composition of solid waste: physical (Individual contents, size, moisture content, and density) and chemical (energy and chemical content) - Typical composition of Indian MSW - Functional elements of SWM system -Legislation and responsibilities - Integrated solid waste management.

MODULE II COLLECTION AND TRANSPORT OF SOLID WASTE 9

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing - Collection services: municipal and commercial - Industrial services - Collection systems: hauled-container system (HCS) and stationary container system (SCS) - Vehicle and labor assessment - Assessment of collection route - Transfer and transport - Transfer station location - Means and methods of transfer.

MODULE III PROCESSING AND DISPOSAL OF SOLID WASTE 9

Definition and necessity - Volume reduction: manual separation, mechanical, and thermal - Land filling method: site selection methods and operations, leachate and gas generations, and movement and control of gas and leachate - Design and operations of landfills - Land farming, deep well injection, and ultimate disposal techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes - Vermi-composting application.

MODULE IV PERSPECTIVES OF HAZARRDOUS WASTE 9

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste - Typical hazardous wastes in MSW- TCLP test - Hazardous waste management: minimization, collection, storage, handling, transport (manifest), and compatibility – National and International legislation for hazardous waste management.

MODULE V TREATMENT AND DISPOSAL OF HAZARDOUS WAST 9

Necessity and types of treatment - Objectives, principles, operations, analysis of solidification, encapsulation, chemical oxidation, incineration, and microwave-plasma detoxification techniques - Planning, operation, design and analysis of hazardous waste landfills, landfill remediation.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze and compare the sources and types of solid waste and its regulatory framework.

CO2: Discuss the various systems of collection and transport of solid waste.

CO3: Compare and contrast volume reduction techniques, evaluate landfill design and operation methods.

CO4: Describe the identification and characterization of hazardous waste.

CO5: Apply the basic scientific principles for solving practical waste management challenges.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Environmental Engineering” by LaGrega et al. M, 2020.
2. “Environmental Engineering” by Peavy, Rowe, Tchobanoglous, McGraw Hill Publishers, New Delhi, 2017.

REFERENCES:

1. “Hazardous Waste Management” by Borthakur, A. CRC Press, 2019.
2. “Manual on Municipal Solid waste management" by CPHEEO, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2016.
3. “Solid Waste Management" by Agarwal, A., & Singh, R. K., Tata McGraw-Hill Education, 2009.
4. “Solid Waste Management in India" by Lakshmanan, S. T., 2014.
5. “Solid Waste Management" Venugopal, T., & Rao, K. S, PHI Learning Private Limited, 2013.

ONLINE RESOURCES:

1. https://www.wasterecycling.org/: https://www.wasterecycling.org/
2. https://ec.europa.eu/environment/waste/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					3							2		
2	1		1										2		
3	2		2										2		
4	2						3						1		
5	3		2										2		
Avg.	2		2			3	3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

MODULE I ENVIRONMENTAL IMPACT ASSESSMENT PERSPECTIVES 9

Definition, sources, and types of solid waste - Comparison of waste generation in India and other developed countries - Per capita generation rates - Sampling and characterization of solid waste - Composition of solid waste: physical (Individual contents, size, moisture content, and density) and chemical (energy and chemical content) - Typical composition of Indian MSW - Functional elements of SWM system -Legislation and responsibilities - Integrated solid waste management.

MODULE II ASSESSMENT AND MONITORING 9

Environmental setting - environmental impact assessment methodology- cost benefit analysis, environmental indices and indicators for describing affected environment, Life cycle assessment. Role of remote sensing and GIS in Environmental Impact Assessment.

MODULE III SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Types, steps in performing socio-economic impact assessment, analysis of public services and facilities impacts, social impacts, impacts of economic profile of the community.

MODULE IV ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental Management Plan - preparation, implementation and review - Mitigation and Rehabilitation Plans - Policy and guidelines for planning and monitoring programmes - Post project audit - Ethical and Quality aspects of Environmental Impact Assessment.

MODULE V SECTORAL ENVIRONMENTAL IMPACT ASSESSMENT 9

EIA related to the following sectors - Infrastructure -construction and housing Mining - Industrial-Thermal Power - River valley and Hydroelectric Projects-Nuclear Power- EIA for coastal projects.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the overall perspectives of Environmental Impact Assessment.

CO2: Design the necessary tools pertaining to assessment of various impacts.

CO3: Recognize and synthesis the diversified socio-economic impacts on the society.

CO4: Design and develop the significant protocols for Environment Management Plan.

CO5: Synthesize and discretise the various impacts originating from typical developmental projects.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Environmental Impact Assessment Methodologies" by Peter W. Rauch, CRC Press, 2020.
2. "Environmental Impact Assessment" by Ramakrishnan J.G, Oxford University Press, 2020.

REFERENCES:

1. “Environmental Impact Assessmen”, 2nd Edition by James Glasson, John R. Treweek, and Andrew Becker, 2020.
2. “Handbook of Environmental Impact Assessment” by Peter W. Frazier, 2020.
3. “Handbook of Environmental Impact Assessment” by R.K. Trivedi, 2018.
4. “Strategic Environmental Assessment” by Thomas Fischer, 2017.
5. “Environmental Law” by Roger E. Meiners and Lawrence E. Westling, 2017.

ONLINE RESOURCES:

1. https://www.iaia.org/
2. https://www.iied.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					3							2		
2			2		2								1		
3		2				3							2		
4			3				3						2		
5	2			2									2		
Avg.	2	2	3	2	2	3	3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	CLIMATE CHANGE AND ADAPTATION	L	T	P	C
		3	0	0	3

MODULE I EARTH'S CLIMATE SYSTEM 9

Introduction - weather and climate - Climate in the spotlight-The Earth's Climate Machine – Climate Classification – Global wind systems – Trade Wind Systems – Trade Winds and the Hadley Cell – Cloud formation and Monsoon Rains – Storms, Hurricanes and Tornado – The Hydrological Cycle – Global Ocean Circulation – El Nino – LA Nino effect – Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming.

MODULE II OBSERVED CHANGES AND ITS CAUSES 9

Observation of Climate Change – Changes in pattern of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – Climate Change modelling.

MODULE III IMPACTS OF CLIMATE CHANGE 9

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for different regions – Uncertainties in the Projected Impacts of Climate Change – Risk of irreversible changes.

MODULE IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES 9

Adaptation Strategy/options in various sectors – Water – Agriculture – Infrastructure and Settlement including coastal zones. Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and practices – Energy supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbon sequestration – Carbon Capture and Storage (CCS) – Waste (MSW & Biowaste, Biomedical, Industrial waste – International and Regional co-operation.

MODULE V CLEAN TECHNOLOGY AND ENERGY 9

Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco-friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Explain the earth's climate system and the concept of global warming.

CO2: Identify the causes for climate change on the earth's surface.

CO3: Comprehend the impact of climate change on society.

CO4: Apply the various climate change adaptation and mitigation measures.

CO5: Evaluate the role of clean technology in climate change adaptation.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Climate Change Impacts on Agriculture: Mitigation and Adaptation" by Manish Sinha, Springer, 2021.
2. "The Climate Crisis: What Scientists Need You to Know" by Rahmstorf, S, Columbia University Press, New York, NY, 2018.

REFERENCES:

1. "Understanding Climate Change" by David Archer, Cambridge University Press, 2016.
2. "Climate Change and Climate Variability on Hydrological Regimes" by Jan C. van Dam, Impacts of IHE, The Netherlands, October, 2009.
3. "Climate Change – An Indian Perspective" by Dash Sushil Kumar, Cambridge University Press India Pvt. Ltd, 2007.
4. Al core 'inconvenient truth" – a Global Warming, video form, Documentary, May 2006.
5. "Climate Change and Sustainable Development: Prospects for Developing Countries" by Anil Maranda, Routledge, 2002.

ONLINE RESOURCES:

1. https://climate.nasa.gov/
2. https://www.climate.gov/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						1		
2		1					3						1		
3						3	3						2		
4			2				3						2		
5	2						3						2		
Avg.	2	1	2			3	3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	MARINE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

MODULE I MARINE AND COASTAL ENVIRONMENT 9

Seas and oceans, continental area, coastal zone, properties of sea water, principles of marine geology, coastal features – beaches, estuaries, lagoons, salt marshes, mangroves and sand dunes– the oceans and climate, coastal zone regulation in India- national and international treaties.

MODULE II OCEAN HYDRODYNAMICS 9

Wave theory, waves in shallow waters – refraction, diffraction and shoaling, approximations for deep and shallow water conditions – tidal classification - general circulation of ocean waters - ocean currents - coastal sediment transport - onshore offshore sediment transport – beach formation and coastal processes - Tsunamis, storm surge, El Nino effect.

MODULE III MARINE POLLUTION 9

Sources of marine pollution – point and non-point sources, pollution caused by effluent discharge, oil exploration, dredging, offshore mining, port and harbour activities, power plants, agriculture runoff, plastic waste, marine debris and marine litter - effects of marine pollution on marine water quality and coastal ecosystems.

MODULE IV MARINE POLLUTION MONITORING 9

Basic measurements - sounding boat, echo sounders – current meters - tide gauge - use of GPS – measurement of coastal water characteristics – sea bed sampling – modelling of pollutant transport and dispersion - oil spill models - ocean monitoring satellites – applications of remote sensing and GIS in monitoring marine pollution – online marine pollution monitoring.

MODULE V MARINE POLLUTION CONTROL MEASURES 9

Marine discharges and effluent standards, pollution control strategies – marine outfall design-selection of optimal marine outfall locations - Total Maximum Daily Load (TMDL) applications – protocols in marine pollution control– Integrated Coastal Zone Management (ICZM) and sustainable development.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Identify the different components of marine environment.

CO2: Summarize the physical concepts lying behind the tides, waves, and oceanic currents and natural processes of various activities happening over the marine environment.

CO3: Identify and measure the marine pollution levels and effects.

CO4: Focus the knowledge of remote sensing and GIS for monitoring marine environment water quality.

CO5: Develop marine pollution control measures.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Oceans and Marine Ecology", 7th Edition by Gary Williams & David Kay, 2020.

2. “Marine Pollution: New Research” by Tobias N. Hofer, Nova Publishers, 2018.

REFERENCES:

1. “Oceanography and Marine Biology” by Robert J. Stewart, John Wiley & Sons, 2023.
2. “Marine Pollution and Climate Change” by Daniel Victor, 2023.
3. “Handbook of Marine Pollution Prevention” by Michael E. Connor, 2018.
4. “The International Law of Marine Pollution” by Alan E. Boyle, Oxford University Press, 2020.
5. “Marine Pollution” by Uwe Horstmann & Peter Wells, Springer, 2017.

ONLINE RESOURCES:

1. https://www.ioc.unesco.org/en/
2. ttps://marinedebris.noaa.gov/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						2						1		
2	2						3						1		
3	2						3						2		
4					3		3						1		
5			3				3						2		
Avg.	2		3		3		3						1		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	INSTRUMENTAL METHOD OF ANALYSIS	L	T	P	C
		3	0	0	3

MODULE I QUANTITATIVE CHEMISTRY **9**

Necessity and scope - Quantitative methods: gravimetric, volumetric, and instrumental - Low level and high-level instruments - Precision, accuracy, and rounding-off data - Types of errors - Detection limits - Quality assurance and quality control - Colorimetry: Beer's and Lambertz laws.

MODULE II OPTICAL METHODS **9**

Definition and types - Absorption, emission, and dispersion and scattering methods - Ultraviolet, infrared, atomic emission, atomic absorption, and inductively coupled plasma (ICP) spectroscopes - Fluorimetry, turbidimetry, and nephelometry.

MODULE III CHROMATOGRAPHIC METHODS **9**

Definition and types - Gas chromatography (GC): packed and capillary columns, EC, FI, FP, TC, NPD, and AFI detectors - High performance liquid chromatography (HPLC) - Ion chromatography - Capillary electrophoresis.

MODULE IV ELECTRICAL METHODS **9**

Definition and types - Potentiometric and polarographic analyses - Glass electrode, membrane electrode, and membrane probe- Merits, demerits, and precautions in use of electrodes - Practical applications.

MODULE V SPECIAL INSTRUMENTS **9**

Necessity and applications - Mass spectroscopy (MS) - X-ray analysis - Scanning electron microscope (SEM) analysis - Nuclear magnetic resonance (NMR) spectroscopy - Radioactive measurements.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the various quantitative-based instruments in environmental monitoring.

CO2: Infer different methods for analysis of samples using instrumentation.

CO3: Analyze the samples using optical, electrical and chromatography methods.

CO4: Comprehend the proper utilization of Advance instruments.

CO5: Employ the advanced analytical techniques in environmental quality monitoring.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Instrumental Methods of Chemical Analysis", 6^{th} Edition by B.K. SHARMA, Goel Publishing House, 2020.
2. “Quantitative chemical analysis”, 10^{th} ed. by Harris, D. C. New York, NY: W.H. Freeman and Company, 2020.

REFERENCES:

1. “Fundamentals of analytical chemistry” 10th ed. by Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. Belmont, CA: Brooks/Cole Cengage Learning, 2021.
2. “Handbook of instrumental methods for the analysis of food” by Mills, I. M., & White, J. D. Cambridge University Press, 2018.
3. “Quantitative Chemical Analysis” 10th ed. by Harris, D.C., Macmillan Learning, 2019.
4. “Analytical chemistry: A modern approach” by Christian, G. D., John Wiley & Sons, 2018.
5. “Instrumental methods of analysis” by Willard, H. H., Merritt, L. L., Dean, J. A., & Settle, F. A., CBS Publishers & Distributors, 2018.

ONLINE RESOURCES:

1. https://www.nist.gov/topics/analytical-chemistry
2. https://www.asms.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				3								2		
2		2			3								2		
3	2				3								2		
4	3				3								2		
5			1		3								2		
Avg.	2	2	1		3								2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	AIR AND WATER QUALITY MODELLING	L	T	P	C
		3	0	0	3

MODULE I MODELING CONCEPT 9

Overview of different types of models-identification of dependent and independent variables- Deterministic and stochastic approach- Steps in model development-numerical and simulations models-calibration and validation of models- Limitations Transport phenomena- Mass balance analysis-Model development and decision making.

MODULE II AIR QUALITY MODELS 9

Air quality parameters - air Quality Index -Types, modelling technique, modelling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation- modifications of Gaussian plume equation- long term average-multiple cell model receptor oriented and source-oriented air pollution models- model performance, accuracy and utilization -air quality mapping.

MODULE III INDOOR AIR QUALITY MODELS 9

Indoor Air Pollutants - Volatile Organic Compounds, Inorganic Gaseous Pollutants Respirable Particulates, Bio-aerosols, Radon and its decay products-Infectious disease transmission- A/C units in indoor- Odours and sick building syndrome-Indoor Air quality Models.

MODULE IV WATER QUALITY MODELLING 9

Water quality parameters- water quality index- Historical development of water quality models - rivers and streams water quality modelling; Lakes and impoundments - water quality response to inputs; water quality modelling process - model sensitivity - assessing model performance.

MODULE V SOFTWARE MODELLING 9

The principles and application of computer models for surface water quality, and air quality.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the significance and need for modelling.

CO2: Summarize the suggestions regarding the modelling to be adopted for different scenarios and also discuss the long-term uses of those models.

CO3: Assess indoor air quality risks associated with different pollutants.

CO4: Employ various modelling concepts to monitor the quality of polluted water and air in future.

CO5: Interpret and comprehend the adoptability of models for the scenario under study.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Air Quality Modelling: The Science and Application” by John Seinfeld and Spyros Pandis, John Wiley & Sons, 2023.
2. “Environmental Modelling: Integrating Ecology, Economics, and Management” by Andrew James, 2022.

REFERENCES:

1. “Atmospheric Dispersion Modelling” by Steven Hanna, John Wiley & Sons, 2023.
2. “Air Quality Modelling” by John Seinfeld and Spyros Pandis, Wiley-Interscience, 2022.
3. “Indoor Air Quality Handbook” by John Spengler, Michael Samet, and John McCarthy, (CRC Press), 2021.
4. “Water Quality Modelling: Advanced Methods” by L. Bengtsson et al, Academic Press, 2020.
5. “Water Quality Engineering” by Larry Mays, John Wiley & Sons, 2020.

ONLINE RESOURCES:

1. https://www.awma.org/
2. https://www.nalms.org/2023nmc/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						2						2		
2			2				3						2		
3	2						3						2		
4					3		3						2		
5		2			3								2		
Avg.	2	2	2		3		3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

MODULE I AIR POLLUTION SOURCES AND METEOROLOGY 9

Definitions - Sources and classification of pollutants - Natural and anthropogenic - Units and measurements - Air quality standards - Meteorology and air pollution - Atmospheric stability and inversions - Mixing height and plume behaviour - Effects of air pollution on human beings, vegetation, animals, materials, and climate.

MODULE II SAMPLING AND MODELING OF AIR POLLUTION 9

Concept and objectives of sampling - Averaging principle - Standard methods for major air pollutants in ambient air - Isokinetic sampling - Objectives of modelling - Types and uses of models - Design of stack height - Fixed-box and Gaussian dispersion models; and important considerations - Principles and application of multiple-cell model.

MODULE III CONTROL OF PARTICULATE MATTER 9

Basic devices of control - Objectives, applications, principles, process descriptions, analyses, design, essential considerations, performances, limitations, and modifications of gravity settler, cyclone separator, ESP, fabric filter, and co-flow venturi scrubber.

MODULE IV CONTROL OF GASEOUS POLLUTANTS 9

Basic devices of control - Objectives, applications, principles, process descriptions, analyses, design, essential considerations, performances, limitations, and modifications of absorption (both packed and plate columns), adsorption (only fixed-bed), combustion, and condensation processes - Typical adsorbents and scale-up procedure - Combustion kinetics - Assessment of air requirement and composition of combustion gas.

MODULE V INDUSTRIAL PROCESSES AND CONTROL STRATEGY 9

Objectives of control - Strategies and philosophies of air pollution control - typical industries and sources of pollutants from mining (both coal and copper), coal-based thermal power plant, cement industry, petroleum refineries, fertilizer industry, and iron and steel plants.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the classification of air pollutants and to understand their effects on environment and the human health.

CO2: Summarize the design concepts of various sampling techniques.

CO3: Demonstrate the working principle involved in the air pollutant control devices.

CO4: Employ the suitable air pollution prevention technologies for various particulates and gaseous pollutants.

CO5: Interpret and comprehend the general air quality monitoring and controlling practices in the various industries.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Air Pollution Control Engineering" by C.S. Rao, 5th Edition, 2022.
2. "Environmental Science and Engineering", 5th Edition, by Gary W. Miller and Susan S. Hyatt, 2020.

REFERENCES:

1. "Environmental Pollution and Control" by K. Vesilind, A. R. Desai, and J. F. Gigliotti, Cambridge University Press, 2020.
2. "Air Quality Monitoring and Modelling" by P. Kumar and G. Singh, Elsevier, 2020.
3. "Air Pollution Control Engineering" by C. D. Cooper and F. C. Alley, Waveland Press, 2019.
4. "Fundamentals of Air Pollution" by Richard P. Pohanish, 4th Edition, 2018.
5. "Industrial Air Pollution Control" by C. E. Davis, Routledge, 2018.

ONLINE RESOURCES:

1. https://www.epa.gov/clean-air-act-overview/air-pollution-current-and-future-challenges
2. https://www.cdc.gov/nceh/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
2	2				2								2		
3	3						3						2		
4			3				3						2		
5	2						3						2		
Avg.	2		3		2		3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	INDUSTRIAL WASTEWATER TREATMENT AND MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I CONSTITUENTS IN WASTEWATER **9**

Characteristics and analysis of wastewater - Physical, inorganic non-metallic, and metallic, organic, and biological - Toxicity constituents in wastewater - Advanced wastewater treatment - Unit operations and unit process.

MODULE II WASTEWATER MINIMIZATION AND REUSE **9**

Waste volume reduction - Waste strength reduction - Standards for disposal of effluent on land and in inland waters - Need for zero discharge and zero damage - Wastewater reuse applications – Public health and Environmental issues in water reuse – Risk Assessment for water reuse – water reclamation technologies.

MODULE III WASTEWATER TREATMENT **9**

Aerobic sequencing batch reactors - Attached growth denitrification process - Anaerobic suspended growth process - Anaerobic sludge blanket process - Attached growth anaerobic process.

MODULE IV PROCESS-BASED INDUSTRIAL WASTEWATER MANAGEMENT **9**

Origin and characteristics of pollution - Process flow and treatment flow sheets of typical industries brewery, winery, distillery, dairy, textile dyeing, and oil refinery industries.

MODULE V MANUFACTURING-BASED INDUSTRIAL WASTE MANAGEMENT **9**

Orgin and characteristics of pollution - Process flow and treatment flow sheets of typical industries: pulp and paper, fertilizer, pharmaceutical, sugar, iron and steel, petrochemical and tannery industries.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the waste water characteristics and environmental implications of various industrial effluents.

CO2: Summarize the various pollution prevention options.

CO3: Assess the remedial technologies for removal of pollutants in industrial effluents.

CO4: Employ the design solutions for the treatment and disposal of treated effluents.

CO5: Implement and comprehend the pollution control methods for specific industries.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Industrial Wastewater Treatment Processes Emerging Technologies and Practices" by J.N.S. Jayaweera, S. Ouki, N.M. Mubarak, 2020.
2. "Industrial Wastewater Treatment Handbook", 3rd Edition by Paul N. Cheremisinoff, 2023.

REFERENCES:

1. "Industrial Wastewater Management" by M. N. Rao and A. K. Datta, 2023.

2. “Physicochemical Treatment Processes for Water and Wastewater”, by Hua Jiang, et al., 2021.
3. “Biological Wastewater Treatment Processes” by Marcos von Sperling, 2020.
4. “Wastewater Engineering: Treatment and Reuse” by Metcalf & Eddy, 2020.
5. “Industrial Wastewater Management” by A.K. Chatterjee and S.C. Gupta, 2019.

ONLINE RESOURCES:

1. https://www.unep.org/resources/report/wastewater-turning-problem-solution
2. https://iwa-network.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
2			2				3						2		
3	3						3						2		
4			3				3						2		
5			3				3						2		
Avg.	3		3				3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I IRRIGATION METHODOLOGY AND CROP WATER REQUIREMENT 9

Importance of irrigation - scope of irrigation engineering- types of irrigation system: surface and subsurface irrigation methods, Sprinkler and Drip Irrigation - Soil-water plant relationship: Soil properties affecting water movement- Soil moisture characteristics and measurement - Infiltration and percolation.

MODULE II CROP WATER REQUIREMENT 9

Crops - Seasons - Definitions related to agriculture and irrigation - Rotation of crops - Crop water requirements - Base period - Duty - Delta – Evapotranspiration- Effective rainfall- - Consumptive use Irrigation Efficiencies - Assessment of irrigation water – irrigation scheduling. Water logging- causes and effects - Factors leading to waterlogging- Drainage Systems- Surface drainage techniques, subsurface drainage methods, Vertical drainage systems.

MODULE III HYDROLOGY AND HYDROGRAPH ANALYSIS 9

Hydrology – Surface hydrology - Precipitation - Types, forms, Measurement of rainfall, evaporation and infiltration – Estimation of runoff– Factors affecting runoff – Computation of volume of runoff and peak flow– Hydrograph concepts assumptions and limitations of unit hydrograph.

MODULE IV GROUND WATER FOR IRRIGATION 9

Occurrence of ground water- aquifer - aquiclude - confined, unconfined and perched aquifer- hydraulics of wells, types of wells and their construction– Types of well screen - Design of well screens – Well development - Ground water yield - specific capacity of a well - measurement of yield of an open well by pumping test and recuperation test.

MODULE V CANAL IRRIGATION 9

Classification of Irrigation Canals - Canal regulations - cross drainage works - canal alignments- Canal lining — Kennedy’s and Lacey’s Regime Theory-Design of unlined canal.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply fundamental principles of irrigation engineering to design and manage efficient and sustainable irrigation systems.

CO2: Demonstrate proficiency in evaluating crop water requirements and implementing appropriate irrigation scheduling techniques.

CO3: Analyze hydrological processes and groundwater dynamics to assess water availability and design effective irrigation strategies.

CO4: Design and optimize irrigation canals, considering factors such as classification, capacity, losses, and lining, to ensure efficient water conveyance.

CO5: Apply knowledge and skills to real-world scenarios, addressing water management challenges and proposing innovative solutions for sustainable irrigation practices.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Irrigation Engineering and Hydraulic Structures" by Garg S.K, Khanna Publishers, New Delhi, 38th Revised Edition 2023.
2. “Engineering Hydrology” by Subramanya, K., Tata McGraw-Hill, 2013.

REFERENCES:

1. "Irrigation - Theory & Practice" by Micheal A.M., Vikas publishing house, New Delhi, 2006.
2. "Irrigation Engineering & Hydraulic Structures" by Sharma R.K., Oxford and IBH Publishing Company, New Delhi, 2002.
3. “Irrigation Water Management” by Dilip Kumar Majumdar, Prentice-Hall of India, New Delhi, 2008.
4. "Irrigation and Water Power Engineering" by Punmia B. C. and Pande B. B. Lal, Laxmi Publications, New Delhi, 2009.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/126105010

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		3				3						2		
2	2		2				3								
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4	3		3										2		
5			3				3			2					
Avg.	3		3	2			3			2			2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF PAVEMENT DESIGN 9

Types of pavement-flexible and rigid- Components of pavement and their functions, Provisions of IRC Guidelines for each component, Comparison between highway and airport pavements, Factors influencing pavement stability: Vehicle and traffic factors-ESWL and Wheel Load Factor- Moisture and climate, soil-CBR, Plate Bearing method for finding modulus of subgrade reaction stress distribution factor- Boussinesq and Burmister theories.

MODULE II DESIGN OF FLEXIBLE PAVEMENT 9

Empirical method based on classification-Group Index method- Methods based on arbitrary strength-CBR method-Provisions of IRC 37- North Dakota Cone method, Plate Bearing method (US Navy method for airfields), Theoretical and semi-theoretical methods- Burmister Design method.

MODULE III STRESSES AND JOINTS IN RIGID PAVEMENT 9

Advantages and Disadvantages of rigid pavement, Stresses in rigid pavement due to wheel load- Westergaard theory – Stresses due to change in temperature-warping stress- Critical combination of stresses. Types of joints, Types of rigid pavement based on reinforcement, Design of reinforcement in longitudinal and transverse direction, tie bars and dowel bars.

MODULE IV DESIGN OF RIGID PAVEMENT 9

Modulus of Rupture of concrete, Design of airport pavement-Portland Cement Association method and Corps of Engineers method- Design of rigid highway pavement- IRC 58 method and PCA method.

MODULE V PAVEMENT DISTRESS, EVALUATION AND REHABILITATION 9

Flexible pavement distress - rigid pavement distress - condition surveys - Types of roughness - present serviceability index - skid resistance - structural evaluation - Bituminous and flexible overlays on rigid pavements - Pavement Management System.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply fundamental principles and IRC guidelines to analyze factors influencing pavement stability.

CO2: Analyze flexible pavement structures based on traffic load, soil conditions, and other design criteria.

CO3: Apply knowledge of joint types and reinforcement design to ensure pavement integrity.

CO4: Create a comprehensive rigid pavement design for highways or airports, considering material properties, traffic loads, and construction practices.

CO5: Evaluate pavement distress mechanisms in pavements, and propose suitable rehabilitation strategies based on condition surveys and cost-benefit analysis.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Highway Engineering” by S.K. Khanna & C.E. Justo, McGraw-Hill Education, 2020.
2. “Principles of Pavement Design” by E.J. Yoder & M.W. Witczak, John Wiley & Sons, 2015.

REFERENCES:

1. “Pavement Engineering: Principles and Practice” by Rajib B. Mallick & Tahar El-Korchi, CRC Press, 2023.
2. “Modern Pavement Management” by W. Ronald Hudson & Ralph Haas & Paul Zaniewski, McGraw-Hill Education, 2023.
3. IRC: 37-2018, Guidelines for the Design of Flexible pavements, Indian Road Congress, New Delhi.
4. IRC: 58-2019, Guidelines for the Design of Rigid Pavements for Highways, Indian Road Congress, New Delhi.
5. IRC: SP: 72-2015, Guidelines for the design of flexible pavements of low volume rural roads, Indian Road Congress, New Delhi

ONLINE RESOURCES:

1. https://www.civil.iitb.ac.in/tvm/nptel/
2. https://nptel.ac.in/courses/105105107

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3				2						2		

1 – Low, 2 – Medium, 3 – High

OURSE CODE	REMOTE SENSING AND GIS	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES AND CONCEPTS **9**

Definition - Historical Importance of remote sensing - Principles - and methods of remote sensing - Electromagnetic spectrum Electromagnetic Radiation and radiation sources - Interference - Atmospheric effects on remote sensing - Energy interaction with energy surface features.

MODULE II AERIAL PHOTOGRAPHY **9**

Definition - Types of air photographs - Geometry of air photo - Parallax - pair of photos - Height determination - Flight planning - Stereoscopy - Monovision - Binocular vision - Aerial photo interpretation - Basic elements - Techniques of photo interpretation - Application of aerial photo interpretation - photographs versus maps.

MODULE III IMAGERY **9**

Landsat imagery - Digital image processing - Comparison with aerial photographs - Imaging devices - Aerial camera - Panoramic camera – Satellites – Geo Stationery – Sun Synchronous Satellites – Platforms and Sensors – types - Characteristics.

MODULE IV GIS **9**

GIS – Structure of GIS – various components of GIS – vector and raster data – analysis of data – Introduction to various GIS softwares – Introduction to GPS – Principles – list of software.

MODULE V APPLICATIONS OF GIS AND REMOTE SENSING **9**

Application of Remote Sensing and GIS in water resources engineering, land use studies, soil investigations, geology, transportation networks, agriculture, forestry, coastal engineering and military services.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze the fundamental principles of remote sensing, including electromagnetic interactions, atmospheric effects, and energy interactions with surface features.

CO2: Interpret aerial photographs using stereoscopic principles and image analysis techniques to extract spatial information and solve real-world problems.

CO3: Compare and contrast various satellite imageries based on their acquisition characteristics, resolutions, and applications.

CO4: Analyze and evaluate the components, data types, and functionalities of GIS to apply them effectively in spatial data analysis and problem-solving.

CO5: Select and integrate geospatial technologies to address real-world problems in various domains.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Fundamentals of remote sensing” by Bhatia S.C, New Delhi Atlantic Publishers, 2018.

2. “Remote Sensing and Image Interpretation” by Lillesand, Thomas.M and Ralph W.Kiefer, John Wiley Sons, 2021.

REFERENCES:

1. ”Applications of Geographic Information Systems in Civil Engineering” by Niraj Kumar Thakur, Springer, 2018.
2. ”Manual of Remote Sensing: Principles and Applications” by Steven M. De Jong, John Wiley & Sons, 2023.
3. ”GIS and Remote Sensing in Hydrology, Water Resources and Environment”, by Biswajeet Pradhan, Springer, 2018.
4. ”Handbook of Satellite Remote Sensing” by Quac Pham & Jochen A. Schiller, CRC Press, 2019.
5. ”Mastering ArcGIS Pro” by Rodney Dangerfield, , ESRI Press, 2023.

ONLINE RESOURCES:

1. https://earthobservatory.nasa.gov/
2. https://www.opengeospatial.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	2		3	2	3					2			2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	TRAFFIC ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I TRAFFIC CHARACTERISTICS **9**

Physical, Physiological, Psychological, Environmental Characteristics, PIEV Theory – Traffic Stream Characteristics, Vehicle Characteristics – Urban Road and Road Characteristics – Geometric Design - Overview.

MODULE II SURVEYS AND STUDIES IN TRAFFIC ENGINEERING **9**

Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – LOS for uninterrupted traffic flow – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accident – Level of Service (LoS).

MODULE III DESIGN OF TRANSPORT INFRASTRUCTURE **9**

Design of roads – Design Speed, Terrain, Gradient curves – Horizontal and Vertical, Super elevation, Sight Distance –Traffic Sign, Road Markings, Traffic Control Aids, simple problems.

MODULE IV INTERSECTION DESIGN AND CONTROL **9**

Design of Intersection – At grade intersection – Uncontrolled, Channelization, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Intersection - Types, Design and Analysis.

MODULE V TRAFFIC MANAGEMENT **9**

Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, Intelligent Transport System for traffic management.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze and evaluate the factors affecting traffic flow, applying PIEV theory to develop strategies for safer and more efficient transportation systems.

CO2: Evaluate and apply appropriate traffic survey and study methods to collect and analyze data, utilizing Level of Service (LOS) concepts to assess traffic flow efficiency.

CO3: Apply principles of safety and efficiency while designing road elements and incorporating traffic signs, markings, and control aids.

CO4: Evaluate and propose intersection design solutions along with optimized traffic signal timing and coordination, considering traffic volume and geometric constraints.

CO5: Estimate the effectiveness of various traffic management strategies, proposing comprehensive plans and promote sustainable transportation practices.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Traffic Engineering and Transport Planning" by Kadiyali.L.R., Khanna Publishers, Delhi, 2020.
2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management, 2018.

REFERENCES:

1. “Fundamentals of Traffic Engineering“ 17th Edition by Wolfgang S. Homburgeret. al., Institute of Transportation Studies, University of California, Berkely, 2023.
2. “The Handbook of Highway Engineering” by Myint Thaik Aung, CRC Press, 2021.
3. “Geometric Design Guide” by American Association of State Highway and Transportation Officials, 2018.
4. “Traffic and Highway Engineering” by Nicholas J. Garber and Lester A. Hoel, John Wiley & Sons, 2015.
5. “Highway Capacity Manual” by Transportation Research Board, USA, 2016.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105
2. https://nptel.ac.in/courses/105105107

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3	2	2	3	2						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED SURVEYING	L	T	P	C
		3	0	0	3

MODULE I ELECTRO OPTICAL AND MICRO WAVE TOTAL STATION 9

Computation of group Refractive Index for light, near infrared and microwaves - First velocity correction and Second velocity correction - Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Care and maintenance of Total Station instruments – Applications of COGO functions -Traversing and Trilateration – Topographic mapping - Recent trends.

MODULE II GPS SATELLITE SYSTEM AND DATA PROCESSING 9

Global Navigation System, Regional Navigation System and SBAS - Basic concepts of GNSS, Glonass, IRNSS - Historical perspective and development - applications GPS - Segments - Space, Control and User segments - satellite configuration - GPS signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability – GPS receivers- GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – Data processing – software modules -solutions of cycle slips, ambiguities, RINEX format.

MODULE III LASER SCANNING 9

Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser – First Return and Last Return – Ellipsoidal and Geoidal Height - Airborne Laser Scanner (ALS) – Components of ALS - GPS, IMU, LASER Scanner, Imaging Device - Terrestrial Laser Scanners (TLS) – Working Principle – Static, Dynamic and Vehicle Mounted TLS - Space Borne LiDAR Missions – Space Borne Radar Altimeter for mapping Sea Surface Topography.

MODULE IV GEODESY AND PPLICATIONS 9

Definitions – Histrory, Classifications, Applications, Problem and purpose of Geodesy -. Reference Surfaces and their relationship. Engineering, Lunar, Planetary and interferometric Synthetic aperture radar Geodesy – Local and International Spheroid - Geometry of ellipsoid - fundamental mathematical relationship of Geodetic, Geocentric and Reduced latitudes and their relationship-Ellipsoidal Co-ordinates in terms of Reduced, Geodetic and Geocentric latitude.

MODULE V PHOTOGRAMMETRIC SURVEY, HYDROGRAPHIC SURVEY AND OTHER MODERN SURVEY 9

Photogrammetry – Terrestrial and Aerial Photogrammetry – Horizontal position of a point from photographic measurement – elevation of a point – Determination of focal length of camera – determination of scale – Ground co-ordinates - Relief displacement – Photo interpretation. Drone survey – principle, mapping and modeling, application and uses, Ground Penetrating Radar - Data Processing, Modeling and Analysis in Environmental Applications – principle and uses.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate and choose the appropriate total station technology and apply COGO functions for traversing, trilateration, and topographic mapping.

CO2: Analyze and process GNSS data effectively, interpreting GPS observables and achieve accurate positioning and coordinate determination in diverse surveying scenarios.

CO3: Distinguish laser scanning data using both airborne and terrestrial systems for diverse surveying applications, accounting for environmental factors and data quality considerations.

CO4: Apply fundamental geodetic concepts and coordinate systems to interpret geospatial data accurately, considering the relationships between local, regional, and global reference surfaces.

CO5: Integrate various modern surveying techniques for data acquisition, processing, and analysis to solve diverse surveying problems, considering data quality, project requirements, and cost-effectiveness.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Advanced Surveying Total Station, GPS, GIS, and Remote Sensing” by Gopi Satheesh and R Sathikumar, Pearson India, 2023.
2. “Laser Scanner Technology: Applications in Geoscience” by Javier Vegas, José Luis González-Aguilar, and Juan Carlos Alonso, Springer, 2020.

REFERENCES:

1. “GPS Theory, Algorithms and Applications” by Guocheng Xu, Springer - Verlag, 2023.
2. “Geodesy: The concepts” by Petr Vanicek and Edward J. Krakiwsky, Elsevier, 2021.
3. “Airborne and Terrestrial Laser Scanning” by George Vosselman and Hans-Gerd Maas, Whittles Publishing, 2023.
4. “Photogrammetry - Geometry from Images and Laser Scans” by Karl Kraus, De Gruyter, 2023.
5. "Laser Scanner Technology" by J. Apolinar Munoz Rodriguez, 2012.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103176
2. https://nptel.ac.in/courses/105104100

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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5			2		3								2		
Avg.	2		2		3								2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	URBAN TRANSPORTATION PLANNING	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF TRANSPORTATION PLANNING 9

Introduction - Interdependence of land use and traffic – transportation planning – different stages – various surveys – difficulties in planning - Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques

MODULE II TRIP GENERATION AND DISTRIBUTION, 9

Purpose of Trip – Trip Generation – Trip Distribution – factors – various models – analysis – traffic assignment – modal split - simple problems

MODULE III DESIGN OF VARIOUS ELEMENTS , 9

Design of intersections – at grade – grade separated interchanges – Parking – Demand – type of parking – Design of Multi Storied and Surface Parking facility - traffic signal design – methods – simple problems

MODULE IV URBAN TRANSPORTATION MODES, 9

Public transport – planning - fares and subsidy – Intermediate public transport – types – characteristics – other urban transportation modes

MODULE V URBAN TRANSPORTATION PROBLEMS, 9

Problems in Present Traffic conditions –– Pedestrian Facilities - traffic and Environment – Air Pollution – Noise Pollution - fuel crisis – remedial measures

COURSEOUTCOMES

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

CO1: Evaluate and plan data collection strategies for urban transportation studies, and analyze diverse data sources by the application of zoning principles.

CO2: Apply trip generation and distribution models to forecast travel demand in urban areas, considering relevant factors and evaluate the model choice for effective transportation planning.

CO3: Analyze and design key urban transportation elements considering traffic demand, safety, and efficiency with relevant standards and regulations.

CO4: Evaluate and propose appropriate public and intermediate public transport options for an urban context, considering ridership, operational efficiency, environmental impact, and social equity.

CO5: Diagnose and propose solutions to major urban transportation problems by integrating knowledge of transportation systems, environmental impacts, and policy measures.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Traffic Engineering and Transport Planning” by Kadiyali.L.R., Khanna Publishers, Delhi, 2020.

2. “Transportation Engineering” by Khisty C.J. and Kent B Lall, Prentice Hall, 2018.

REFERENCES:

1. ” Transportation Engineering and planning” by Tassos A. Papacostas, Tata McGraw Hill, 2019.
2. “Introduction to Transportation Planning” by Bruton M.J., Routledge, 2014
3. “Metropolitan Transportation Planning” by John W. Dickey, Taylor & Francis, 2019.
4. “Principles of Urban Transport Planning” by Hutchinson, B.G, Routledge, 2016.
5. “Urban Transportation Planning: A Decision-Oriented Approach” by Michael D. Meyer and Eric J. Miller, “Urban Transportation Planning: A Decision-Oriented Approach” by McGraw-Hill Education, 2014.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/124/107/124107158/
2. https://nptel.ac.in/courses/105105107

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2			2	1								2		
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3	3		3												
4	3					2	2								
5	3		3										2		
AVg.	3		3	2	2	2	2						2		

1-low, 2-medium,3-high

COURSE CODE	TRANSPORTATION SYSTEMS PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I TRANSPORTATION AND SOCIETY 9

Role of Transport in Society and Economy - Functions and Problems in Transportation Planning - Economic, Geographical, Political, Technological, Social and Cultural Factors in Planning of Transportation System. Transport Technology: System Classification and their Variation; Conventional Systems and Unconventional Systems - Air, Water and Ground Modes

MODULE II MODES OF TRANSPORT AND THEIR CHARACTERISTICS 9

Propulsion Forces - Factors in Operation - Levels of Service and Performance Criteria - Quality of Service: Capacity and Levels of Service of different Transportation Systems; mobility and accessibility – Flexibility - Speed, Acceleration, Deceleration - Comfort and Environmental Effects - Time Spent and Cost – Integration of modes.

MODULE III A BRIEF HISTORICAL DEVELOPMENT OF TRANSPORTATION SYSTEMS 9

Growth of Transport - Road Development Plans - Imbalances in Transport System - National Transport Policy Recommendations - Optimum Inter Model Mix-Study - Vision 2021, NHDP, PMGSY, Rural Roads Vision 2025 - IRC, CRRI etc. - Inland waterways in India

MODULE IV PLANNING OF PASSENGER AND GOODS TERMINAL FACILITIES 9

Planning of passenger and goods terminal facilities of Air, Water, Railway and Highway Transportation Systems – requirements and typical layouts - passenger facilities - parking configuration - terminal requirements – goods facilities and containerization

MODULE V OPERATIONAL CONTROLS 9

Operational Controls of Air, Water, Railway and Highway Transportation Systems: Functions of Control & Communications - Signals and Traffic Control Devices - Navigational Aids of the different Transportation Systems. Air Traffic Control; Navigational Control. Automatic Signaling Systems of Railway and Highway Movements.

COURSEOUTCOMES

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

CO1: Evaluate the economic, social, and environmental impacts of various transportation systems, advocating for sustainable and equitable solutions.

CO2: Compare and contrast various transportation modes based on performance, service quality, and environmental impact, by selecting appropriate options for specific needs

CO3: Evaluate the historical evolution of transportation systems in India by analyzing current policies and initiatives for achieving an optimal multimodal mix

CO4: Design and evaluate passenger and goods terminal facilities for different transportation modes, considering user needs, operational efficiency, and sustainability principles.

CO5: Analyze and explain operational control systems for air, water, rail, and highway transportation systems, their effectiveness in ensuring safety, efficiency, and traffic management.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Traffic Engineering and Transport Planning” by Kadiyali.L.R. Khanna Publishers, Delhi, 2020.
2. “Transportation Engineering” by Khisty C.J. and Kent B Lall, Prentice Hall, 2018.

REFERENCES:

1. “Transportation Engineering and Planning” by Tassos A. Papacostas, McGraw-Hill Education, 2019.
2. “Transportation Engineering: Planning and Design” by C.S. Papacostas and Panayiotis Prevedouros, , John Wiley & Sons, 2023.
3. “Airport Planning & Design” by Walter J. Horonjeff and Kenneth M. Linster, McGraw-Hill Education, 2019. .
4. “Airport Systems: Design, Planning, and Management” by Richard H. Stinson, J. Ross Publishing, 2019.
5. ” Handbook of Transportation Systems Engineering” by Andrew J. Graham, Wiley-Blackwell, 2021.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105107
2. https://archive.nptel.ac.in/courses/105/106/105106058/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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AVg.	3		3	2	2	3	3						2		

1-low, 2-medium,3-high

COURSE CODE	TRANSPORTATION ECONOMICS AND FINANCE	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTORY CONCEPTS IN TRANSPORTATION DECISION MAKING 9

Overall transportation project development, budgeting, financial planning, the process of transportation project development, models associated with transportation impact evaluation.

MODULE II TRANSPORTATION COSTS 9

Classification of transportation costs, transportation agency costs, transportation user costs, general structure and behavior of cost functions and road pricing. Estimating Transportation Demand and Supply - supply equilibration, dynamics of transportation demand and supply, elasticity of travel demand and supply, classification of elasticity.

MODULE III VEHICLE OPERATING COSTS 9

Fuel costs - Maintenance and spares, Depreciation - Crew costs - Value of travel time savings - Accident costs. Economics of traffic congestion - Pricing policy.

MODULE IV ECONOMIC ANALYSIS OF PROJECTS 9

Methods of evaluation - Cost-benefit ratio, first year rate of return, net present value, and internal-rate of return methods; Indirect costs and benefits of transport projects.

MODULE V FINANCING OF ROAD PROJECTS 9

Methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Design-Build-Operate-Transfer Schemes – Risk Analysis – Value for Money analysis - Case Studies.

COURSEOUTCOMES

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

CO1: Analyze and apply economic principles to the entire transportation project development process, including financial planning, impact evaluation, and relevant models.

CO2: Interpret different transportation costs and apply cost functions and road pricing concepts to inform decision-making

CO3: Evaluate the key components of vehicle operating costs and their implications for policy decisions.

CO4: Enumerate the economic viability of transportation projects using various methods and considering both direct and indirect costs and benefits.

CO5: Assess transportation projects using economic analysis tools and public-private partnerships thereby ensuring value for money.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Kenneth A. Small, “Transportation Economics” ,2023.
2. Susan Perkins and William H. Schneider, “Transportation Planning Handbook”, 2021.

REFERENCES:

1. W.G. Waters, “Handbook of Transport Modelling”, 2023.
2. David A. Henshe, “Transportation Impact Assessment”, 2022.
3. Richard B. Dial, “Handbook of Road Pricing: Theory, Practice, and Case Studies” 2020.

4. Umar Zafar, “Sustainable Transportation Engineering: An Introduction”, 2020.
5. Edward S. Beimborn, “Handbook of Transport Economics”, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105107
2. https://archive.nptel.ac.in/courses/105/106/105106058/

CO-PO&PSOMAPPING

CO	PO												PSO		
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AVg.	3		2		2	2							2		

1-low, 2-medium,3-high

COURSE CODE	INTELLIGENT TRANSPORT SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I INTELLIGENT TRANSPORTATION SYSTEM AND DEFINITIONS 9

Introduction to Intelligent Transportation System (ITS) – Definition of ITS and Identification of ITS-Need for ITS, Objectives, Historical Background, Benefits of ITS

MODULE II DATA COLLECTION TECHNIQUES 9

ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection

MODULE III FUNCTIONAL AREAS 9

Telecommunication in ITS - functional areas of ITS – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS)

MODULE IV TRAFFIC MANAGEMENT AND AUTOMATION 9

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management, Mobile Applications; Automated Highway Systems - Overview of ITS implementations in developed countries, ITS in developing countries.

MODULE V INTELLIGENT TRANSPORT SYSTEM IN INDIAN CITIES 9

Incorporation of ITS technologies in Indian cities – Transportation Planning applications – Metro rail systems – user friendly apps – case studies

COURSEOUTCOMES

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

CO1: Analyze and explain the need, objectives, benefits, and historical context of Intelligent Transportation Systems (ITS).

CO2: Apply various data collection techniques used in ITS, including detectors, and video data to analyze and manage transportation systems.

CO3: Evaluate the core functionalities of ITS, including ATMS, ATIS, CVO, AVCS, APTS, and ARTS, and evaluate their potential impact on various transportation stakeholders.

CO4: Assess the potential of ITS technologies for travel and traffic management, while considering automated highway systems and global implementation trends.

CO5: Interpret the incorporation of ITS technologies in Indian cities, analyzing their applications, user impacts, and case studies, and suggesting potential improvements.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Intelligent Transport Systems” by Srinivasa R Kumar, Orient Blackswan Pvt Ltd, 2021
2. “Intelligent Transport Systems” by Pradip Kumar Sarkar & Amit Kumar Jain, PHI Learning, 2018.

REFERENCES:

1. “Intelligent Transportation Systems Handbook” by Robert Bosch GmbH, 2023.
2. “Transportation Systems Engineering: Theory and Practice” by Ioannis S. Sifakis, 2023.
3. “Intelligent Transportation Systems Standards” by John C. Morris, 2021.
4. “Introduction to Intelligent Transportation Systems (ITS)” by Joseph C. Herrera, 2020.
5. “Handbook of Intelligent Transport Systems” by Mahbub Alam and Richard Curran, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-32.pdf

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					2	1						2		
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5	3					2							2		
AVg.	3				2	2	1						2		

1-low, 2-medium,3-high

COURSE CODE	ROAD SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I ROAD SAFETY AND ITS FACTORS 9

Road accidents, Trends, causes, Collision diagrams; Highway safety; Human factors and road user limitations; Speed and its effect on road safety; Vehicle factors; Highway safety in India. Multi-causal dynamic systems approach to safety; Crash Vs Accident; Road safety improvement strategies; Elements of a road safety plan, Safety data Needs; Safe vehicle design.

MODULE II STATISTICAL INTERPRETATION AND ANALYSIS OF CRASH DATA 9

Before-after methods in crash analysis, Recording of crash data; Accident Investigation and Analysis; Statistical testing and the role of chance; Black Spot Identification and Investigations, Case Studies.

MODULE III ROAD SAFETY AUDITS 9

Key elements of a road safety audit, Road Safety Audits & Investigations, Work zone safety audit; Crash investigation and analysis, Methods for identifying hazardous road locations, Case Studies.

MODULE IV CRASH RECONSTRUCTION 9

Describe the basic information that can be obtained from the roadway surface, understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case Studies

MODULE V MITIGATION MEASURES 9

Mitigation Measures: Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry and safety; Safety in urban areas; Public transport and safety; Road safety policy making, Stakeholders involvement; Road safety law.

COURSEOUTCOMES

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

CO1: Evaluate the multi-dimensional factors contributing to road accidents and propose evidence-based safety improvement strategies within the framework.

CO2: Apply statistical methods to analyze crash data, identify black spots, and draw informed conclusions for targeted safety interventions

CO3: Contrast road safety audits using recognized methodologies, identify potential hazards, and recommend effective countermeasures

CO4: Illustrate the scientific principles and engineering analysis to reconstruct crash scenarios, determine contributing factors, and support legal proceedings

CO5: Propose evidence-based mitigation measures to address various road safety challenges, considering engineering interventions, policy frameworks, and stakeholder engagement

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Traffic Engineering and Transport Planning" by Kadiyali.L.R. Khanna Publishers, Delhi, 2020.
2. "Transportation Engineering" by Khisty C.J. and Kent B Lall, Prentice Hall, 2018.

REFERENCES:

1. "Road Safety Inspections and Audits" by Rune Elvik, 2022.
2. "Human Factors in Road Safety" by Jens Rasmussen, Kinga M. Wisniewski, and Rune Elvik, 2020.
3. "Statistical Methods for Road Safety Analysis" by W.C. Mannering and Kenneth L. Caves, 2019.
4. "Handbook of Transportation Safety" by Robert J. Haver, 2019.
5. "Road Safety: An Introduction" by David Jamieson, 2020.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ce35/preview

CO-PO&PSOMAPPING

CO	PO												PSO		
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AVg.	3		3			3							2		

1-low, 2-medium,3-high

COURSE CODE	VALUATION OF IMMOVABLE PROPERTIES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF VALUATION AND VALUATION OF LAND & BUILDING 9

Definition - Cost, Price and Value - Types of Properties under Valuation - Various Purposes of Valuation- Different types of Value - Factors affecting Value - Different Methods of Valuation.

Types of Land - Location of Land and its Value - Belting Method of Valuation - Market Value and Guideline Value of Land - Building FSI - Plot Coverage - Types of Structure - Life of Various types of Building - Methods of Calculating Depreciation - Valuation by Land and Building Method.

MODULE II FREE HOLD AND LEASE HOLD PROPERTIES AND FIXATION OF FAIR RENT 9

Free hold and Lease hold Properties - Lease, Rent and License - Different forms of Lease - Lessor - Lessee - Sub-lessee - Reversion - Lessor' Rights - Lessee's Rights - Meaning of Different Rents - Fixation of Fair Rent - Principles of fixation of fair rent-Amenities to be considered - Rent fixation for Residential & Non-Residential purposes, Commercial Buildings, Apartments

MODULE III VALUATION OF APARTMENTS 9

FSI - Super Built-up Area - Undivided Share of Land - Different Methods of Valuation - Procedure of Valuation by Composite Rate Method - Valuation by Other Methods - Procedure for Valuation of Flat under Construction - Stage Value of a flat - Valuation of an existing flat - Joint Venture Agreement

MODULE IV VALUATION FOR BANKS 9

Purposes - Security - Primary and Collateral - Present, Market, Forced Sale and Auction Value - Valuation of Building under Construction - Valuation of Ready Built House - Valuation of Ready built Flats - Valuation of Flats under construction - Valuation of Properties offered as Collateral Security - How to become a Panel Valuer of Banks - Problems involved in Bank Valuation - Precautions to be taken in Bank Valuation - Points to be remembered in Bank valuation.

MODULE V VALUATION FOR TAXATION 9

Direct and Indirect Taxes - Valuation for Income Tax - Estimation of Cost of Construction by Plinth area rate method - Valuation by CPWD and State PWD Rates - Cost of Construction by accounting method - Valuation for Capital Gains Tax - Fair Market Value as on 01.04.1981 and 01.04.2001 - Section 50C of Income Tax Act - Valuation for individual Property - Valuation of Apartment

COURSEOUTCOMES

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

CO1: Analyze and apply fundamental valuation principles to land and buildings, considering various purposes and methods, demonstrating a clear understanding of key terminology and factors impacting value

CO2: Integrate between freehold and leasehold properties and effectively calculate fair rent, applying legal principles and considering amenities and property type.

CO3: Interpret the valuation methods, including the composite rate method, to accurately assess the value of apartments considering FSI, super built-up area, and stage of construction.

CO4: Demonstrate expertise in bank valuation, accurately assessing property value for security purposes and understanding the role of panel valuers, while adhering to ethical and legal guidelines.

CO5: Apply valuation principles for tax purposes, including income tax and capital gains tax, considering relevant legislation and methods for estimating construction costs and fair market value.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Valuation of Urban and Rural Land" by A.M. Michael & John G. Wilkins, Routledge, 2023.
2. "Valuation of Apartments" by S.K. Agarwal, Khanna Publishers, 2022.

REFERENCES:

1. "Modern Law of Real Property" by Michael Bridge, Cavendish Publishing, 2023.
2. "Fundamentals of Real Estate Appraisal" by Richard Ratcliff, American Institute of Real Estate Appraisers (AIREA), 2021.
3. "The Law of Leasehold Reform, Housing and Urban Development Acts" by Stephen Furmston, Sweet & Maxwell., 2021.
4. "Valuation of Real Properties" by Rangwala, Charotar Publishing House, 2020.
5. "Property Valuation" by Peter Wyatt, Wiley-Blackwell, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/109107115

CO-PO&PSOMAPPING

CO	PO												PSO		
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5	3												2		
AVg.	3				1	2							2		

1-low, 2-medium,3-high

COURSE CODE	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

MODULE I ENGINEERING ECONOMICS AND COST ANALYSIS 9

Introduction to Economics- Flow in an economy, Law of supply and demand, Macroeconomics and micro economics - Concept of Engineering Economics - Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis - Material selection for product - Design selection for a product, Process planning.

MODULE II DECISION ANALYSIS AND FINANCIAL EVALUATION TECHNIQUES IN ENGINEERING PROJECTS 9

Make or buy decision, Value engineering - Function, aims, Value engineering procedure. Interest formulae and their applications-Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

MODULE III PRICING 9

Determinants of price – Pricing under different objectives – Pricing under different market structures – Pricing discrimination – Pricing of joint products – Pricing methods in practice (Theory only).

MODULE IV REPLACEMENT ANALYSIS, MAINTENANCE STRATEGIES 9

Replacement and Maintenance analysis - Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset - capital recovery with return – concept of challenger and defender.

MODULE V DEPRECIATION METHODS IN ENGINEERING ECONOMICS 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year’s digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation.

COURSEOUTCOMES

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

CO1: Identify economic principles and cost analysis techniques to evaluate and optimize engineering projects, considering both economic efficiency and engineering feasibility.

CO2: Determine financial evaluations of engineering projects using time value of money concepts and decision analysis tools, recommending optimal solutions.

CO3: Analyze different pricing strategies in various market structures, critically evaluating their impact on market dynamics and business profitability.

CO4: Prepare the optimal replacement time for assets and develop effective maintenance strategies, balancing economic considerations with performance and reliability requirements.

CO5: Select and apply appropriate depreciation methods for calculating asset value decline, ensuring accurate financial reporting and informed decision-making.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Engineering Economics: Analysis and Practice" by Donald G. Newnan, Jerome P. Lavelle, and Ted G. Eschenbach, Oxford University Press, 2021.
2. "Engineering Economy" by Leland Blank and Anthony Tarquin, McGraw-Hill Education, 2020.

REFERENCES:

1. "Principles of Engineering Economics" by John R. Park, Pearson Education India, 2020.
2. "Modern Engineering Economy" by Theodore E. Riggs & David G. Cleland, McGraw-Hill Education, 2019.
3. "Economic Analysis for Engineering and Managerial Decision Making" by Stephen G. Gilley, James R. Riggs, & David G. Cleland, McGraw-Hill Education, 2018.
4. "Engineering Economics" by N. Ravichandran, Sri Krishna Publications Media P Ltd, 2019.
5. "A Text Book of Engineering Economics" by S.D. Umale, Himalaya Publishing House, 2019.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112107209

CO-PO&PSOMAPPING

CO	PO												PSO		
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5	3				1								2		
AVg.	3		2		1	2							2		

1-low, 2-medium,3-high

COURSE CODE	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures Facets of Maintenance, importance of Maintenance, routine and preventive maintenance, causes of deterioration. Non-destructive Testing Techniques

MODULE II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete based on Strength and Durability - Thermal properties, microstructure of concrete – packing density- Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion

MODULE III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Health and safety precautions for handling and applications of repair materials, Special mortars and concretes- Polymer Concrete and Mortar, Quick setting compounds, Grouting materials-Gas forming grouts, Sulfoalumate grouts, Polymer grouts, Acrylate and Urethane grouts, Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets.

MODULE IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING 9

Concrete protection methods – reinforcement protection methods- self-regulating anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, cathodic protection, Structural health monitoring.

MODULE V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jacketing, steel jacketing, FRP jacketing, Strengthening, Beam shear strengthening, Flexural strengthening

COURSEOUTCOMES

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

CO1: Understand the concepts of maintenance, repair, rehabilitation, retrofit, and strengthening as applied to structures.

CO2: Identify and categorize different types of cracks in concrete, understanding their causes and effects.

CO3: Select suitable repair materials for various concrete deterioration scenarios, considering their properties, compatibility, and application techniques.

CO4: Understand the principles of Concrete protection methods structural health monitoring and its applications

CO5: Analyze different beam strengthening techniques for shear and flexure enhancement.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Maintenance and Repair of Civil Structures” by Atul Prakashan, 2023.
2. “Concrete Repair, Rehabilitation, and Retrofitting” by Zbigniew Zembaty, Springer, 2019.

REFERENCES:

1. “Structural Rehabilitation of Existing Buildings” by M.A. Aziz, Springer, 2023.
2. “Guide for Evaluation and Repair of Concrete Surfaces” by ACI Committee, 546 American Concrete Institute, 2020.
3. “Rehabilitation of Buildings and Infrastructure” by Edward Heindl, Wiley, 2019.
4. “Repair and Rehabilitation of Reinforced Concrete Structures” by Franco Antonucci, CRC Press, 2018.
5. “Advanced Materials for Rehabilitation and Retrofit of Structures” by Michael C. Forde, Springer, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/106/105106202/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2												3		
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5	3		2										3		
AVg.	3		2										3		

1-low, 2-medium,3-high

COURSE CODE	ADVANCED CONSTRUCTION TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I SPECIALIZED CONSTRUCTION TECHNIQUES 9

Construction aspects and procedures of specialized construction techniques - Box pushing -Box type retaining walls - Slip form for Chimney and Silo construction - Sheet piling and Diaphragm walls - Well and Caisson - Underpinning - Shotcreting & Guniting - Vacuum dewatering - Finishing & Curing method.

MODULE II UNDERGROUND CONSTRUCTION 9

Site investigation and Geological studies - Drilling - Pneumatic breakers - Explosives - Blasting. Tunneling technology- Mechanized shield- Micro method- Cut and cover method-Pipe Jacking - Hazards and safety measures in underground construction.

MODULE III OFFSHORE CONSTRUCTION 9

Underwater construction - Stages of offshore structure, Construction, Facilities and Methods of fabrication- Equipment's- Crane barges- derrick barges - Drilling vessels.

MODULE IV BRIDGE CONSTRUCTION TECHNIQUES 9

Types of Bridge- Based on span- Material- Type of super structure- Support condition -Position of floor - High flood level- Bridge construction methods - In situ and Precast construction methods- Balanced cantilever methods - Span by span method - Incremental launching method.

MODULE V EARTHWORK AND MATERIAL HANDLING EQUIPMENTS 9

Importance of construction equipment's their classification, selection and contribution rate of production (Output), Owning and operating cost.

Fundamentals of earth work operations - Selection of equipment for earth work- Types of earth work equipment - Tractors, Motor graders, Scrapers, Front end waders, Earth movers. Material handling equipment - Forklifts and related equipment - conveyors-hauling equipment.

COURSEOUTCOMES

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

CO1: Apply appropriate specialized construction techniques like box pushing, diaphragm walls, and shotcreting, considering project conditions and safety requirements.

CO2: Identify safe and efficient underground construction methods like tunneling and pipe jacking, considering geological challenges and hazard mitigation strategies.

CO3: Select suitable offshore construction equipment and methodologies based on the type of structure, fabrication needs, and environmental factors.

CO4: Outline bridge construction methods like balanced cantilever or incremental launching, considering bridge type, site constraints, and economic feasibility.

CO5: Select appropriate earthwork and material handling equipment based on project requirements, cost-effectiveness, and environmental considerations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Advanced Construction Technology” by M.L. Gambhir, McGraw-Hill Education, 2023.
2. “Construction Technology” by R.B. Peuri, Wiley Blackwell, 2020.

REFERENCES:

1. “Handbook of Tunnel Construction” by Michael S. Mooney, CRC Press, 2023
2. “Offshore Structures: Design, Construction and Application” by Dongwook Choi and Jin-Yong Kim, Academic Press, 2022. (2nd Edition)
3. “Bridge Engineering: Design, Construction, and Analysis” by W. F. Chen and J.Y. Zhan, Springer, 2020. (2nd Edition)
4. “Earthwork & Its Equipment” by B.C. Punmia & Ashok Kumar Jain, Laxmi Publications, 2019. (8th Edition)
5. “Construction Equipment Management for Engineers & Managers” by William R. Riggs & Namdar Gowrishankar, McGraw-Hill Education, 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/103/105103206/
2. https://archive.nptel.ac.in/courses/105/105/105105212/

CO-PO&PSOMAPPING

CO	PO												PSO		
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AVg.	3	2	2		1	2							3		1

1-low, 2-medium,3-high

COURSE CODE	CONTRACT MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I CONSTRUCTION CONTRACTS **9**

Elements of Contracts - Types of Contracts - Features - Suitability - Salient Features of Indian contract Act 1872 as Relevant to Construction Contracts - Design of Contract Documents - International Contract Document - Standard Contract Document - Law of Torts- Contract for Engineering and Architectural Services- Contract between Owner and Contractor.

MODULE II TENDERS **9**

Types of Tenders - Notice Inviting Tender - Prequalification - Preparation and Submission of -Bid Documents & Tenders - Bidding - Acceptance/Rejection of Tenders - Evaluation of Tender from Technical, Contractual and Commercial Points of View - Contract Formation and Interpretation - Potential Contractual Problems - World Bank Procedures and Guidelines - Tamilnadu Transparency in Tenders Act - Local and International Competitive Bidding - Global Tendering.

MODULE III CONTRACT ADMINISTRATION AND MANAGEMENTS **9**

Selection of Project Management Team - Possession of Construction Site - Duties of Employers - Duties of Contractors - Settlement of Variations & Clarifications in Construction - Documentation and Maintenance of Construction Progress Records.

MODULE IV LEGAL REQUIREMENTS **9**

Legal Requirements for Planning - Property Law - Agency Law - Local Government Laws for Approval - Statutory Regulations - Social Security - Welfare Legislation - Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration - Insurance and Safety Regulations

MODULE V ALTERNATE DISPUTE RESOLUTION **9**

Claims and Disputes in Construction contracts - Various Methods of Settlement of Disputes - Alternate Dispute Resolution - Negotiation, Mediation, Conciliation and Arbitration - Salient Features of The Arbitration and Conciliation Act 1996 - Formation of Arbitration Tribunal - Interim Award - Conduct of Arbitration Proceedings - Award Writing and Setting aside of Award.

COURSEOUTCOMES

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

CO1: Select appropriate construction contract types based on project needs and legal requirements, ensuring compliance with the Indian Contract Act and international standards.

CO2: Prepare tender documents according to international and local bidding procedures, applying technical, contractual, and commercial criteria for effective contract formation.

CO3: Manage contract administration processes by defining roles and responsibilities, tracking variations, and maintaining proper documentation for optimal project control.

CO4: Identify and comply with relevant legal regulations related to planning and labor welfare.

CO5: Choose appropriate alternative dispute resolution methods to resolve contractual conflicts efficiently.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Black's Contract Law” by Michael J. Trebilcock and Douglas G. Stuart, 10th Edition, 2023.
2. “Construction Contracts: Law and Management” by Peter Hirst & Andrew Stones, Wiley Blackwell, 2020.

REFERENCES:

1. “Complex Procurement Contract Management” by David Brown, Routledge, 2023.
2. “Construction Law in India” by P.L. Malik, Viraj Publications, 2022. (8th Edition)
3. “International Construction Contracts: Law and Practice” by M. Lew and Patrick G. Coyne, Julian Routledge, 2022.
4. “Handbook of Contract Management in Construction” by Ali D. Haidar, Springer Cham, 1st Edition, 2021
5. “Construction Tendering and Bidding” by Michael O'Regan, Routledge, 2021.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103093

CO-PO&PSOMAPPING

CO	PO												PSO		
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AVg.	2				1	3		2			2		1	3	

1-low, 2-medium,3-high

COURSE CODE	FORMWORK FOR CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PLANNING, SITE EQUIPMENT & PLANT FOR FORM WORK 9

Introduction – Formwork as a temporary structure – Requirements for formwork – classification of formwork- Key areas of cost reduction of formwork – Economical planning of form materials- Planning for Safety - Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan – Transporting plant

MODULE II MATERIALS, ACCESSORIES, PROPRIETARY PRODUCTS 9

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load.

MODULE III DESIGN OF FORMS AND SHORES 9

Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on columns and walls. Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Slab props - Heavy Duty props.

MODULE IV BUILDING AND ERECTING THE FORM WORK 9

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems – Flying system forms- Prefabricated panel systems – Giant forms- curved wall forms- Beam or girder forms – suspended forms. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities

MODULE V FORMS FOR DOMES AND TUNNEL 9

Formwork for domes - Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method – Continuous Advancing Slope method.

COURSEOUTCOMES

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

CO1: Develop and implement cost-effective formwork plans, considering safety regulations, resource allocation, and site constraints, ensuring project schedule adherence.

CO2: Select and specify appropriate formwork materials and accessories based on structural requirements, performance data, and economic considerations.

CO3: Design safe and efficient formwork systems for various concrete elements like walls, slabs, beams, columns by analyzing loads, selecting appropriate formwork components, and verifying structural integrity.

CO4: Construct and erect formwork according to design specifications, following safety protocols and addressing potential failure causes.

CO5: Plan and implement specialized formwork solutions for complex curved structures like domes and tunnels, considering different construction methods and concrete placement techniques.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Formwork for concrete structures" by Kumar Neeraj Jha., McGraw Hill Education (India) Private Limited, New Delhi,2017.
2. "Formwork for Concrete", Special Publication No.4 by Hurd, M.K., American Concrete Institute, Detroit, 1996.

REFERENCES:

1. "Formwork for Concrete" by Austin, C.K., Cleaver -Hume Press Ltd., London, 1996.
2. "Formwork for concrete structures" by Michael P. Hurst, Construction Press, London and New York, 2003.
3. "Formwork for Concrete Structures" by Robert L. Peurifoy and Garold D. Oberlender, McGraw Hill, 1996.
4. "Construction Methods and Management" S. C. Rangari, 8th Edition, 2020.
5. "Civil Engineering Ethics" by James R. Chudley, 2020.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104030/

CO-PO&PSOMAPPING

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4	2					2									1
5	3		3										3	2	
AVg.	3		3			2					3		3	2	1

1-low, 2-medium,3-high

COURSE CODE	ENTREPRENEURSHIP IN CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I CONCEPT OF ENTREPRENEURSHIP AND INDUSTRIAL ENTERPRISES 9

Entrepreneur- Qualities, functions and classification of an Entrepreneur -Entrepreneurship - Meaning - Factors influencing Entrepreneurship - Intrapreneurship - Entrepreneurial Organizations and Strategic Management- Innovation and Entrepreneurial Marketing- Managerial Competencies as an Entrepreneurial Manager- Business idea generation techniques - Identification of Business opportunities - Feasibility study - Preparation of Project Report - Tools of Appraisal; Classification of industries - Large, Micro, Small and Medium Enterprises (MSME), Cottage, light, heavy, public, private, joint cooperative sectors, MNC, capital intensive and labour intensive industries. Institution for the development of small-scale industries - NSIC, SIDCO, SIDO, SISI, TANSI, DIC, Concessions, rebates, incentives and subsidies to small scale units

MODULE II BUSINESS TAXATION 9

Direct and indirect taxes-Income Tax- Income Tax Act 1961 - Basic Concepts and Definitions - Income, Assessee, Person, Previous Year, Assessment Year, Gross Total Income, Total Income. Meaning of Permanent Account Number, Return of Income, TDS, Advance Tax, Rates of Taxation, Assessment Procedure. Service Tax-Customs Duty, Excise Duty -Goods And Services Tax (GST)- Definitions & computations - Deductions-exemptions - Payment of Tax- Furnishing of Return- Interest as Delayed Payment of Tax- Punishments/ Penalties Relating to Taxes- Appeal before the respective Commissioners- Appeal before Appellate Tribunal; Startup India, Stand Up India, Mudra Loan - Industrial Estates-Special Economic Zones(SEZ)-Export Oriented Units(EOU) Procedures in setting of small scale units - Licensing - Registration - Financing - Working

MODULE III CORPORATE BUSINESS LAW 9

Indian Contract Act - Terms of contract - Forms of contract - Offer and Acceptance Considerations. Capacity - Flaw in consent, Void agreements - Illegal agreements. Memorandum of Association- Share Capital - Kinds of Shares - Voting Rights - Borrowing powers of companies - Membership in a company - Directors - Legal position - Appointment, removal, Rights, Duties and Powers - Qualification and Disqualification. Meetings and Resolutions - Statutory Meeting - Annual General Meeting - Extraordinary General Meeting - Resolutions - Ordinary & Special.

MODULE IV AUDIT 9

Definition of Audit - Difference between auditing and accountancy - Scope of auditing -Objectives of auditing - Nature and Scope of internal audit - Financial vs. operational audit - Internal control; nature and scope - Verification of evidence - Detailed checking vs. sample checking - Internal audit and statutory audit

MODULE V BANKING FINANCIAL SERVICES 9

Central Banking and Role of RBI and their functions. Commercial Banks - E Banking - Personal Identification Number - Electronic Fund Transfer-Electronic Clearing System. Negotiable Instruments - Promissory Note - Bills of Exchange, Cheque, Draft - Definitions, Features - Crossing - Endorsement - Material Alteration - Paying Banker - Rights and Duties - Statutory Protection - Dishonour of Cheques - Merchant Banking - Functions - Issue Management - Managing of new issues - Underwriting - Capital market - Stock Exchange - Role of SEBI- Venture capital - Mutual Funds - Credit Rating. Insurance - Different types - Life, marine, fire, motor, health, pension plan, annuity, rural insurance.

COURSEOUTCOMES

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

CO1: Identify business opportunities in the civil engineering sector, considering entrepreneurial qualities, market factors, and institutional support mechanisms.

CO2: Analyze the legal and financial landscape of starting and operating a civil engineering business, including tax regulations, subsidies, and financing options.

CO3: Develop legal and ethical business practices in the civil engineering industry, understanding basic contract principles and corporate governance structures.

CO4: Infer internal controls and financial health of civil engineering businesses, applying basic auditing principles and procedures.

CO5: Plan secure funding and utilize financial services effectively for their civil engineering ventures, analyzing market instruments and regulations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Entrepreneurship in Civil Engineering: Business Planning and Management for Engineers” by Daniel W. Liston, 2023.
2. "Entrepreneurial Development" by Srinivasan N.P, C.B Gupta., Sultan Chand and Sons Publishers, 2020

REFERENCES:

1. “Project Management for Construction” by Chris Hendrickson, 8^{th} edition, 2021.
2. "Law of Insurance" by Dr. M.N. Mishra., Central law agency, 2021
3. “Income Tax including GST” by Monica Singhania, Vinod K. Singhania, 2021
4. “The Civil Engineer's Guide to Innovation and Entrepreneurship” by Daniel M. Frangopol, Anastasios D. Symeonidis, and Carlos M. Pestana, 2020.
5. "Mercantile Law" by S. Badre Alam., P. Saravanavel, Macmillan Publishers, 2019

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110106141

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					1			2				1		
2	2					2									
3	2							2							
4	2				1										
5	2										3				
AVg.	2				1	2		2	2		3		1		

1-low, 2-medium,3-high

COURSE CODE	PROFESSIONAL PRACTICE FOR CIVIL ENGINEERS	L	T	P	C
		3	0	0	3

MODULE I BUILDING BY LAWS RULES AND REGULATION AND PLAN APPROVAL PROCESS 9

Building by laws - importance - acts and rules of public interest - state and central – approval bodies–Metros – Corporation – Municipalities - Town Panchayats. Preparation and Submission of Drawings and Documents for Building Approval and Layout. Land use Classification in urban & Mofussil Areas-Related Regulatory and approvals.

MODULE II MUNICIPAL SERVICES (WATER SUPPLY SEWAGE AND ELECTRICAL CONNECTIONS 9

Local approvals and clearances for residential, industrial and commercial Buildings - General specifications for water supply and sewers - Water Supply – Process for waste water connections to public Mains. Domestic water supply connection from public mains, types and sizes of pipes, special installation in multi-storeyed buildings. Connections to Public sewers.

General Specifications - Electrical supply for residential, industrial and commercial Buildings - List of procedures – Standards - Local approvals and clearances for residential, industrial and commercial Buildings-Temporary – Permanent Services-Consumer Guidance TNEB.

MODULE III ESTABLISHMENT FOR PROFESSIONAL PRACTICE 9

Establishment of firm - Consultancy, Construction - Registration of firms with GST, CST, Companies –IT - Licensing from local bodies – Metros - Municipalities, town panchayats - Obtaining Chartered Engineership, approved valuership, registered valuership with income tax, Bank Empanelment- Membership of other professional bodies- BAI, ACCE(I) Etc., - Registration of contractors with Government Departments, Public undertakings & Private organizations.

MODULE IV DOCUMENTATION FOR PROJECT COMMENCEMENT AND CLOSURE AND TAX ASSESSMENT 9

Documentation for formal approval of work commencement - Procedures. Documentation for procurement and mobilization of resources – Record of works – Changes - Deviation - Preparation of running account bill & Final bill. Submission of project closure report. Handing over documents – Procedure for contract closure.

MODULE V SAFETY EDUCATION AND TRAINING 9

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, safety laws.

COURSEOUTCOMES

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

CO1: Apply the legal and regulatory framework for building construction, ensuring compliance with local bylaws, obtaining approvals, and preparing necessary documents.

CO2: Analyze the required municipal services for residential, industrial, and commercial buildings, understanding specifications, procedures, and approvals for water supply, sewage, and electrical connections.

CO3: Demonstrate civil engineering practice, obtaining necessary registrations, licenses, and memberships, and complying with legal and ethical requirements.

CO4: Organize project documentation throughout its lifecycle, ensuring proper commencement procedures, resource mobilization, bill preparation, closure reports, and tax compliance.

CO5: Identify and implement safety training programs for themselves and others in the construction industry, understanding legal requirements, awareness strategies, and best practices.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Estimating and Costing in Civil Engineering" by Dutta B.N., UBS Publishers & Distributors Pvt. Ltd., 2010.
2. "A Text Book of Estimating and Costing (Civil)" by Kohli D.D. and Kohli R.C., Chand &; Company Ltd., 2004.

REFERENCES:

1. "Construction Contracts: Law and Management" by Michael I. Bushell, 2022.
2. "Sustainable Infrastructure" by Scott A, 2021.
3. "Green Building Handbook: Comprehensive guide to green building principles, technologies, and practices, applicable to civil engineering projects" by Paul S. Cipes, 2021
4. "Professional Practice for Civil Engineers" by John P. Clougherty, 2021
5. "Civil Engineering Ethics" by James R. Chudley, 2020
6. " Ethics in Engineering" by W.M.Martin and; R.Schinzinger., McGraw-Hill, 2005
7. "Safety Management in Industry" by Krishnan N.V., Jaico Publishing House, Bombay,1997
8. Hand Book of Consolidated Data - 8/2000, Vol.1, TNPWD.
9. Tamil Nadu Transparencies in Tenders Act, 1998, Standard Data Book for Analysis and Rates, IRC, New Delhi, 2003.
10. Handbook of Occupational Health and Safety, NSC Chicago, 1982.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/noc/courses/105/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2					3							2	2	
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3	2							3							
4	1										3			2	
5	2					3									2
AVg.	2					3		3			3		2	2	2

1-low, 2-medium,3-high

COURSE CODE	BUILDING INFORMATION MODELLING	L	T	P	C
		3	0	0	3

MODULE I BIM WITH BUILDING SYSTEMS 9

Review of Buildings and Systems- Building components and systems Integrating BIM in Construction Contracts- Contract Systems, Work Organization and Process Details.

MODULE II BIM MODELING WITH AUTODESK REVIT 9

BIM for modelling (Autodesk Revit) Model Support in Coordination, Creating Levels and Grids, Walls Modelling, Object Modification, Doors and Windows, Floors and Roofs, Curtain, Stairs and Ramps, Dimensions and Constraints, Annotation and Documentation.

MODULE III OPTIMIZING BUILDING DESIGN AND PERFORMANCE 9

Importing and modifying families of objects and elements, Clash Detection, Model Support in Coordination. BIM for Energy Analysis, Use of BIM for the Tasks of Energy Demand Calculation and Building Simulation. BIM for Construction Safety and Health.

MODULE IV INTEGRATING BIM FOR SAFER, MORE EFFICIENT CONSTRUCTION 9

Integrating BIM in the Safety Planning Process, Safety and BIM-Based Quantity Take-Off. BIM in Industrial Prefabrication for Construction.

MODULE V BIM FOR PREFABRICATION & 3D PRINTING 9

BIM in Industrial Prefabrication for Construction- Production Models for Digital Production Methods. BIM for 3D Printing in Construction.

COURSEOUTCOMES

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

CO1: Integrate BIM within construction contracts, considering different systems, contract types, and project workflows.

CO2: Create and modify building models in Autodesk Revit, applying best practices for efficient coordination and documentation

CO3: Analyze BIM for energy analysis, clash detection, and construction safety planning, optimizing building design and performance

CO4: Evaluate BIM into construction workflows for improved safety, efficiency, and quantity take-off.

CO5: Apply BIM for prefabrication production models and explore its potential for 3D printing in construction

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Building Information Modeling: BIM in Current Practice” by Michael Gagnon, Flavius C. Bologea, Azhar Irani, 2019
2. “BIM for Facility Management” by Thomas O'Connor, Daniel Talbott, 2019.

REFERENCES:

1. “BIM for Structural Engineers: Leveraging Building Information Modeling for Efficient Structural Design and Analysis” by Behzad Razavi, 2019.
2. “BIM for MEP Contractors: A Practical Guide to Integrating Mechanical, Electrical & Plumbing Systems into Building Information Models” by John Messner, 2018.
3. “BIM for Architects: Integrating Design, Construction and Facility Management” by Eddy Krygiel, John Frazer, 2018.
4. “Digital Twins: Bridging the Physical and the Virtual World” by Christoph Reinhart, Markus Bechmann, Daniel Menges, 2020.
5. “BIM Handbook: Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors” by Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, 2018.

ONLINE RESOURCES:

1. https://www.coursera.org/learn/bim-fundamentals

CO-PO&PSOMAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2		2			1							2	3	
2	3				3					2					
3	3		3				2								
4	2										2				
5	3		3												
AVg.	3		3		3	1	2			2	2		2	3	

1-low, 2-medium,3-high

OPEN ELECTIVES

COURSE CODE	TOWN PLANNING AND ARCHITECTURE	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF TOWN PLANNING 9

Evaluation of planning – Objects of town planning – principles of town planning- origin of towns – growth of towns – origin – direction – various forms of planning

MODULE II ELEMENTS OF ARCHITECTURE 9

Introduction of architecture - definition - Evaluation of geometric forms - function and history - Sphere, Cube, Pyramid, Cylinder and Cone - aesthetic qualities of Architecture - Proportion, Scale, Balance, Symmetry, Rhythm and axis - Contrast in Form - Harmony.

MODULE III PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS 9

Factors affecting orientation - Sun-Wind-Rain - Orientation criteria for Indian conditions - Principles governing the theory of planning - Planning of residential buildings.

MODULE IV DEVELOPMENT PLANS 9

Principles of city planning - levels of planning- scope and contents of regional plan, master plan, detailed development plan and structure plan - preparation and implementation - planning of new towns – slum clearance and urban renewal.

MODULE V PLANNING LEGISLATION AND DEVELOPMENT CONTROL RULES 9

Planning legislation and administration - Tamil Nadu Town and Country planning Act, Tamil Nadu Housing Board Act, Tamil Nadu slum clearance and Improvement Act. Zoning regulations - sub division regulations – building regulations - Floor Space Index - minimum plot sizes and building frontage - open spaces - minimum standard dimensions of building elements

COURSEOUTCOMES

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

CO1: Define town planning objectives, principles, origins, growth, and various planning forms

CO2: Comprehend architecture's definition, geometric forms, history, and aesthetic qualities, including proportion, scale, balance, symmetry, rhythm, and contrast

CO3: Analyze factors influencing orientation like sun, wind, rain, and apply criteria for Indian residential building planning

CO4: Grasp city planning principles, levels, and content of regional, master, development, and structure plans, including implementation strategies

CO5: Comprehend planning legislation, including Tamil Nadu Town and Country Planning Act, Housing Board Act, and Slum Clearance Act, and zoning regulations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Sustainable Urban Planning: Theory and Practice" by Douglas Crawford, Routledge, 2023.
2. "Urban Land Use Law: Cases and Materials" by David Getches, Thomson Reuters, 2022.

REFERENCE BOOKS:

1. "The Practice of Local Government Planning" by Frank S. So, & David Johnstone, John Wiley & Sons, 2019.
2. “Urban Planning for Public Health” by Edward Ng, 2023.
3. “The city in the Age of Climate Change: Planning Livable Urban Settlements” by Kees Ornstein, David Satterthwaite, and Harriet Bulkeley, 2022.
4. “Equity in the Built Environment” by David Harvey, 2023.
5. "Architecture: Form, Space & Order" by Francis D Ching, John Wiley & Sons, 2019.

ONLINE RESOURCES:

1. https://smartcities.gov.in/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					2							1		
2	1									2					
3	2					1							2		
4	2					3									
5	3					3									
AVg.	2					2				2			2		

1-low, 2-medium,3-high

COURSE CODE	CLIMATE CHANGE AND ADAPTATION	L	T	P	C
		3	0	0	3

MODULE I EARTH'S CLIMATE SYSTEM 9

Introduction - weather and climate - Climate in the spotlight-The Earth's Climate Machine – Climate Classification – Global wind systems – Trade Wind Systems – Trade Winds and the Hadley Cell – Cloud formation and Monsoon Rains – Storms, Hurricanes and Tornado – The Hydrological Cycle – Global Ocean Circulation – El Nino – LA Nino effect – Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming

MODULE II OBSERVED CHANGES AND ITS CAUSES 9

Observation of Climate Change – Changes in pattern of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – Climate Change modelling.

MODULE III IMPACTS OF CLIMATE CHANGE 9

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for different regions – Uncertainties in the Projected Impacts of Climate Change – Risk of irreversible changes.

MODULE IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES 9

Adaptation Strategy/options in various sectors – Water – Agriculture – Infrastructure and Settlement including coastal zones. Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and practices – Energy supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbon sequestration – Carbon Capture and Storage (CCS) – Waste (MSW & Biowaste, Biomedical, Industrial waste – International and Regional co-operation.

MODULE V CLEAN TECHNOLOGY AND ENERGY 9

Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco-friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power.

COURSEOUTCOMES

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

CO1: Illustrate the fundamentals of weather, climate, global wind systems, monsoons, storms, ocean circulation, El Nino, greenhouse effect, and global warming

CO2: Analyze climate change observations, temperature, precipitation, sea level rise, drivers, sensitivity, Montreal Protocol, UNFCCC, IPCC, and modeling

CO3: Assess climate change impacts on agriculture, forestry, water resources, human health, industry, society, using scenarios and projections

CO4: Explore adaptation strategies in water, agriculture, infrastructure, health, tourism, transport, energy, mitigation technologies, and international cooperation

CO5: Understand Clean Development Mechanism, carbon trading, and examples of future clean technologies including biodiesel, compost, and renewable energy

TOTAL: 45 PERIODS

TEXT BOOKS:

1. “Adaptation to Climate Change: Theory and Practice”, 2nd Edition by Susanne Moser and Lisa Dilling, Cambridge University Press, 2018.
2. “Climate Change Adaptation - Earthscan Climate” by Lan Burton, James Adejuwon, Jyoti Kulkarni, Neil Leary, Rodel Lasco, and Vicente Barros, Routledge, 2018.

REFERENCE BOOKS:

1. “Climate Adaptation” by Susanne Moser and Ilan Kelman, Routledge, 2020.
2. “Handbook of Climate Change and Society “(Second Edition) by Stephen Schneider, Susanne Moser, and Michael Mastrandrea, Routledge, 2020.
3. “Urban Adaptation to Climate Change”, by Joana Baptista et al., Springer, 2020.
4. “Indigenous Peoples and Climate Change” by Melissa K. Nelson et al,. Routledge, 2021.
5. “The Green New Deal” by Simon & Schuster, Alexandria Ocasio-Cortez and Edward Markey, 2019

ONLINE RESOURCES:

1. https://climate.nasa.gov/
2. https://climateknowledgeportal.worldbank.org/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
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3	2						3						2		
4			2				3						2		
5	2						3						2		
AVg.	2		2	2			3						2		

1-low, 2-medium,3-high

COURSE CODE	METRO SYSTEMS AND ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF TRANSPORTATION SYSTEMS 9

Transportation systems in India – various modes of transport – public transport – Intermediate public transport – types – characteristics – other urban transportation modes – drawbacks- various transit systems

MODULE II MRTS 9

Definition – Mass Rapid Transit System – History of MRTS - Need for MRTS – connectivity in Indian conditions – cities having MRTS – infrastructure – operations – fares and ticketing - case study.

MODULE III BRTS and LRTS 9

Bus Rapid Transit System – terminology – history -features - performance – cost - drawbacks – Light Rail Transit System – necessity – types – gauge- capacity integration with cycles – comparison to other rail modes

MODULE IV METRO RAIL SYSTEMS 9

History of Metro trains - Need for Metro rail – connectivity in Indian conditions – cities having Metro - construction techniques adopted in Metro Rail stations - Case study – Delhi Metro (DMRC) – Chennai Metro (CMRL)

MODULE V INTELLIGENT TRANSPORT SYSTEM (ITS) 9

Definition – Intelligent Transport System – Principles - Application of ITS technologies in various countries – smart transportation – mono rail - case studies

COURSEOUTCOMES

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

CO1: Analyze transportation systems in India, including modes, public, intermediate transport, urban modes, drawbacks, and transit systems

CO2: Comprehend Mass Rapid Transit System definition, history, necessity, Indian context, cities with MRTS, infrastructure, operations, fares, and case studies

CO3: Understand Bus Rapid Transit System terminology, history, features, performance, costs, drawbacks, Light Rail Transit System, and comparisons

CO4: Grasp Metro trains' history, necessity, Indian context, cities with Metro, construction techniques, and case studies

CO5: Understand Intelligent Transport System definition, principles, global applications, smart transportation, monorail, and case studies

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Urban Transportation Planning and Policy" by Shakya, R, CRC Press, 2022.
2. "Planning and Operation of Metro Rail Systems" by D'Souza, S. A, John Wiley & Sons 2021.

REFERENCE BOOKS:

1. “Urban Public Transportation Systems: Principles and Application” by Vuchic, L. R, John Wiley & Sons, 2020
2. “Metro Rail Transit Systems in India: Planning, Design, and Operation” by. Gupta, S. K., & Kumar, K, Springer, 2019.
3. “Transportation Planning Handbook” by Hall, R. W., & Lumsdaine, R. L, CRC Press, 2019.
4. “Urban Transportation Planning” by Sivakumar, R, New Age International Publishers 2020.
5. “Transportation Engineering.” by Agarwal, V. K., & Sharma, T. N, S. Chand Publishing, 2022.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_me75/preview

CO-PO&PSOMAPPING

CO	PO												PSO		
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4	3														
5	3					2									
AVg.	3					2							2		

1-low, 2-medium,3-high

COURSE CODE	RENEWABLE ENERGY RESOURCES	L	T	P	C
		3	0	0	3

MODULE I ENERGY PERSPECTIVES 9

Conventional and non-conventional energies - Energy and sustainable development - Global energy scenario - Energy scenario in India - Energy consumption pattern in rural and urban regions in India - Energy efficiency and economy - Energy losses and its control - Renewable energy potential mapping - Plant load factor.

MODULE II SOLAR ENERGY RESOURCES 9

Concept of solar energy - Solar energy to light and to thermal conversions - Total energy and necessary infrastructure - Units and measurement of solar radiation - Temperature dependent collecting devices and their efficacies - Design aspects - Typical applications: heating, cooling, lighting, power generation and cooking.

MODULE III WIND ENERGY RESOURCES 9

Wind potential in India - Wind turbines and their types - Merits and demerits - Wind power and appropriate coefficient - Efficiency and performance of wind machines -Energy conversion and storage - Synchronous inverters - Various storage aspects: battery, flywheel, hydrogen and compressed air.

MODULE IV BIOMASS ENERGY 9

Biomass potential in India - Gobar gas and producer gas - Characteristics of biomass - Objectives, principles and operational aspect of bio-gassifiers - Pyrolysis and incineration - Power generation from municipal solid waste and industrial Sludges - Application of biodiesel plants - Fuel cells.

MODULE V TIDAL ENERGY 9

Tidal aspects in coastal India - Tidal energy conversion system: mechanical to electrical and thermal to electrical - conceptualization and potential of geothermal energy - Geothermal vents.

COURSEOUTCOMES

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

CO1: Grasp conventional and non-conventional energies, energy scenarios, consumption patterns, efficiency, renewable potential, and plant load factor

CO2: Comprehend solar energy concept, light and thermal conversions, infrastructure, radiation measurement, collecting devices, design, and applications

CO3: Understand wind potential, turbine types, merits, power coefficients, efficiency, energy conversion, storage methods, and synchronous inverters

CO4: Grasp biomass potential, characteristics, gobar gas, bio-gasifiers, pyrolysis, incineration, power generation, biodiesel, and fuel cells.

CO5: Comprehend tidal aspects, tidal energy conversion, geothermal energy potential, and geothermal vents in coastal India

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Renewable Energy Power: Technology, Economics, and Policies” by Godfrey Boyle, 2021.
2. “The Energy Bible” by David Goodstein and Michael E. Jaffe, 2023.

REFERENCES:

1. , “Fundamentals of Solar Energy: Engineering Physics and Design” by Mehregan Sharifi, Mohammad Mehrpooya, Mohammad Amin Eshghi 2022.
2. "Renewable energy" by Godfrey Boyle, Open University, Oxford University Press in association with the Open University, 2021
3. "Renewable Energy Sources and Emerging Technologies" by P. Kothari, K.C Singal, Rakesh Ranjan, PHI Learning Pvt. Ltd, New Delhi, 2018.
4. “Tidal Energy Development: Environmental Impact Assessment and Mitigation” by Robert H. Charlie, Springer-Verlag Berlin Heidelberg, 2018.
5. "Renewable Energy & Sustainable Design" by Scott Grinnell, CENGAGE Learning, USA, 2016.

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ge06/preview
2. https://swayam.gov.in/nd2_nou20_cs09/preview

CO-PO&PSOMAPPING

CO	PO												PSO		
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1	2						3						2		
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3	3												2		
4	3						2						2		
5	3												2		
AVg.	3				2		3						2		

1-low, 2-medium,3-high

COURSE CODE	PRINCIPLES OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 9

Sustainable development- Evolution of Environmental awareness and Sustainable development, global Sustainable development goals -components and factors affecting Sustainable Development- Demographic dynamics and sustainability- Environmental issues and crisis- ozone layer depletion, global warming and climate change

MODULE II ENVIRONMENTAL ASPECTS 9

International Environmental summits, conventions and agreements-Tiwari committee recommendation - Role of Pollution Control Board - Transboundary issues - Ecological indicators- Ecological foot print- Carbon foot print - Basic concept of Environmental impact assessment

MODULE III SOCIO ECONOMIC AND JUDICIAL ASPECTS 9

UN Sustainable development policies through trade- World Trade Organization-International monetary fund and World bank - Circular Economy and Sustainable Development - Socio economic policies for sustainable Development- Role of Judiciary in Sustainable Development - Major Environmental Cases in India - Development of Environmental Policies in India – Environment Protection Act, 1986 - EIA notification 2006 - National Conservation Strategy and Policy Statement on Environment and Development, 1992 - Policy Statement for the Abatement of Pollution, 1992 - National Environment Policy, 2006. SDG India

MODULE IV STRATEGIES FOR SUSTAINABLE DEVELOPMENT 9

Economic growth and Sustainable Development - Resource depletion and resource protection- - Internet of things and Sustainable Development - Sustainable Management of Forest, Land, water- Natural Disaster management- case studies.

MODULE V CLEANER PRODUCTION AND LIFE CYCLE ASSESSMENT 9

Cleaner Production, definition, aim, application-Generic process of Cleaner Production Assessment. Life cycle Assessment -definition, necessity and elements- ISO Environmental standards. Environmental Audit -Green Chemistry - case studies.

COURSEOUTCOMES

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

CO1: Grasp the evolution of environmental awareness, sustainable development goals, components, demographic dynamics, and environmental issues

CO2: Understand international environmental summits, agreements, pollution control board roles, transboundary issues, ecological indicators, and impact assessment.

CO3: Comprehend UN sustainable development policies, trade, circular economy, socio-economic strategies, judiciary's role, environmental policies, and SDG India

CO4: Understand economic growth, resource protection, IoT, sustainable management of forest, land, water, and natural disaster management through case studies

CO5: Grasp cleaner production, life cycle assessment, ISO standards, environmental audit, green chemistry, and case studies

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Sustainable Development: Concepts, Principles, and Frameworks” by Stephen A. Grunert and Paul G. Falkowski, Routledge, 2022.
2. “The Future of Sustainability: Rethinking Environment and Development” by Mark Swilling, Routledge, 2018.

REFERENCES:

1. “Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist” by Kate Raworth, Chelsea Green Publishing, 2021.
2. , “Circular Economy Handbook: Achieving Circular Materials Economy through Design and Business Strategy” by Pascal Heyen, Walter R. Stahel, and Gunter Geschka Springer, 2020:
3. “Environmental Law” by J.B. Manoj Kumar, S. Chand & Company, 2019.
4. “Implementing Environmental Agreements: Global Governance, Institutions and Economics” by Paula Castro and David Victo, MIT Press, 2018
5. "Environmental and Natural Resource Economics" by Tietenberg T. and Lynne Lewis, Harper Collins, Routledge, 2016

ONLINE RESOURCES:

1. https://www.iisd.org/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
2	3					2							2		
3	3						3						2		
4	2						3						2		
5	3						3						2		
AVg.	3					2	3						2		

1-low, 2-medium,3-high

COURSE CODE	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I NATURAL DISASTERS 9

Definition – Hazard, Risk, Vulnerability, Resilience, Capacity – Classification of natural disasters – Geological – Meteorological - Hydrological – Medical – Earthquakes – Tectonic plate movements- Measuring Earthquake – Volcanic Eruptions- Cyclones, Typhoons & Hurricanes – Tornados – Tsunamis- Cloudbursts/Heavy rains – Floods/ Flash floods- Landslides – Blizzards/ Snowstorms – Avalanches – Cold wave – Heat wave – Droughts – Famines – Wild fires – Epidemics – Impact/Extinction Events

MODULE II ANTHROPOGENIC DISASTERS 9

Introduction – Industrial Accidents- Structural failures – Road and Rail Accidents – Air craft accidents- Space accidents – Maritime accidents – Oil spills – Wars- Terror strikes – Arson/Looting – Group clashes/strikes – Stampedes – Blasts – Fire accidents – Power outages- Acid rains – Radiation Hazards

MODULE III DISASTER MANAGEMENT CYCLE 9

Introduction – Impact of Disasters- Disaster management cycle – Mitigation – Hazard mapping – Vulnerability analysis- Mitigation measures for buildings – Preparedness – Disaster Management plan- Early warning systems – Evacuation plans – Inventory of resources – Education and training of personnel – Public awareness programs - Role of GIS and Information Technology Components in Preparedness – Response and recovery phase of Disaster- Standard operating procedure

MODULE IV INTERNATIONAL COOPERATION AND ORGANISATIONAL STRUCTURES FOR DISASTER MANAGEMENT 9

Introduction – United Nations and Subsidiary agencies – World Conference on Disaster management- International Federation of Red cross and Red crescent – The International Emergency management society – International Association of Emergency Managers – International recovery platform – Need for organisational structure for disaster management – Identifying agencies and responsibilities – National Disaster Management systems

MODULE V DISASTER MANAGEMENT INDIA 9

Introduction – Policy framework for Disaster management – Objectives of National policy on Disaster management – National crisis Management committee – Organisational structure at the centre level – National Disaster management authority – The National Executive Committee – National Disaster responsive force – National Institute of Disaster Management- National Platform for Disaster risk reduction – Organisational structure at State level- International Cooperation

COURSEOUTCOMES

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

CO1: Assess and categorize diverse natural disasters, analyzing their effects on infrastructure and suggesting ways to minimize their impact.

CO2: Assess structural weaknesses linked to various human-made disasters, proposing preventative actions and emergency strategies.

CO3: Utilize phases of the disaster management cycle to create thorough plans for readiness, response, and recovery in situations pertinent to structural engineering

CO4: Compare and contrast global cooperation efforts and organizational setups in disaster management, highlighting their strengths and drawbacks concerning structural safety.

CO5: Describe India's disaster management policy framework and institutional setup, critically examining its efficacy in ensuring structural resilience.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Disaster Management” by R. Subramanian, Vikas Publishing House Pvt. Ltd, New Delhi, 2018
2. “Disaster Management Handbook: A Guide for Practitioners” by Jacky Shreve and Kevin Fox, Routledge, 2020.

REFERENCES:

1. “Natural Disasters and Climate Change: Securing the Future” by Donald Prothero, Oxford University Press, 2020.
2. “Structural Design for Earthquake”: by Eurocode 8 by Paulose C. P., CRC Press, 2019.
3. “Anthropogenic Disasters: Hazard, Vulnerability, and Mitigation” by David E. Alexander, Routledge, 2018.
4. “Handbook of Disaster Research” (2nd Edition) by W. Nick Carter, Dennis Mileti, and Thomas F. Drabek, Springer, 2018.
5. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/104/105104183/
2. https://archive.nptel.ac.in/courses/124/107/124107010/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3					3							2		
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3			2			3							3		
4	2					3									
5	3					3							2		
AVg.	3		2			3							3		

1-low, 2-medium,3-high

COURSE CODE	PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3

MODULE I UNION GOVERNMENT AND ADMINISTRATION 9

President & Vice President; Parliament, Judiciary - structure, functions, work processes; Recent trends; Council of Ministers; Cabinet Secretariat; Prime Minister's Office; Central Secretariat; Committees; Boards; Constitutional bodies; non-constitutional bodies.

MODULE II STATE GOVERNMENT AND ADMINISTRATION 9

Union-State executive, legislative and financial relations; Governor; Chief Minister; Council of Ministers; Chief Secretary; State Secretariat; Directorates; Niti Aayog and Finance Commission.

MODULE III DISTRICT ADMINISTRATION SINCE INDEPENDENCE 9

Changing role of the Collector; Union state- local relations; Imperatives of development management and law and order administration; District administration and democratic decentralization.

MODULE IV RURAL DEVELOPMENT 9

Institutions and agencies since independence; rural development programmes: foci and strategies; Decentralization and Panchayati Raj; 73rd Constitutional amendment.

MODULE V LAW AND ORDER ADMINISTRATION 9

British legacy; National Police Commission; Investigative agencies; Role of central and state agencies including paramilitary forces in maintenance of law and order and countering insurgency and terrorism; Current trends in politics; Police- public relations; Reforms in Police Department

COURSEOUTCOMES

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

CO1: Explore Union government structures, functions, and linkages, noting recent trends and their implications for governance.

CO2: Scrutinize executive, legislative, and financial systems of Union and state governments, emphasizing interactions and key institutions' roles.

CO3: Assess district administration's evolving responsibilities in development, law enforcement, and decentralization, considering Union-state-local dynamics.

CO4: Track rural development institution progress, assessing their decentralization role and response to contemporary challenges post the 73rd Amendment.

CO5: Recommend law enforcement reforms, addressing community relations, national security, and agency roles in modern challenges.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Introduction to Public Administration” by Ramesh K. Arora & Rajni Sharma, New Age International Publishers, 2022.
2. “Indian Administration” by M. Laxmikant, McGraw-Hill Education, 2023.

REFERENCES:

1. "The Practice of Public Administration" by Jay M. Shafritz, Russell L. Perry, & Steven W. Maynard, Routledge, 2021.
2. "Comparative Public Administration" by Robert B. Denhardt & Janet Vinzant, Routledge, 2020.
3. "Decentralisation and Panchayati Raj" by Yogendra Singh, Orient Blackswan, 2020)
4. "Law and Order Administration in India" by C.M. Dixit, Pearson Education India, 2019.
5. "Rural Development in India: Concepts, Challenges, and Strategies" by B.B. Misra & P.K. Mishra, Routledge, 2018.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_lw05/preview

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1					3									
2	1					3									
3	1					3									
4	1					3									
5	1					3									
AVg.	1					3									

1-low, 2-medium,3-high

COURSE CODE	ELEMENTARY EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I BASICS OF SEISMOLOGY 9

Earth and its interior- Plate Tectonics- Elastic rebound theory- Convection Currents- The Earth quake- Inter Plate Earthquake (Convergent Boundaries- Divergent Boundaries and Transform Boundaries)- Intra Plate Earthquake (Faults and Types of Faults)- Seismic Waves- Basic Terminology- Measuring Units and Instruments

MODULE II THEORY OF VIBRATION 9

Concept of inertia and damping – Types of Damping – Difference between static forces and dynamic excitation – Degrees of freedom – SDOF idealization – Equations of motion of SDOF system for mass as well as base excitation – Free vibration of SDOF system – Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode shapes - Introduction to MDOF systems

MODULE III EARTHQUAKE LOAD ANALYSIS ON STRUCTURES 9

Introduction to methods of Earthquake Load Analysis (Linear Static- Linear Dynamic- Non-Linear Static- Non Linear Dynamic) Analysis of Structure by Linear Static Method (Seismic Coefficient Method)

MODULE IV BEHAVIOR OF MASONRY STRUCTURES DURING EARTHQUAKE 9

Inertia forces in structures - Behavior of Brick Masonry Structures: Behavior of Brick Masonry Walls- Box Action - Different types of Bands - Behavior of Stone Masonry Structures: Behavior of Stone Masonry Walls - Earthquake Resistant Features of Stone Masonry Structures

MODULE V EARTHQUAKE RESISTANT FEATURES OF RC STRUCTURES 9

Behavior of RC Structures- Load Transfer Path- Strength Hierarchy - Reversal of Stresses- Importance of Beam Column Joints-Importance of Stiffness and Ductility (Capacity Design Concept) in Structures-Effect of Short Column - Effect of Soft Storey-Improper Detailing- Earthquake Design Philosophy - Effect of Masonry Infill Walls - Effect of Flexibility and Effects of Setbacks- Effect of Eccentricity- Effect of Pounding- Effect of Floating Columns

COURSEOUTCOMES

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

CO1: Elucidate earthquake seismology's fundamentals and its societal implications for understanding seismic events.

CO2: Utilize structural dynamics principles to evaluate free and forced vibration responses in SDOF structural systems.

CO3: Assess multi-storeyed structures using Equivalent Static Method and Response Spectrum methods in accordance with Indian Standards.

CO4: Demonstrate ductile detailing and masonry structure behavior in line with Indian standards, including the concept of base isolation.

CO5: Explain reinforced concrete structure behavior conforming to Indian standards, highlighting key aspects of design and construction.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Earthquake Resistant Design of Structures" by Pankaj Agarwal and Manish Shrikhande, PHI Learning Pvt. Ltd., New Delhi, 2023
2. "Earthquake Resistant of Structures" by Duggal.S.K, Oxford University Press, New Delhi,2018.

REFERENCES:

1. "Dynamics of Structures - Theory and applications to Earthquake Engineering", 5th Edition by Anil K. Chopra, Prentice Hall of India Pvt. Ltd., New Delhi, 2021.
2. "Earthquake Resistant Design of Masonry Buildings", 2nd Edition by Miha Tomazevic, , Imperial College Press, 2020.
3. IS 1893:2016 Part I Criteria for earthquake resistant design of structures: Part 1: General Provisions and Buildings
4. IS 1893: 2014 Part II Criteria for earthquake resistant design of structures: Part 2: Liquid Retaining Tanks
5. IS 4326: 2013 Code of practice for earthquake resistant design and construction of buildings
6. IS 13920: 2016 Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
7. IS 13827: 1993 Improving earthquake resistance of earthen buildings - Guidelines.
8. IS 13828: 1993 Improving earthquake resistance of low strength masonry buildings - Guidelines.
9. IS 13935: 2009 Seismic Evaluation, Repair and Strengthening of Masonry Buildings - Guidelines

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2					3							1		
2	3												3		
3	3												3		
4	3												3		
5	3												3		
AVg.	3					3							3		

1-low, 2-medium,3-high

COURSE CODE	GREEN BUILDINGS	L	T	P	C
		3	0	0	3

MODULE I PLANNING OF BUILDING **9**

Planning of building: Principles of planning, Relevant building bylaws, site selection for buildings, orientation of buildings, common errors in planning, Provision of rain water harvesting

MODULE II GREEN BUILDING TECHNOLOGIES **9**

Necessity - Concept of Green building. Principles of green building – Selection of site and Orientation of the building – usage of low energy materials – effective cooling and heating systems – effective electrical systems – effective water conservation systems - Certification systems- Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED), case studies

MODULE III SUSTAINABLE DESIGN FUNDAMENTALS **9**

Life Cycle impacts of materials and products - sustainable design concepts - strategies of design for the Environment -The sun- earth relationship and the energy balance on the earth's surface, climate, wind - Solar radiation and solar temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings - Thermal properties of building materials.

MODULE IV ENERGY EFFICIENT BUILDINGS **9**

Passive cooling and day lighting - Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency Energy audit and energy targeting- Technological options for energy management.

MODULE V INDOOR ENVIRONMENTAL QUALITY MANAGEMENT **9**

Psychometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination Requirement-Auditory requirement- Energy management options- Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines - Heat rejection equipment- Energy efficient motors- Insulation.

COURSEOUTCOMES

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

CO1: Assess how various construction materials and techniques affect embodied energy and carbon emissions, considering environmental impact.

CO2: Apply diverse energy analysis approaches and standards to evaluate building efficiency and performance effectively.

CO3: Formulate plans for enhancing energy efficiency in buildings, integrating efficient systems and promoting user-friendly practices.

CO4: Understand the economic viability and ecological advantages of energy-efficient technologies and retrofits for buildings.

CO5: Create and execute sustainable building designs that prioritize energy conservation, occupant comfort, and environmental health

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Sustainable Construction: Green Building Design and Delivery" by Kibert, C., John Wiley & Sons, 2016
2. "An Energy Approach- Air-conditioning Principles and Systems" by Edward G Pita, Pearson Education, 2018

REFERENCES:

1. "The New Eco-Architecture" by Colin Porteous, Spon Press, 2017.
2. Energy Conservation Building Codes: www.bee-india.nic.in
3. "Building Energy Management Systems" by Lever More G J, E and FN Spon, London, 2010.
4. "Energy Conservation in Buildings" by Ganesan T P, ISTE Professional Center, Chennai, 2009.
5. "Design with Energy: The Conservation and Use of Energy in Buildings" by John Littler and Randall Thomas, Cambridge University Press, 2014.

CO-PO&PSOMAPPING

CO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2						3						2		
2	3						3						2		
3	3		2				3						2		
4	2						3						1		
5	3		3				3						2		
AVg.	3		3				3						2		

1-low, 2-medium,3-high

VALUE ADDED COURSES

	BUILDING CONSTRUCTION PROCESS- AN OVERVIEW	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION OF BUILDING CONSTRUCTION PROCESS – STEP BY STEP 3

Site Selection – Marking - Earth works excavation – Concreting - Brick works -Plastering – Flooring - Painting

MODULE II QUANTITY MEASUREMENT OF BUILDING 3

Quantity Calculation of each element - Material calculation - Rate arriving per unit

MODULE III GOOD CONCRETE MAKING 3

Batching – Mixing – Transporting – Compacting – Finishing - Curing

MODULE IV BUILDING MATERIAL AND ITS SELECTION PROCESS 3

Materials available in the market and select with practical approach

MODULE V CONSTRUCTION PRACTICES 3

Do’s and don’ts in construction practices - Emerging Technologies in Construction

COURSEOUTCOMES

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

CO1: Explain the key stages of building construction, including site selection, excavation, foundation works, and material installation

CO2: Apply basic techniques for quantity estimation of various building elements and materials, understanding project material requirements and costs.

CO3: Analyze properties and applications of construction materials, selecting appropriate materials based on project demands and sustainable practices

TOTAL: 15 PERIODS

REFERENCES:

1. “Greeno Construction Technology", by Roy Chudley, Roger, Pearson Education, 2016.
2. “Materials for Civil and Construction Engineers”, by Michael S. Mamlouk, John P. Zaniewski, Pearson, 2017.
3. Building Construction Handbook by Federico M. Mazzolani.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1		1								3	3	
2	2	2	2		1									3	3
3	3	2	3				2						3	3	
AVg.	2	2	2		1		2						3	3	3

1-low, 2-medium,3-high

	APPLICATIONS OF IoT IN CIVIL ENGINEERING	L	T	P	C
		1	0	0	1

MODULE I IOT CHARACTERISTICS **3**

Defining IoT Characteristics of IoT - Physical design of IoT - Logical design of IoT - Functional blocks of IoT - Communication models & APIs

MODULE II IOT STANDARDS AND COMPONENTS **3**

Requirement of international standard (case study) - Design of IoT systems - Development of prototypes for civil engineering projects

MODULE III RELEVANCE OF IOT FOR THE FUTURE **3**

IoT in Construction site - Internet of Everything - IoT and Individual Privacy .

MODULE IV IOT IN INDIAN SCENARIO IOT **3**

Aadhaar - IOT for concrete and curing services - IoT for rural empowerment

MODULE V IOT APPLICATIONS (CASE STUDIES) **3**

Intelligent Traffic systems - Smart Parking - IoT for smart cities

COURSEOUTCOMES

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

CO1: Describe what IoT is and how it works today and design and program IoT devices

CO2: Design an IoT device to work with a Cloud Computing infrastructure

CO3: Transfer IoT data to the cloud and in between cloud providers

TOTAL: 15 PERIODS

REFERENCES:

1. "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are Changing the World" by Micahel Miller, Pearson Education, USA, 2015.
2. "Internet of Things (A Hands-on Approach)" by Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014.
3. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything" by Francis daCosta, 1st Edition, A press Publications, 2013

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3		3								3		
2	2	2	3		3								1	1	
3	2	2	2		2								1	1	
AVg.															

1-low, 2-medium,3-high

	CERTIFICATION AND CAREER ROAD MAP IN CIVIL ENGINEERING	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION **3**

Planning Approval Meaning, Controls / Regulating Competent Authority, Types of Approval, Checklist for Approval, E-DCR Online Drawing Submission

MODULE II CORPORATION/LOCAL BODY APPROVAL **3**

Residential - Group Housing / Villas, Apartments, Commercial include office buildings, warehouses, and retail buildings, Industrial & Institutional - Factories and other premises used for manufacturing, altering, repairing, Schools & Colleges or any other educational Institutions.

MODULE III THE DISTRICT TOWN & COUNTRY PLANNING OFFICE **3**

Residential - Group Housing / Villas, Apartments, Commercial include office buildings, warehouses, and retail buildings, Industrial & Institutional - Factories and other premises used for manufacturing, altering, repairing, Schools & Colleges or any other educational Institutions. .

MODULE IV DTCP CHENNAI APPROVAL **3**

Residential - Group Housing / Villas, Apartments, Commercial include office buildings, warehouses, and retail buildings, Industrial & Institutional - Factories and other premises used for manufacturing, altering, repairing, Schools & Colleges or any other educational Institutions.

MODULE V E-DCR ONLINE DRAWING APPROVAL **3**

E-DCR online drawing submission, E-DCR stages, E-DCR scrutiny process, Scope of the E-DCR system, E-DCR drawing specification

COURSEOUTCOMES

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

CO1: Apply relevant regulations and procedures for obtaining approvals from diverse authorities like corporations, local bodies, and DTCP offices

CO2: Create and submit project drawings electronically using the E-DCR platform

CO3: Develop a personalized roadmap outlining relevant certifications, skills development, and networking strategies

TOTAL: 15 PERIODS

REFERENCES:

1. The Town and Country Planning Act, Government of India (2023) ,1971.
2. Handbook of Civil Engineering for Practitioners and Students by Vazirani, V.N., Ratnam, M., & Gupta, S.P, Khanna Publishers, 2002.
3. The Civil Engineer's Career Guide by Ambrose, J, McGraw-Hill Education, 2023.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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2	1		2		3									3	
3	1	1								2		3			
AVg.															

1-low, 2-medium,3-high

	ENVIRONMENTAL MONITORING	L	T	P	C
		1	0	0	1

MODULE I CONCEPTS OF ENVIRONMENTAL MONITORING 5

Objectives and functions of monitoring - Selection of monitoring sites - Sampling: Grab Sampling, Composite Sampling, Integrated Composite Sampling - Sampling Frequency and Preservation - Preparation of standard solutions: primary standards, secondary standards, stock solution, standard solution, normality, molarity, percent solution, standardization of solutions, Expression of results; mg/l, ppm.

MODULE II AIR QUALITY MONITORING 5

Ambient air quality monitoring - Source of air quality monitoring - Frequency and mode of sampling: Sampling time and sampling locations for air quality monitoring – Environmental procedures for determination of: NOx, Sox, CO, PM (Particulate Matter) - Structure of monitoring report for air quality monitoring.

MODULE III WATER QUALITY MONITORING 5

Physical water characteristics: Colour True and apparent colour, Temperature, Odor – Threshold method, Turbidity – Visual and Instrumental method, Solids – Total solids , Total suspended solids, total dissolved solids - Inorganic and non-metallic constituents: pH, Potentiometric method, Alkalinity, Hardness, Acidity, Chlorides and Sulphates, Metallic constituents: Chromium , Fe, by spectrophotometer - Organic constituents: BOD and COD - Structure of monitoring report for water quality monitoring. .

COURSEOUTCOMES

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

CO1: Analyze environmental parameters relevant to specific monitoring objectives and calculate required sampling frequency.

CO2: Interpret analytical results considering potential errors, limitations, and environmental significance.

CO3: Evaluate the quality and completeness of collected environmental data and draw conclusions based on analyzed data

TOTAL: 15 PERIODS

REFERENCES:

1. “Air Quality Monitoring and Assessment” by Hinds, W. C. (2012), Wiley-Blackwell.
2. “Standard Methods for the Examination of Water and Wastewater” by American Public Health Association, American Water Works Association, & Water Environment Federation. (2023), APHA-AWWA-WEF.
3. “Environmental Monitoring and Assessment” by Davis, W. J., Jr. (2004), Wiley-Blackwell.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2										3		
2	2	3					2						3	3	
3	2	3	3										3		
AVg.															

1-low, 2-medium,3-high

	PYTHON FOR CIVIL ENGINEERS	L	T	P	C
		1	0	0	1

MODULE I BASICS OF PYTHON PROGRAMMING **3**

Introduction- Python interpreter- interactive and script mode; values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

MODULE II CONTROL STATEMENTS AND FUNCTIONS IN PYTHON **3**

Conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Functions: Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion.

MODULE III DATA STRUCTURES: STRINGS, LISTS, SET **3**

Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions; list processing: list comprehension, searching and sorting, Sets: creating sets, set operations.

MODULE IV DATA STRUCTURES: TUPLES, DICTIONARIES **3**

Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries.

MODULE V CIVIL ENGINEERING APPLICATIONS **3**

Programming for Concrete Mix Design, Concrete quantity calculation, Brickwork material Calculation, Cement and Sand material calculation for Mortar

COURSEOUTCOMES

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

CO1: Develop simple Python program in interactive and script mode.

CO2: Construct Python programs using functions and strings and use Python to lists, set, tuples, dictionaries to represent compound data.

CO3: Build Python Programs to read and write data from/to files and develop python programs to handle exceptions.

TOTAL: 15 PERIODS

REFERENCES:

1. “Programming and Problem Solving with Python” by Ashok Namdev Kamthane, Amit Ashok Kamthane, Mc-Graw Hill Education,2018.
2. “Exploring Python” by Timothy A. Budd, Timothy A. Budd.
3. “Introduction to Programming in Python: An Inter-disciplinary Approach” by Robert Sedgewick, Kevin Wayne, Robert Dondero, Pearson India Education Services Pvt. Ltd., 2016.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	2		3								1	1	
2	2	2	3		3								1	1	
3	2	3	3		3								1	1	
AVg.															

1-low, 2-medium,3-high

	3D PRINTING OF CIVIL ENGINEERING STRUCTURES	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION **3**

Three-Dimensional Printing – Introduction, Prototyping fundamentals, Historical development, Classification, commonly used terms.

MODULE II ADDITIVE MANUFACTURING TECHNOLOGY **3**

Definition, Additive vs Conventional Manufacturing, Advantages of AMT, Classification of AMT Process – Stereolithography – Fused Deposition Modelling – Selective Laser Sintering – 3D Printing, Applications to various fields.

MODULE III 3D PRINTING IN CONSTRUCTION **3**

Problems in Construction Industry – Need for Automation, Application of 3D Printing – Contour Crafting – Advantages and Limitations, 3D Printing software – Computer Aided Drafting.

MODULE IV CONCRETE MIX FOR 3D PRINTING **3**

Mix goals – Criteria – Compressive strength – Extrudability – Flowability – Buildability – Setting time, Materials – binders – additives – mineral admixtures – fibres, Mix proportioning.

MODULE V CASE STUDIES AND CHALLENGES **3**

3D printed structures using contour crafting, 3D printed buildings in India, Challenges in 3D printing –curing time – bonding – automated fabrication –connections.

COURSEOUTCOMES

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

CO1: Describe about 3D printing methodology and identify the process required for fabricating.

CO2: Draft the necessity models in the CADD Software and design the concrete mix with various materials.

CO3: Identify the challenges in the field for new methodology.

TOTAL: 15 PERIODS

REFERENCES:

1. “3D Printing and Design” by Khanna Editorial, Khanna Publishing House, Delhi, 2021.
2. “3D Printing and Rapid Prototyping- Principles and Applications” by CK Chua, Kah Fai Leong, World Scientific, 2019.
3. “Laser-Assisted Fabrication of Materials”, by J.D. Majumdar and I. Manna, Springer Series in Material Science, 2017

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2				2								1		
2	2		2										2	2	
3		3				2							2		
AVg.	2	3	2		2	2							2	2	

1-low, 2-medium,3-high

	ALTERNATIVE BUILDING MATERIALS FROM WASTE	L	T	P	C
		1	0	0	1

MODULE I ENVIRONMENTAL ISSUES **3**

Environmental issues – Global warming – Eco friendly materials – Materials related to energy and carbon di oxide emission

MODULE II BLOCKS AND BRICKS **3**

Waste based blocks and bricks – Advantages – Disadvantages – Applications

MODULE III CEMENTS **3**

Pozzolana – Types – Agro and industrial based waste – Characterization – Process adopted to improve properties - Applications in cement / mortar / concrete

MODULE IV AGGREGATES **3**

Artificial aggregates – Waste as replacement for aggregates – Characterization – Applications in Cement / mortar / concrete Recycled coarse aggregate – Recycled fine aggregate

MODULE V MISCELLANEOUS ELEMENTS **3**

Wastes used for non-structural elements - Partitions – Walls – Roofing system – windows

COURSEOUTCOMES

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

CO1: Evaluate the environmental footprint of conventional building materials across their lifecycle.

CO2: Develop recommendations for appropriate applications of waste-based materials in building projects, considering both technical performance and environmental benefits.

CO3: Describe their design solution effectively, communicating its potential contribution to sustainable construction practices.

TOTAL: 15 PERIODS

REFERENCES:

1. "Waste-Based Building Materials: Opportunities and Challenges" by Bhatty, J. I. (2023), McGrawHill Education.
2. "Sustainable Construction Materials: A Handbook" by Blenkinsop, S., Cook, M., & Roberts, T. (2020), Springer Nature.
3. "The Routledge Handbook of Sustainable Buildings", by Sayigh, A. (Ed.). (2022), Routledge.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2						3						1		
2			3				3						2		
3	2						3			3			2		
AVg.	2		3				3			3			2		

1-low, 2-medium,3-high

	SUSTAINABILITY IN CONSTRUCTION	L	T	P	C
		1	0	0	1

MODULE I FUNDAMENTALS OF SUSTAINABLE BUILDING 3

The context and principles of sustainable design - A view of the current state of sustainable building in national and internationally - Physical, psychological and financial benefits of Sustainable construction.

MODULE II SUSTAINABLE ARCHITECTURE AND DESIGN 3

Role of architecture in sustainable construction - An introduction to sustainable site planning and ecological design - Importance of transportation planning, siting and relationship to sustainability - Benefits of adopting a natural systems-based approach - Biomimicry as a design tool based on ecosystem analogy.

MODULE III ENERGY EFFICIENT DESIGN 3

Importance of building energy systems - impacts of energy with human experience and the global environment –Low Energy Building Strategies - Fundamental building energy systems: HVAC, lighting and water conservation.

MODULE IV SUSTAINABLE MATERIALS SELECTION 3

Factors in material selection–Material considerations when designing a green construction – Eco friendly building materials: Environmental impact study of building materials about composition, production and recycling, physical properties - Life cycle assessment.

MODULE V SUSTAINABLE BUILDING TECHNOLOGIES 3

Wastes used for non-structural elements - Partitions – Walls – Roofing system – windows

COURSEOUTCOMES

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

CO1: Analyze and evaluate the principles and benefits of sustainable construction practices

CO2: Apply sustainable design principles and strategies to building projects

CO3: Evaluate the challenges and opportunities associated with promoting sustainable construction in the industry.

TOTAL: 15 PERIODS

REFERENCES:

1. “Sustainable Construction: Materials, Methods, and Practice” by Blenkinsop, S, Routledge, 2023.
2. “Green Building: A Guide for Architects, Designers, and Engineers” by Wilson, A, Taylor & Francis, 2022.
3. “The Building Green Handbook: Sustainable Design and Construction”, by Athena Institute, Schiffer Publishing, 2023.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2						3						2		
2			3				3						2		
3		2				3	3						2		
AVg.	2	2	3			3	3						2		

1-low, 2-medium,3-high

	DETAILING OF STEEL STRUCTURES USING TEKLA	L	T	P	C
		1	0	0	1

LIST OF EXPERIMENTS

1. Create a simple model consisting of columns, beams, and braces.
2. Model a basic steel frame with different types of connections
3. Modeling a Simple Beam-Column Connection
4. Detailing of welded connection for tension
5. Detailing of welded connection for compression
6. Detailing of welded connection for bending
7. Detailing of purlin connection 8. Modeling a Plate with Stiffeners

COURSEOUTCOMES

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

CO1: Use Tekla to create accurate and efficient 3D models of steel structures with various elements and connections.

CO2: Detail the steel connections according to industry standards and design requirement by Tekla features.

CO3: Create construction drawings and reports from Tekla models for fabrication and production.

TOTAL: 15 PERIODS

REFERENCES:

1. "Steel Detailing: Principles and Applications" by Peter Beest, John Wiley & Sons, 2014.
2. "Detailing for Steel Construction" by Glenn J. Rourke and Ronald T. Packard, WCB McGraw-Hill, 2020
3. "Steel Designers' Manual", by Steel Construction Institute (SCI).

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				3								2		
2	2		2										2		
3					3								1	3	
AVg.	2		2		3								2	3	

1-low, 2-medium,3-high

	PRE - ENGINEERED BUILDING DETAILING	L	T	P	C
		1	0	0	1

LIST OF EXPERIMENTS

1. Design and model a base plate connection for a pre-engineered column.
2. Detailing of primary structural members such as frames, columns, and beams.
3. Generate fabrication drawings for the base plate and anchor bolts.
4. Create a model of a simple roof truss using pre-engineered components.
5. Detail the connections between truss members and purlins.
6. Detail the connections between panels and columns.
7. Generate fabrication drawings for the panels and connection details.
8. Detailing of welds, bolts, and stiffeners.

COURSEOUTCOMES

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

CO1: Apply pre-engineered building detailing principles to design, model, and generate fabrication drawings for various structural components.

CO2: Analyze and optimize connections in pre-engineered buildings considering strength, serviceability, and construction practicality.

CO3: Create clear and precise drawings that facilitate efficient fabrication processes.

TOTAL: 15 PERIODS

REFERENCES:

1. “Pre-Engineered Building Detailing Manual" by John A. Underwood, McGraw-Hill Education, 2021.
2. “Pre-Engineered Metal Buildings: Design and Construction” by David J. DeFranco, David A. Pekel, and James R. Ocel, 2021.
3. Steel Detailers Manual (Latest Edition) by American Institute of Steel Construction (AISC)

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		2		2								2	3	
2	3		3										3		
3					2									3	
AVg.	3		3		2								3	3	

1-low, 2-medium,3-high

	BASIC PLUMBING	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION TO PLUMBING SYSTEMS 3

Basic Plumbing Terminology - overview of different types of plumbing systems (residential, commercial, industrial) - components of a plumbing system – fixtures - pipes – valves – traps - vents - plumbing codes and standards - Introduction to hydraulic principles applied to plumbing systems

MODULE II WATER SUPPLY SYSTEMS 3

Water Sources and Treatment - pipe Materials and Selection - water Distribution Systems- Valves, Pumps, and Water Meters - Sizing and Design Considerations

MODULE III DRAINAGE AND WASTEWATER SYSTEMS 3

Types of drainage systems - drainage Pipe Materials and Installation - drainage Fixture UnitsTraps - Interceptors - Backflow Prevention – Storm water Drainage

MODULE IV PLUMBING FIXTURES AND MATERIALS 3

Types of Plumbing Fixtures - fixture Installation and Rough-in - Water Closets – Sinks - Tubs, Showers- Bidets - Faucets and Valves -Types of plumbing materials - Energy-Efficient Plumbing Appliances

MODULE V MAINTENANCE 3

Common plumbing problems and their solutions - Leak detection and repair - Fixture maintenance and repair - Vent Pipe Materials and Installation - Winterization and freeze protection- Safety considerations in plumbing systems

COURSEOUTCOMES

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

CO1: Explain the function and operation of various plumbing components, including fixtures, pipes, valves, and traps

CO2: Apply hydraulic principles to design and size plumbing systems

CO3: Identify and interpret relevant plumbing codes and standards.

TOTAL: 15 PERIODS

REFERENCES:

1. Building Services Handbook by Fred Hall, 11th Edition (2020), Routledge.
2. Domestic Plumbing: Design and Installation by Ray Wailes, 4th Edition (2017), Routledge.
3. International Plumbing Code 2021 by International Code Council (ICC).
4. Uniform Plumbing Code by International Association of Plumbing and Mechanical Officials (IAPMO).
5. Plumbing Principles and Practice by Kenneth R. Wakeman, 7th Edition (2021), Fairmont Press.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1		1			2					3		
2	3	3	3		2								1	1	
3	2	1	1				2						2		2
AVg.	2	2	2		2		2	2					2	1	2

1-low, 2-medium,3-high

	GREEN BUILDING RATING	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION TO GREEN BUILDING CONCEPTS 3

Overview of Sustainability in Civil Engineering - importance of Green Building Rating Systems - Environmental Impact of Conventional Construction - Principles of Sustainable Design - Introduction to Green Building Rating Systems

MODULE II LEED (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN) 3

History and Evolution of LEED - LEED Rating System Categories (New Construction, Existing Buildings, etc.) - LEED Credits and Categories (Sustainable Sites, Water Efficiency, Energy, Materials, Indoor Environmental Quality) - Certification Levels and Requirements - Case Studies of LEED Certified Buildings

MODULE III BREEAM (BUILDING RESEARCH ESTABLISHMENT ENVIRONMENTAL ASSESSMENT METHOD) 3

Overview of BREEAM - BREEAM Rating Categories (Management, Health and Wellbeing, - Energy, Transport, Water, Materials, Waste, Land Use and Ecology) - BREEAM Assessment Process- BREEAM Certification Levels and Criteria - International Applications and Case Studies

MODULE IV SUSTAINABLE CONSTRUCTION MATERIALS AND TECHNIQUES 3

Selection of Environmentally Friendly Materials- Low-Impact Construction Techniques- Energy Efficient Building Envelope Design - Life Cycle Assessment (LCA) in Construction - Integration of Renewable Energy Sources

MODULE V IMPLEMENTATION AND FUTURE TRENDS 3

Integrating Green Building Practices in Civil Engineering Projects - Challenges and Opportunities in Sustainable Construction - Cost-Benefit Analysis of Green Building Strategies - Green Building Trends and Innovations - Emerging Technologies in Sustainable Construction

COURSEOUTCOMES

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

CO1: Explain of the principles underlying sustainable construction and the environmental, eco and social considerations involved.

CO2: Develop proficiency in major green building rating systems, such as LEED and BREEAM, by comprehending their criteria and scoring mechanisms.

CO3: Design practices and green building strategies in civil engineering projects, focusing on site development, energy efficiency, and material selection to enhance environmental performance.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. Green Building Rating Systems: Implementation and Application (2022) by Edward K. Heaney, John Wiley & Sons
2. Sustainable Design for Civil Engineers: Water, Energy, and Buildings (2020) by Charles J. Kibert, John Wiley & Sons

REFERENCES:

1. “Green Building Handbook: Volume 1: Commercial, Industrial, and Institutional Buildings” by Ross Montgomery, Routledge.2012
2. “BREEAM In-Use International: Technical Manual”, BREEAM In-Use Assessment Process, IHS Markit, 2020.
3. “LEED Certification Process and Requirements” by US Green Building Council, USGBC Press, 2019

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1		1	2	3								
2	2	2	2		2										
3	2	2	3		2		3						3	3	3
AVg.	2	2	2		2	2	3						3	3	3

1-low, 2-medium,3-high

	DRONE SURVEYING	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION ON DRONES **3**

Introduction to Drones, History of Drone/UAS/UAVs, payload, battery life, Specs for good results, Regulations of DGCA and Drone license, Pre and Post Flight planning- Flight execution and photography, data collection- Image Format, GSD, Scale and Resolution.

MODULE II SURVEYING WITH DRONE **3**

Consideration for hardware selections, comparison on surveying drone and its accuracy, Techniques of controlling errors, Consideration of GCP in vertical and horizontal accuracies, Planning and estimation of drone surveying jobs, Autonomous flight vs. manual and hybrid flight profiles.

MODULE III IMAGE PROCESSING AND PHOTOGRAMMETRY **3**

Aerial Triangulation, post processing software's, Analysing Data, Contouring, DEM, DSM, Cut, Fill, and Volumetric Measurement Calculation and orthophoto generation.

MODULE IV MAPPING AND MODELING **3**

Introduction to mapping and modelling concepts, Understanding RTK, PPK and GCP's, Overview of popular data processing software platforms and functions.

MODULE V APPLICATIONS **3**

Application of drone for Surveying & Mapping-Construction, Irrigation and Agricultural, Engineering Land Survey and Transportation.

COURSEOUTCOMES

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

CO1: Understand the fundamentals of drone technology, including its history, terminology, p considerations, battery life, specifications for optimal results, and relevant regulations.

CO2: Apply drone surveying principles by selecting appropriate hardware, comparing surveying drone accuracy, implementing techniques to control errors.

CO3: Apply knowledge in image processing and photogrammetry techniques using drone-captured data, post-processing software, data analysis, contouring and orthophoto generation.

TOTAL: 15 PERIODS

TEXT BOOK:

1. Lillesand and Kiefer, "Remote Sensing and Image Interpretation", 5th Edition, published by John Wiley and Sons, 2008.
2. One Nation Under Drones: Legality, Morality, and Utility of Unmanned Combat Systems by John E. Jackson.
3. A.M. Chandra, S.K. Ghosh, "Remote Sensing and Geographical Information System", Narosa, Publishing house, 1st Edition, 2007.

REFERENCES:

1. David P Paine, “Aerial Photography and Image Interpretation”, 2nd Edition, published by Wiley, Higher Education, 2006.
2. Drones and Support for the Use of Force by James Igoe Walsh.

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CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1		1			2					2		
2	2	2	2											3	3
3	3	2	3		2									3	3
AVg.	2	2	2		1			2					2	3	3

1-low, 2-medium,3-high

	ARCHAEOLOGY OF INDIA	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION TO INDIAN ARCHAEOLOGY 3

Introduction to the basic principles and methodologies of archaeology - role of archaeology in reconstructing India's past - Evolution of archaeological practices in India - Contributions of early archaeologists and their pioneering discoveries. - Archaeological sites across India - cultural and historical significance.

MODULE II CHRONOLOGICAL FRAMEWORK OF INDIAN ARCHAEOLOGY 3

Prehistoric cultures and human evolution in the Indian subcontinent - Paleolithic, Mesolithic, and Neolithic periods - Ancient Indian Civilizations - Indus Valley Civilization. - Classical and Medieval Periods - cultural and architectural developments.

MODULE III TECHNIQUES AND METHODS IN INDIAN ARCHAEOLOGY 3

Excavation Methods - detailed exploration of excavation techniques employed in Indian archaeology - Dating Techniques - Radiocarbon dating, thermoluminescence, and other relevant techniques - Preservation and Conservation - Importance of preserving archaeological sites and artifacts - Strategies and challenges in the conservation of India's archaeological heritage

MODULE IV ARCHAEOLOGICAL SITES AND MUSEUMS 3

Harappa, Mohenjo-daro, and other Indus Valley sites - Ajanta and Ellora Caves -Agra, Fatehpur Sikri, and other Mughal monuments - National Museum, Delhi, and other archaeological museums

MODULE V CONTEMPORARY ISSUES IN INDIAN ARCHAEOLOGY 3

Heritage Management and Policies - current policies and initiatives for heritage management in India - Challenges and opportunities in preserving archaeological sites - Role of archaeologists in public awareness and education - Community involvement and collaborative projects - Emerging trends and technologies in the field of Indian archaeology.

COURSEOUTCOMES

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

CO1: Understand the basic principles, methodologies, evolution of archaeology and the his significance of archaeological sites across India.

CO2: Understand the chronological framework of Indian archaeology, including prehistoric cultures and human evolution.

CO3: Apply archaeological technique to excavation methods, dating techniques such as radiocarbon dating and thermoluminescence, and preservation and conservation strategies in Indian archaeology.

TOTAL: 15 PERIODS

TEXT BOOK:

1. Dr. A. K. Sharma "Indian Archaeology: Principles and Practices", Archaeological Publications, India, 2021

2. R.C. Majumdar, "History of Ancient India", Motilal Banarsidass Publishers, 2020.
3. K.M. Srivastava,"A Guide to Archaeological Sites in India", Cambridge University Press, 2019.
4. Nita Mathur and Vinita Tewari, "Heritage Management in India", Routledge, 2020

REFERENCES:

1. Vincent A. Smith, "Early India: A Concise History", Oxford University Press, 2004.
2. Clive Orton "Archaeological Methods and Techniques", Hodder Arnold, 2020.
3. Christopher Bronk Ramsey, "Dating Methods in Archaeology", Oxford University Press, 2008.
4. K.N. Arjunamurthy and K. Paddayya, "The Future of Archaeology in India", Cambridge University Press, 2014

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/124106009

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CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1			2		2					3		
2	2	1	1										2		
3	2	2	3		2										3
AVg.	2	2	2		2	2		2					3		3

1-low, 2-medium,3-high

	RETROFITTING AND REHABILITATION OF HERITAGE STRUCTURES	L	T	P	C
		1	0	0	1

MODULE I INTRODUCTION TO HERITAGE STRUCTURES AND CONSERVATION PRINCIPLES 3

Definition and significance of heritage structures - Types of heritage structures – religious – residential – commercial - Deterioration mechanisms and threats to heritage structures - Importance of conservation and rehabilitation - International and national guidelines for heritage conservation - Ethics and challenges in heritage conservation.

MODULE II ASSESSMENT AND DIAGNOSIS OF HERITAGE STRUCTURES 3

Visual inspection and documentation techniques - Non-destructive and destructive testing methods - Structural and material characterization - Identifying structural deficiencies and pathologies - Identification and analysis of traditional building materials - Understanding the impact of climatic conditions.

MODULE III RETROFITTING TECHNIQUES AND MATERIALS 3

Strengthening strategies for various structural elements (beams, columns, walls, foundations) - Minimally invasive and reversible intervention methods - Use of traditional and new materials in retrofitting - Repair and strengthening of masonry structures - Preservation and restoration of architectural elements - Balancing modern requirements with historical aesthetics.

MODULE IV REHABILITATION PLANNING AND DESIGN 3

Adaptive reuse of heritage structures for contemporary uses - Balancing modern functionality with heritage conservation - Formulating conservation plans for heritage structures - Integrating conservation with urban planning - Incorporating sustainability in rehabilitation projects - Energy-efficient solutions for heritage structures.

MODULE V PROJECT IMPLEMENTATION AND MANAGEMENT 3

Construction methodology and quality control for heritage projects - Monitoring and maintenance of retrofitted structures - Planning and executing retrofitting and rehabilitation projects - Budgeting, scheduling, and risk management in heritage conservation.

COURSEOUTCOMES

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

CO1: Understand the heritage structures, their significance, and deterioration mechanisms, impc of conservation and rehabilitation, challenges in heritage conservation.

CO2: Assess and diagnosing heritage structures and identify structural deficiencies, pathologies, and traditional building materials.

CO3: Apply retrofitting techniques and materials to heritage structures includes selecting appropriate strengthening strategies for various structural elements.

TOTAL: 15 PERIODS

TEXT BOOK:

1. Donald Insall, “The Conservation of Buildings and Historic Places” Wiley-Blackwell, 2020.

2. Carl Schwegler, “Structural Assessment of Historic Buildings”, John Wiley & Sons, 2020.
3. Valerie J. Goldstein, “Adaptive Reuse of Historic Buildings”, Wiley-Blackwell, 2013.

REFERENCES:

1. Eduardo Miranda and Sérgio Lopez, “Retrofitting Strategies for Existing Structures’, Springer, 2014
2. James Douglas and Daniella Izzo, “Designing for Sustainable Heritage”, Routledge, 2019.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ar08

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1			2	1	2					3		
2	2	2												3	3
3	2	2	3		2									3	3
AVg.	2	2	1		2	2	1	2					3	3	3

1-low, 2-medium,3-high

LIST OF COURSES FOR MAJOR/MINOR

COURSE CODE	DESIGN OF CONCRETE STURCTURES	L	T	P	C
		3	0	0	3

MODULE I YIELD LINE THEORY **9**

Introduction to yield line theory of slabs - Application to square, rectangular, triangular and circular slabs with simply supported or fixed boundary conditions subjected to uniformly distributed loads (by upper bound theorem).

MODULE II RETAINING WALLS **9**

Design of gravity and cantilever retaining walls for level surface filled with/without uniform surcharge-stability requirements - Description of inclined backfill (no problems)-Counterfort-Introduction and concepts only.

MODULE III BUILDING FRAMES **9**

Difference between multi-storeyed load bearing and framed structures-Elastic analysis using substitute frames for gravity loadings approximate analysis of single and two bay frames up to 3 storeys for lateral loads using portal and cantilever methods.

MODULE IV GROUND AND UNDER GROUND WATER TANK **9**

Classifications- Design of ground level square and rectangular tanks – IS code IS 3370 Pt IV coefficients. Design of underground rectangular tank.

MODULE V OVERHEAD WATER TANK AND BRIDGES **9**

Introduction to overhead rectangular, circular and Intze type tanks with staging. Design of circular water tank-Design of ring beam-staging- Types of bridges - IRC loadings - Design of single span slab bridges for class a loading only (Restricted to two lane).

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply the upper bound theorem to analyze and design square, rectangular, triangular, and circular slabs with various boundary conditions under uniform loads for optimized slab design.

CO2: Evaluate and design gravity counterfort and cantilever retaining walls for diverse scenarios (level surface with/without surcharge), adhering to stability requirements.

CO3: Analyses the substitute frames for gravity loads and portal/cantilever methods for lateral loads.

CO4: Design of ground-level and underground rectangular tanks, leveraging IS code provisions. Select and design suitable overhead tanks and their staging systems, considering diverse loading and functional requirements.

CO5: Apply IRC codes to design single-span slab bridges for A Class loading (two lanes).

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Reinforced Concrete Design", by Unnikrishna Pillai and Devados Menon, Tata Mc Graw Hill Publishing Co, New Delhi, 2021.

2. "Advanced Reinforced Concrete Design", Krishna Raju N., CBS Publishers and Distributors, Delhi, 2016.

REFERENCES:

1. "Seismic Design of Concrete structures" by Park, R., Paulay, T., & Priestley, M.J.N. (2nd edition), John Wiley & Sons, 2017.
2. "Reinforced Concrete Limit State Design" by Ashok K Jain, New Chand Brothers, Roorkee, 2012.
3. "Plain and Reinforced Concrete" Vol.I and Vol. II, by Jain, O.P and Jaikrishna Nemchand and Brothers, Roorkee, 2007.
4. "Structural Analysis in Theory and Practice" by Sergio Castillioni, (2^{nd} Edition), Springer, 2022.
5. "IS 456 - 2000 Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.
6. "IS 3370 (Part I) - 1965 (Re-established: 1999) - Code of Practice for Concrete Structures for the Storage of Liquids", Bureau of Indian Standards, New Delhi.
7. "IS 3370 (Part III) - 1965 (Re-established: 1999) - Code of practice for Concrete Structures for the Storage of Liquids", Bureau of Indian Standards, New Delhi.
8. "IRC: 5 - 1998 - Standard Specification and Code of Practice for Road Bridges (Section I)", Bureau of Indian Standards, New Delhi.
9. "IRC: 6 - 1966 - Standard Specification and Code of Practice for Road Bridges (Section II)", Bureau of Indian Standards, New Delhi.
10. "IRC: 21 - 2000 - Standard Specification and Code of Practice for Road Bridges (Section III)", Bureau of Indian Standards, New Delhi.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105216/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		3		2								3		
2	3		3				2						3		
3	3		2										3		
4	3		3										3	2	
5	3		3												
Avg.	3		3		2		2						3	2	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I DESIGN OF LONG COLUMNS AND DEEP BEAMS 9

Design of long column subjected to biaxial bending moment and axial load, SP 16. Behavior of deep beams - Designs as per IS 456 - 2000.

MODULE II CHECK FOR SERVICEABILITY 9

Limit State of Serviceability - calculation of deflection and cracking - Check for deflection and cracking as per IS 456 - 2000.

MODULE III DESIGN OF FLAT SLAB AND GRID FLOOR 9

Grid and coffered floors, general features, rigorous and approximate method of analysis and design of grid floor - Design of flat slab with and without drop, column and middle strip, proportioning of flat slab element as per IS 456-2000

MODULE IV LIMIT ANALYSIS 9

Limit Analysis of RCC structures - Fundamental principles, concept of moment redistribution - moment rotation characteristics permissible rotation capacity - Cambridge method - A.L.L. Baker's method of Limit analysis.

MODULE V TALL STRUCTURES 9

Analysis of R.C. Chimneys by Elastic theory - Design by LSD. Design of square bunker using Rankine's theory. Design of circular Silo using Jansen's theory and Airy's theory (Derivation not required for both theories).

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Design long columns under biaxial bending and axial loads and deep beams, handling complex bending scenarios in concrete elements.

CO2: Assess deflection and cracking in concrete structures using Limit State of Serviceability principles. Effectively controlling deflection and cracking within permissible limits to ensure structural functionality.

CO3: Analysis and design of grid floors and flat slabs with/without drops, employing both rigorous and approximate methods.

CO4: Apply limit analysis principles to assess ultimate bearing capacity of RCC structures.

CO5: Evaluate and apply appropriate theories to design diverse tall structures in selecting and implementing suitable methods for each scenario. Apply IRC codes to design single-span slab bridges for A Class loading (two lanes).

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Limit State Design of Reinforced Concrete” by P.C. Varghese, PHI Learning Private
2. "Advanced Reinforced Concrete Design" by Krishna Raju N., CBS Publishers and Distributors, Delhi, 2016.

REFERENCES:

1. "Plain and Reinforced Concrete" by Jain and Jai Krishna., Nem Chand Brothers, Roorkee, 2010.
2. IS 456:2000 Plain and Reinforced Concrete, Bureau of Indian Standards (BIS).
3. SP 16 Design Aids for Wind Loading on Helical Piles, BIS.
4. "Limit State Design of Concrete Structures" by M.L. Gambhir, Macmillan India Ltd., Delhi, 2011.
5. "Design of Reinforced Concrete" by Structures,S. Ramamrutham, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2011.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105105/

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3										3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF BRIDGES	L	T	P	C
		3	0	0	3

MODULE I REINFORCED CONCRETE DECK SLAB BRIDGES 9

Introduction - Classification of Bridges - Types of IRC loadings - Design of solid deck slab bridges for IRC loading -Concept of design of skew slab bridges.

MODULE II REINFORCED CONCRETE TEE BEAM AND DECK SLAB BRIDGES 9

Design of tee beam and deck slab bridges- Courbon's theory - Pigeaud's curves -Concept of balanced cantilever and continuous bridges.

MODULE III PRESTRESSED CONCRETE BRIDGES 9

Design of prestressed concrete bridges -Design of girder section -Maximum and minimum prestressing forces -Eccentricity -Check for stresses at various sections -Design of End block.

MODULE IV STEEL BRIDGES 9

Design of through type and deck type steel highway bridges for IRC loading - Design of stringers, cross girders and main girders.

MODULE V BRIDGE BEARINGS 9

Types of bearings - Design of steel roller and rocker bearings - Design of RC rocker bearing - Design of elastomeric pad bearing

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply IRC codes and design principles to analyze and design solid deck slab bridges for various loading conditions, demonstrating comprehension of skew slab bridge design concepts.

CO2: Illustrate Courbon's theory and Pigeaud's curves to design tee beam and deck slab bridges, differentiating between balanced cantilever and continuous bridge behavior.

CO3: Design prestressed concrete bridge sections, calculating prestressing forces, eccentricity, stresses, and end block dimensions, ensuring structural integrity.

CO4: Analyze and design through and deck type steel highway bridges for IRC loadings, focusing on stringers, cross girders, and main girders.

CO5: Select and design appropriate bridge bearings based on loading and structural requirements.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Design of Bridges", by Krishna Raju, N., Oxford & IBH Publishing Co. Pvt. Ltd., 2018.
2. "Essentials of Bridge Engineering" by Johnson Victor, D, Oxford and IBH Publishing Co., 2019.

REFERENCES:

1. "Bridge Engineering" by Ponnuswamy S., Tata McGraw-Hill, 2019.
2. “Concrete Bridge Practice” by Raina.V.K, Tata McGraw Hill, 2007.
3. IRC 5:1998 Standard Specifications and code of practice for Road Bridges, Section I - General.
4. IRC 6:2014 Standard Specifications and code of practice for Road Bridges, Section I - Loadings.
5. IRC 83:2015 Standard Specifications and code of practice for Road Bridges, Bearings.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ce63/preview/

CO - PO & PSO MAPPING

CO	PO												PSO		
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5	3		2										3		
Avg.	3		3		2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED STEEL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PLASTIC ANALYSIS AND CONNECTIONS 9

Plastic Analysis - Kinematic theorem, Static theorem and Uniqueness theorem - Propped cantilevers - Fixed beams and Continuous beams - Portal Frames. Connections - flexible, semi-rigid and rigid or moment resisting connections. Column cap.

MODULE II STEEL TOWERS 9

Transmission line towers - Micro Wave Towers - Loads on Towers - Shape, Sag and Tension in Uniformly loaded conductors - Analysis of towers - Design of member in towers - Design of tower foundations.

MODULE III INDUSTRIAL BUILDINGS 9

Components of Industrial Structures - Design of Gantry Girder. Welded Plate Girder – Elements of Plate Girder. Design of roof truss - Analysis and Design of Single Bay Gable Frame with Knee Bent.

MODULE IV CHIMNEY 9

Analysis and Design of self-supporting steel Chimney – Design of Chimney base plate – Design of Chimney foundation.

MODULE V LIGHT GAUGE STEEL MEMBERS 9

Light gauge sections - types of sections, material - local buckling of thin elements - stiffened and multiple stiffened compression members - Unstiffened elements - Laterally supported and unsupported flexural members.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply plastic analysis theorems to optimize steel structures and design flexible, semi-rigid, and rigid connections.

CO2: Analyze and design transmission line and microwave towers, incorporating loads, conductor tension, and member design, while ensuring foundation stability.

CO3: Develop and optimize industrial structures like gantry girders, welded plate girders, roof trusses, and single-bay gable frames with knee bents.

CO4: Analyze and design self-supporting steel chimneys, including base plate and foundation, considering wind, seismic, and thermal loads for structural integrity.

CO5: Evaluate and implement appropriate light gauge steel members for compression and flexural applications, ensuring efficiency, safety, and consideration of local buckling.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Design of Steel Structures” by Subramanian. N, Oxford University Press (3rd edition). New Delhi, 2017.
2. “Limit State Design of Steel Structure” by Duggal. S. K, Tata McGraw Hill Publication, 2011.

REFERENCES:

1. "Design of Steel Structures" by Jayagopal. L. S., Tensing. D., Vikas Publications House Ltd, Noida.
2. "Design of Steel Structures by Limit State Design" by Bhavikatti. S. S, I.K International Pvt. Ltd., New Delhi 2011.
3. "Limit State Design in Structural Steel" by Shiyekar. M.R., PHI learning Pvt. Ltd., Delhi, 2013.
4. IS 800 - 2007, Code of Practice for use of Structural Steel in General Building Construction, Bureau of Indian Standards, New Delhi.
5. IS 801: 1975, Code of Practice for use of cold formed light gauge steel structural members in general construction, Bureau of Indian Standards, New Delhi.
6. IS 802: Part 1 Section - 1, Code for Practice for use of Structural Steel in Overhead Transmission line Towers, Materials and Loads and Permissible Stresses, Bureau of Indian Standards, New Delhi, 1995
7. IS 6533-2 (1989), Code of Practice for Design and Construction of Steel Chimney, Bureau of Indian Standards, New Delhi, 1989.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_oe02/preview/

CO - PO & PSO MAPPING

CO	PO												PSO		
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5	3		3		2										
Avg.	3		3		2		2						3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

MODULE I BASIC CONCEPTS **9**

Indeterminacy - Static, Kinematic - Generalized measurements - Degrees of Freedom - Constrained measurements - Behavior of Structures - Principle of Superposition - Equilibrium, Compatibility and Force displacement relations.

MODULE II ENERGY CONCEPTS **9**

Strain energy; stiffness and flexibility matrices for strain energy - Betti's law and its applications - Properties of stiffness and flexibility matrices - Contra gradient law- Coordinate transformations - Transformation of element matrices to structure matrices - orthogonal transformations.

MODULE III MATRIX STIFFNESS METHOD **9**

Transformation of element stiffness matrices from local to global coordinates – Application of direct stiffness method to two span continuous beams and pin-jointed plane frames (frames of maximum three members) - Advantages of direct stiffness method.

Element stiffness matrices for truss, beam and plane frame elements - Development of structure stiffness matrix by element approach Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by matrix stiffness approach.

MODULE IV MATRIX FLEXIBILITY METHOD **9**

Element flexibility matrices for truss, beam and plane frame elements - Development of structure flexibility matrix by element approach –Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by flexibility matrix approach.

MODULE V FINITE ELEMENT METHOD **9**

Introduction to finite element analysis – Concept of discretization of continuum - Finite element analysis procedure – Relevant basics of elasticity – Stress-strain relation (Constitutive relation) - Strain-displacement relation – Concept of strain-displacement matrix – Types of 1-D, 2-D and 3- D finite elements –Displacement function – Convergence and compatibility requirements - Development of shape functions for truss element (2-noded and 3-noded), beam element and CST element

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply fundamental principles of indeterminacy, degrees of freedom, structural behavior, and equilibrium to analyze and solve basic structural problems using superposition, compatibility, and force-displacement relations.

CO2: Apply energy principles to develop stiffness and flexibility matrices, understanding their properties and transformations.

CO3: Employ stiffness method to analyze two-span continuous beams and pin-jointed plane frames, understanding the advantages and limitations of this method.

CO4: Analyze statically indeterminate beams and plane frames using the flexibility matrix method, in both stiffness and flexibility approaches.

CO5: Develop finite element models for basic trusses, beams, and plates, employing discretization, stress-strain relations, and shape functions.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Advanced Structural Analysis" by Kasiraj B.M., Alpha Science International" (2nd edition)., New Delhi, 2014.
2. "Finite Element Analysis – Theory and Programming (Revised Edition)" by Krishnamoorthy, C. S. Tata McGraw Hill, New Delhi, 2022.

REFERENCES:

1. "Structural Analysis" by Pearson Education, Hibbeler R. C., New Delhi, 9th ed., 2017.
2. "A Unified Classical and Matrix Approach" by Ghali A., Neville A. M. And Brown T. G., Structural Analysis –Spoon Press, London and New York, 2017.
3. "Computational Structural Mechanics" by Rajasekharan S. and G. Sankarasubramanian, Prentice Hall of India, New Delhi, 2012.
4. "Elements of Matrix and Stability Analysis of Structures" by Manicka Selvam V.K., KhannaPublishers, Delhi, 2010.
5. "Advanced Structural Analysis" by Desayi, P., Krishnamurthy, C.S., Oxford University Press, Oxford, UK, 2017.

ONLINE RESOURCES:

1. https://nptel.ac.in

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3	2	2		2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF PREFABRICATION 9

Types of prefabrication - Advantages and disadvantages of prefabrication-Economy of prefabrication - Modular coordination - Standardisation - Prefabrication system and structural schemes - Prefabricated elements - Beams - Columns - Slabs-Roof and floor panels - Wall panels – Staircase.

MODULE II PRECAST CONCRETE-MANUFACTURING AND ERECTION TECHNIQUES 9

Standard practices and techniques of precast concrete manufacturing and handling -Cycle of precasting - Reinforcement- Preparation of moulds -Preparation and transportation of concrete-Production tolerances -Transportation and erection of prefabricated elements - Equipments for handling precast elements.

MODULE III DESIGN PRINCIPLES 9

Disuniting of structures-Structural behaviour of precast structures - Handling and erection stresses - Design of cross section based on efficiency of material used- Problems in design because of joint flexibility-Allowance for joint deformation.

MODULE IV JOINTS AND CONNECTIONS 9

Types of precast element connections - Column to foundation connections -Column to column connections-Beam to column connections-Beam to beam connections-Floor to beam connections-Wall to wall connections- Joints for different structural connections - Dimensioning and detailing of joints for different structural connections - Construction and expansion joints in precast construction.

MODULE V DESIGN PRINCIPLES FOR ABNORMAL LOADS 9

Code provisions- Equivalent design loads for considering abnormal effects such as earthquakes, cyclones - Progressive collapse -Importance of avoidance of progressive collapse.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate and select appropriate prefabrication systems and elements based on economic, standardization, and structural considerations.

CO2: Plan and manage the precast concrete production process, including reinforcement, mold preparation, concrete handling, transportation, and erection, ensuring quality and safety.

CO3: Design precast concrete structures for efficient material use, considering handling and erection stresses, joint flexibility, and potential deformation issues.

CO4: Develop and detail efficient and structurally sound connections for precast elements, ensuring proper load transfer and stability.

CO5: Analyze robust design solutions for precast structures using relevant code provisions and methods, addressing abnormal loads and ensuring progressive collapse resistance.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Precast Concrete Handbook", by PCI Committee on Buildings, 9th Edition, Precast / Prestressed Concrete Institute, Chicago, 2017.
2. "Precast Concrete Construction", by Menn, C., Ernst & Sohn, Berlin, 2016.

REFERENCES:

1. "Precast concrete materials, Manufacture properties and usage", by Levit M., Applied Science Publishers, London, 2000.
2. "IS 15627:2008 Precast Concrete Blockwork for Load-Bearing Walls", Bureau of Indian Standards (BIS)
3. IS 15916-2010: "Indian Standard Code of Practice for Building Design and erection using Prefabricated Concrete", Bureau of Indian Standards, New Delhi.
4. "Precast concrete Connection Details", Structural Design Manual, Society for the Studies in the use of Precast Concrete, Netherland Behor Verlag, 2009.
5. "Precast Concrete Structures", by Nawy, E.G., John Wiley & Sons, Hoboken, NJ, 2013.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/124/105/124105013/

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3		2	2							3	3	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

MODULE I BASICS OF FINITE ELEMENT METHOD 9

General description - Basic element shapes - Discretization process - Node numbering – Mesh generation - Steps involved in finite element method - Application of finite element method - Advantages and disadvantages of finite element method.

MODULE II APPROXIMATE METHODS OF ANALYSIS 9

Energy principles - Variational methods - Rayleigh Ritz method - Method of collocation - Subdomain method - Galerkin Method - Least squares approach

MODULE III ANALYSIS OF TRUSSES 9

Stiffness matrix for an axial element - Direct stiffness approach - Element assembly into global stiffness matrix -two dimensional trusses - displacement of joints - forces in the members.

MODULE IV ANALYSIS OF BEAMS AND FRAMES 9

Beam stiffness - Direct stiffness approach - Element assembly into global stiffness matrix –solution for beam problems - Two-Dimensional beam element - rigid plane frames.

MODULE V PLANE STRESS AND PLANE STRAIN PROBLEMS 9

Basic concepts of plane stress and plane strain - derivation of stiffness matrix for constant - strain, linear strain triangular elements - rectangular elements - Iso-parametric elements - Lagrange and Serendipity elements - static condensation - axisymmetric elements.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply the fundamental principles of the finite element method (FEM) to discretize and analyze simple engineering problems, understanding its strengths and limitations.

CO2: Formulate and apply various approximate methods to solve simple engineering problems, comparing their strengths and weaknesses.

CO3: Develop and implement the direct stiffness method to analyze two-dimensional trusses, calculating joint displacements and member forces.

CO4: Apply the direct stiffness approach to analyze beams and rigid plane frames, formulating element stiffness matrices, assembling the global system, and solving for displacements and internal forces.

CO5: Analyze and evaluate the performance of different element stiffness matrices) for triangular, rectangular, and iso-parametric elements in solving plane stress and plane strain problems.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "A First Course in Finite Element Method", by Daryl L Logan, 6th Edition, CengageLearning, 2016.
2. "An Introduction to Finite Element Method", by Reddy J N, 3rd Edition, McGraw HillEducation, 2015

REFERENCES:

1. "Introduction to Finite Elements in Engineering", by Tirupathi R. Chandrupatla, Ashok D. Belegundu 4th Edition, Pearson, 2011.
2. "Finite Element Analysis", by Krishnamoorthy C.S, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. "Finite Element Analysis in Engineering Design", by Rajasekaran S, S.Chand and Company Ltd., 2003.
4. "Applied Finite Element Analysis", by Larry J.Segerlind, by John Wiley and Sons, New York, 2010.
5. "Concepts and Applications of Finite Element Analysis", by Robert D. Cook, David S. Malkus, John Wiley and Sons, India Edition, 2007.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_me43/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3		2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Planning of an industrial building based on the functional requirements, Lighting and ventilation – Fire safety norms – Protection against noise and vibration - factories act, Different types of loadings.

MODULE II INDUSTRIAL BUILDINGS 9

Roofs for industrial buildings – Steel and RCC - Design of Roof - Pre-Engineered Buildings - Design of multi storied deck slab, Steel platform.

MODULE III MATERIAL HANDLING SYSTEMS 9

Cranes -Types-design of EOT - Manual overhead cranes - Design of A-cranes, Monorails. Design of conveyers, conveyer towers.

MODULE IV INDUSTRIAL STORAGE STRUCTURES 9

Beam stiffness - Direct stiffness approach - Element assembly into global stiffness matrix –solution for beam problems - Two-Dimensional beam element - rigid plane frames.

MODULE V BEHAVIOUR OF LATERAL LOAD RESISTING SYSTMES 9

Lateral load resisting systems – structural walls – shear walls.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Develop and design industrial buildings considering functional needs, lighting, ventilation, fire safety, noise/vibration control, statutory requirements, and various loading types

CO2: Analyze and design roof systems (steel and RCC), pre-engineered buildings, multi-storied deck slabs, and steel platforms for industrial applications.

CO3: Apply engineering principles to design and analyze various material handling systems, including EOT cranes, manual overhead cranes, A-cranes, monorails, conveyors, and conveyor towers.

CO4: Perform structural design of silos and bunkers, including their supporting systems, considering specific storage requirements and loading conditions.

CO5: Evaluate and design efficient lateral load resisting systems (structural walls, shear walls) for industrial buildings, ensuring structural stability.

TOTAL: 45 PERIODS

TEXT BOOK:

1. ” Seismic Design of Industrial Buildings”, by Satyendra Gupta and Ajay Gupta, 2014.
2. “Design of Industrial Structures”, by David P. Billington, Charles O. Harris Jr, and JohnR. Hoemann, 2014.

REFERENCES:

1. “Foundations for Industrial Machines Handbook for Practising Engineers” by K.G. Bhatia, Taylor and Francis, 2009.
2. “Design of electrical transmission lines” by Sriram Kalga, Prasad Yenumala, CRC press, Taylor and Francis, 2016.
3. "Design of Steel Structures" by Punmia B.C., Ashokkumar Jain, Laxmi Publications, New Delhi-2004.
4. "Metal Building System - Design and specifications" by Alexander Newman, Second Edition, Mc Graw Hill, NewDelhi-2004.
5. “Transmission Line Structures” by Santhakumar A.R.and Murthy S.S., Tata McGraw Hill, 2004.
6. ,"Machine Foundation Design Handbook" by Prakash V. Varde 2018.

ONLINE RESOURCES:

2. https://archive.nptel.ac.in/courses/105/106/105106113/

CO - PO & PSO MAPPING

CO	PO												PSO		
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Avg.	3		3			2							3	2	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SMART MATRIALS AND STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPALS OF SMART MATERIALS 9

Introduction to Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto - resistance effect.

MODULE II CHARACTERISTICS OF SMART MATERIALS 9

Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids.

MODULE III HIGH-BAND WIDTH AND LOW STRAIN SMART SENSORS 9

Piezeoelctric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magnetostrictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors.

MODULE IV SMART ACTUATORS 9

Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magnetovolume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.

MODULE V ADVANCES IN SMART STRUCTURES & MATERIALS 9

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Derive and explain the relationships between applied forces, electric fields, and magnetic fields in piezoelectric and magnetostrictive materials.

CO2: Compare and contrast different smart material types based on their actuation and sensing mechanisms and limitations.

CO3: Design a multi-sensor smart system for structural health monitoring, considering sensor placement, sensitivity, and data acquisition requirements, including a detailed diagram and rationale.

CO4: Calculate the required actuation force for a specific application using appropriate piezoelectric or magnetostrictive actuator models.

CO5: Evaluate and discuss emerging trends in smart materials and structures, including self-sensing, energy harvesting, and intelligent system design.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Smart Materials: Design Principles and Applications" by Bartosch, S., Springer, Cham, 2019.
2. "Smart materials and structures" by Newell, F. M., & Hubbard, G. M., John Wiley & Sons, 2022.

REFERENCES:

1. "Smart Materials and Structures" by Ahmad, A., & Devasia, M, CRC Press, 2021.
2. "Theoretical and Experimental Modal Analysis" (Mechanical Engineering Research Studies. Engineering Control Series, 9) by Maia, N.M.M and Silva, J.M.M., Research Studies Press, 2012.
3. "Smart Materials and Technology" by Michelle Addington and Daniel L. Schodeck, Elsevier, 2005.
4. "Mechanics of Composite Materials", by Jones, R.M., Taylor & Francis, Abingdon, 2013.
5. "Instrumentation – Devices and Systems", by Rangan C.S., Sarma G.R. and Mani V.S.V., Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 2010.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106068/

CO - PO & PSO MAPPING

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5	3														
Avg.	3		3	1	2							2	2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	OFFSHORE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I WIND EFFECTS **9**

Wind on Structures - Wind Load Estimation - Wind Tunnel Testing - Wind Loading Codes and Standards - Rigid Structures - Behavior of Rigid Structures under Wind Load - Structural Response and Deformation - Flexible Structures - Dynamic Response of Flexible Structures - Aeroelasticity Considerations - Static and Dynamic Effects - Static Analysis of Structures under Wind Load - Dynamic Effects - Vortex Shedding, Flutter, Buffeting

MODULE II WAVE HYDRODYNAMICS **9**

Wave Generation - Mechanisms of Wave Generation - Mathematical Models for Wave Generation - Propagation of Small and Finite Amplitude Wave Theories - Linear Wave Theories - Nonlinear Wave Theories - Wave Energy and Pressure Distribution - Wave Energy Spectrum - Pressure Distribution on Structures

MODULE III WAVE LOADING **9**

Wave Forces on Structures - Hydrodynamic Forces on Offshore Structures - Wave-Induced Loads on Different Types of Structures - Environmental Loadings - Combined Loading from Wind and Waves - Storm Conditions and Extreme Loading - Use of Morrison Equation - Introduction to Morrison Equation - Applications in Estimating Wave Forces.

MODULE IV OFFSHORE STRUCTURE MODELLING **9**

Different Types of Structures - Fixed Platforms - Floating Platforms - Subsea Structures - Foundation Modeling - Soil-Structure Interaction - Pile Foundation Design - Static Methods of Analysis - Static Equilibrium Analysis - Load Distribution in Offshore Structures - Dynamics of Offshore Structures - Dynamic Analysis Methods.

MODULE V DESIGN OF OFFSHORE STRUCTURES **9**

Loads - Combination of Wind, Wave, and Environmental Loads - Load Factors and Safety Considerations - Design of Platforms - Structural Design Principles - Material Selection and Fatigue Analysis - Derricks and Helipads - Structural Design and Analysis - Safety and Operational Considerations - Jacket Towers and Mooring Cables - Design Principles for Jacket Structures - Mooring System Design and Analysis - Design Examples.

COURSE OUTCOMES

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

CO1 : Differentiate and analyze the nature of static and dynamic wind loads on various building types and geometries.

CO2 : Explain the wave generation process and apply relevant wave theories to assess offshore structure performance.

CO3 : Calculate and interpret forces acting on offshore structures under various environmental conditions.

CO4 : Develop accurate structural models of offshore structures considering different loading regimes.

CO5 : Design individual components of offshore structures to meet strength, stability, and functionality requirements.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Offshore Structures: Designing for Environmental Load", T.K. Sarpkaya, John Wiley & Sons, 2014.
2. “Ocean Engineering for the Polar Regions", Johan V. Ringheim, Springer, 2014.

REFERENCES:

1. "Hydrodynamics of Ship and Offshore Structures", John Newman, Cambridge University Press, 2010.
2. “Recommended Practice for Design and Construction of Fixed Offshore Platforms", API RP 2A.
3. “Environmental Conditions for Offshore and Coastal Structures", DNV-RP-C205.
4. “Case Studies in Offshore Engineering", Torgeir Moan, Elsevier, 2010.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1		1			2		2			2		
2	2	2	1	1	1		1	2		2			2		
3	2	2	3	1	2			2					3		
4	2	3	3	2	3			2			1		3	2	
5	1	2	3		2			2		2	1		3	3	1
Avg.	**2**	**2**	**2**	**1**	**2**		**1**	**2**		**2**	**1**		**3**	**3**	**1**

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I CONCRETE AND TESTING **9**

Cement hydration - Concrete - Quassi-brittle nature of concrete- Micro-cracking, crack propagation - stress concentration at openings -Destructive, semi-destructive & Non-destructive testing methodology - Rebound hammer test - Ultrasonic Pulse Velocity UPV Test - Penetration resistance test - Pull-out Test - Pull-off Method - Break-off test - Cover Measurement - Half-cell electrical potential method - Introduction to Microscopic Analysis.

MODULE II CONCRETE ADMIXTURES **9**

Chemical Admixtures- Hydration of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh Cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, and new generation super plasticizer. Mineral Admixture-Fly ash, Silica fume, GGBS and their effect on concrete property in fresh state and hardened state.

MODULE III SPECIAL CONCRETES **9**

Fibre Reinforced Concrete - High performance concrete - Ultra high strength concrete - Self Compacting Concrete - Polymer Concrete - Sulphur concrete - Geo polymer concrete - Recycled aggregate concrete - Bacterial concrete – Nano concrete.

MODULE IV CONCRETING UNDER SPECIAL CIRCUMSTANCES **9**

Underground construction - Concreting in marine environment - Underwater construction - Extreme weather concreting

MODULE V DURABILITY OF CONCRETE **9**

Factors affecting durability - Tests on permeability - water absorption - chemical Attack- Sulphate attack - carbonation - chloride penetration - fire - frost action

COURSE OUTCOMES

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

CO1 : Analyze the behavior of concrete under various loading conditions and evaluate the suitability of different test methods for characterizing its key properties.

CO2 : Evaluate admixture interactions with other concrete components and propose innovative mix designs optimized for performance and cost in diverse applications

CO3 : Categorize various types of concrete based on their inherent properties and make informed choices for different structural and environmental requirements.

CO4 : Develop and implement effective strategies for successful concrete placement and curing under a range of exposure conditions, utilizing appropriate techniques and best practices.

CO5 : Evaluate the limitations and uncertainties associated with performance and durability predictions for concrete structures, proposing strategies for mitigation and ensuring long-term integrity.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Concrete Technology", Santhakumar, A.R., 5th Edition, Oxford University Press, New Delhi, 2022.
2. "Properties of Concrete", Neville, A.M., 6th Edition, Pearson Education Ltd., New Delhi, 2018.

REFERENCES:

1. "Concrete Microstructure, Properties and Materials", Mehta, P.K. and Monteiro, P.J.M., 4th Edition, McGraw-Hill Education, 2016.
2. "Concrete Technology", Gupta, B.L. and Gupta, Amit, 14th Edition, Standard Publishers and Distributors, New Delhi, 2019.
3. "Concrete Technology", Shetty, M.S., 9th Edition, S. Chand and Company, New Delhi, 2023.
4. "Concrete Technology", Gambhir, M.L., 2nd Edition, Tata McGraw Hill Book Co. Ltd., Delhi, 2020.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	1	1	1			2	1	2	3	2	
2	2	1	3	1	2	1	2			2	1	1	3	3	
3	2	1	2	1	1	1	2			2	1	1	3	2	
4	1	1	2	1	2	1	2			2	2	1	2	2	
5	2	2	1	2	2	1	3			2	1	2	2	1	
Avg.	**2**	**1**	**2**	**1**	**2**	**1**	**2**			**2**	**1**	**1**	**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I COMPOSITE STRUCTURE **9**

Introduction to steel-concrete composite construction - Benefits and applications of composite structures - Types of composite structures (beams, columns, slabs) - Theory of composite structures - Shear connection between steel and concrete - Composite action and effective section properties - Behavior under flexure, shear, and torsion - Introduction to steel-concrete-steel sandwich construction - Benefits and applications of sandwich panels - Design considerations for sandwich panels

MODULE II DESIGN OF COMPOSITE BEAMS **9**

Behavior of composite beams - Deflections, stresses, and strains in composite beams - Ultimate strength considerations (flexure, shear, web buckling) - Design of composite beams - Design codes and standards - Serviceability limit states (deflection, crack control) - Strength limit states (flexure, shear, connection design) - Software tools for composite beam design

MODULE III DESIGN OF COMPOSITE COLUMNS AND TRUSSES **9**

Steel-concrete composite columns - Behavior and design of composite columns (axial, flexure, biaxial loading) - Confinement requirements for concrete - Design of composite trusses: - Design of chord and web members in composite trusses - Connection design in composite trusses - Stability considerations (buckling)

MODULE IV DESIGN OF CONNECTIONS **9**

Types of connections - Welded connections - Bolted connections - Shear studs - Other connection types - Design of connections in composite structures - Design for shear transfer - Design for moment transfer - Fatigue considerations - Design of connections in composite trusses: - Connection details for chord and web members - Gusset plate design - Fatigue considerations

MODULE V COMPOSITE BOX GIRDER BRIDGES **9**

Types of box girder bridges - Advantages and applications - Behavior of box girder bridges: - Torsional behavior - Shear lag - Local buckling considerations - Design concepts - Design codes and standards for bridges - Serviceability and strength limit states - Fatigue design - Construction considerations - General case studies on steel - concrete composite construction in buildings - seismic behavior of Composite structures.

COURSE OUTCOMES

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

CO1 : Explain the behaviour of steel-concrete composite and sandwich structures under various loading conditions.

CO2 : Design efficient composite beams for specified loads and spans using relevant design codes and software.

CO3 : Utilize design principles and code provisions to create stable and load-resistant composite columns and trusses.

CO4 : Choose and design appropriate connections for composite structures, ensuring adequate strength and stiffness against shear and other forces.

CO5 : Analyze the behaviour of composite box girder bridges and predict their response to different loading scenarios.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Design of Steel and Composite Structures", T.Y. Lin and Ned H. Burns, John Wiley & Sons, 2020.
2. "Composite Structures of Steel and Concrete", R.P. Johnson, 3rd Edition, Wiley, 2013.

REFERENCES:

1. "Case Studies in Composite Bridges", P.C. Wasti and N.K. Jain, Springer, 2020.
2. "Standard Specifications and Code of Practice for Road Bridges. Section V- Steel Road Bridges", IRC 24:2010, Indian Road Congress.
3. "Finite Element Analysis and Design of Steel and Concrete Composite Bridges", Niels G. Ottosen, Taylor & Francis, 2005.
4. "Behavior and Design of High-Strength Concrete Composite Bridges", Lihua Fang and Li Yu, CRC Press, 2023.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1		1		1			2	-	2	2	-	
2	3	2	3		2		1			2	2	2	3	2	
3	3	2	3		2		1			2	2	2	3	2	
4	3	2	3		2		1			2	2	2	3	2	
5	3	3	2	1	3		1			2	2	2	3	2	
Avg.	**3**	**2**	**2**	**1**	**2**		**1**			**2**	**2**	**2**	**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	THEORY OF PLATES	L	T	P	C
		3	0	0	3

MODULE I PLATE BEHAVIOUR AND SMALL DEFLECTION THEORY **9**

Introduction - Thin and thick plates - Plate behaviour - Material behaviour - Isotropic and orthotropic Materials, Differential equation of plates in Cartesian co-ordinate system - boundary conditions - Rigorous solution - Navier's Method - Levy's Method.

MODULE II SYMMETRICAL BENDING OF CIRCULAR PLATES **9**

Differential equation for symmetrical bending of laterally loaded circular plates - Simply supported edges-Clamped edges - Circular plate with a circular hole at the centre - Circular plate concentrically loaded.

MODULE III APPROXIMATE METHODS **9**

Energy methods - Galerkin's Method - Ritz Method, Method of Images - Plate strip - Influence surfaces - Membrane and Various Analogies - Simultaneous Bending and Stretching.

MODULE IV NUMERICAL METHODS **9**

Finite difference method - Improvements for solution, matrix displacement analysis of Grids - introduction to Finite Element Method**.**

MODULE V PLATES OF OTHER SHAPES AND ADVANCED TOPICS **9**

Triangular plates - Elliptic plates - Sector plates - Skew plates - Plates on elastic foundation - Continuous plates - Large Deflection theory - Thermal stresses - Multilayered plates. - Mindlin's theory of plates.

COURSE OUTCOMES

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

CO1 : Explain the fundamental concepts of plate behavior and analyze the behavior of thin and thick plates under various loading conditions using plate theory to solve for deformations and stresses.

CO2 : Analyze symmetrical bending of circular plates under various boundary conditions using classical plate theory to determine deflections, moments, and stresses.

CO3 : Analyze plates by various approximate methods and solve bending and stretching problems.

CO4 : Apply numerical techniques, including finite difference method and finite element method and analyze the behavior of grids and structures.

CO5 : Analyze the response of plates with various shapes under different loading conditions using established plate theories and interpret the results to predict bending, deflection, and stress.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Theory and Analysis of Plates - Classical and Numerical Methods", Rudolph Szilard, Prentice Hall, 1995.
2. "Theory of Plates and Shells", S. Timoshenko and S.W. Krieger, McGraw-Hill Book

Company, New York, 1990.

REFERENCES:

1. "Theory of plates", K. Chandrashekhara, University Press India Limited, Hyderabad, 2001.
2. "A Text Book of Plate Analysis", N.K. Bairagi, Khanna Publishers, New Delhi, 1996.
3. "Beams, Plates and Shells", L.H. Donnell, McGraw-Hill Inc., 1976.
4. "Plates Theories and Applications", K. Bhaskar and T.K. Varadan, Springer Cham, 2022.
5. "Plates and Shells, Theory and Analysis", Ansel C. Ugural, 4th Edition, CRC Press, 2018.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	-	-	2	2	2	-	2	3	2	-
2	3	2	3	1	1	-	-	2	1	2	-	2	3	2	-
3	3	2	3	2	2	-	-	2	2	2	-	2	3	2	-
4	3	2	3	2	3	-	-	2	2	2	-	2	3	2	-
5	3	2	3	1	2	-	-	2	1	2	-	2	3	2	-
Avg.	3	2	3	1	1.8	-	-	2	1.6	2	-	2	3	2	-

1 – Low, 2 – Medium, 3 – High

COURSE CODE	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

MODULE I PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES 9

Role of ground improvement in foundation engineering - Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils - Selection of suitable ground improvement techniques based on soil conditions.

MODULE II DEWATERING 9

Dewatering Techniques - Well points - Vacuum and electro osmotic methods - Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits - Design for simple cases.

MODULE III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 9

In-situ densification of cohesion less soils - Dynamic compaction – Vibro - flotation, Sand compaction piles and deep compaction; Consolidation of cohesive soils - Preloading with sand drains and fabric drains, Stabilization of soft clay ground using stone columns and lime piles- Installation techniques – Simple design - Relative merits of above methods and their limitations.

MODULE IV EARTH REINFORCEMENT 9

Concept of reinforcement - Types of reinforcement material - Reinforced earth wall - Mechanism – Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

MODULE V GROUTING TECHNIQUES 9

Types of grouts - Grouting equipment’s and machinery - Injection methods - Grout monitoring – Stabilization with cement, lime and chemicals - Stabilization of expansive soil.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze geotechnical challenges in alluvial, lateritic, and black cotton soils and recommend appropriate ground improvement techniques based on soil properties and project requirements.

CO2: Develop dewatering systems using wellpoints, vacuum, and electro-osmotic methods for efficient control of groundwater in construction projects, considering seepage analysis and practical limitations.

CO3: Select and design in situ densification consolidation techniques for cohesionless and cohesive soils, evaluating their relative merits and limitations.

CO4: Design and evaluate reinforced earth walls using various materials and mechanisms, considering applications in soil reinforcement and the functional roles of geotextiles in filtration, drainage, separation, road works, and containment.

CO5: Illustrate grouting procedures for soil stabilization with cement, lime, and chemicals, considering the treatment of expansive soils.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Soil Mechanics and Foundations (8th Edition)” by B. C. Punmia, Laxmi Publications, 2019.
2. “Dewatering in Building Construction (2nd Edition)” by Jacob Sandstedt, CRC Press, 2018.

REFERENCES:

1. “Principles of Foundation Engineering (7th Edition)” by D. P. Coduto, Prentice Hall, 2019.
2. “Grouting in Geotechnical Engineering (4th Edition)” by Paul I. Mayhew, ICE Publishing, 2019.
3. “Modern Ground Improvement Techniques (2nd Edition)” by Yoshitaka Ooi, CRC Press, 2019
4. “Ground Improvement Techniques (4th Edition)” by M. J. Tomlinson, CRC Press, 2018.
5. “Ground Improvement by Deep Mixing” by Yasushi Matsuda, Fumihiko Ohya, and Hideaki Igarashi, by John Wiley & Sons, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105108075

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2											3	1	
2	3	2	1										3	2	
3	3	2	2										3	2	
4	3	2											3	2	
5	3	2	3		2								3	2	
Avg.	**3**	**2**	**2**		**2**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF DEEP FOUNDATION	L	T	P	C
		3	0	0	3

MODULE I PILE CLASSIFICATIONS 9

Function - classification of piles - Factors governing choice of pile foundation - Load transfer principles - piling equipment and methods - changes in soil condition during installation of piles - requirement of code of practice - responsibility of engineer and contractor.

MODULE II AXIALLY LOADED PILES AND PILE GROUPS 9

Allowable load evaluation of piles and pile groups - Static method - cohesive - cohesion less soil – time effects - Dynamic method-pile driving formulae - Wave equation application – modelling – theoretical analysis - Interpretation of field test results and pile load test results - Settlement of Piles and Pile groups.

MODULE III LATERAL AND UPLIFT LOAD EVALUATION 9

Piles subjected to Lateral loads - Broms method, elastic -p-y curve analyses - Batter piles - response to moment - pile subjected to uplift loads - load -deformation behavior - Lateral and uplift load test data interpretation. Foundation on week compressible-collapsible soil – case studies.

MODULE IV STRUCTURAL DESIGN OF PILE AND PILE GROUPS 9

Pile foundation - structural design - pile cap analysis, pile - raft system basic interactive analysis - pile and pile groups subjected to vibrations - fundamental solutions.

MODULE V CAISSONS 9

Caissons types - Stability of caissons - principles of analysis and design, seismic influences.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate and select suitable pile foundation types and installation methods based on site-specific conditions, load requirements, and code specifications.

CO2: Estimate and assess the axial load capacity of single piles and pile groups using both static and dynamic methods, interpreting field and test data to make informed design decisions.

CO3: Analyze and design piles subjected to lateral and uplift loads using appropriate methods by considering soil-pile interaction and interpreting test data for safe and reliable foundation design.

CO4: Apply structural design principles to analyze and design pile caps, pile-raft systems, and pile groups subjected to static and dynamic load.

CO5: Illustrate and design different types of caissons for stability under various loading conditions, considering seismic influences and relevant design codes.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Design of Shallow and Deep Foundations” by Frank, R., Cuira, F., & Burlon, S. CRC Press, Taylors & Francis Group, 1st Edition, Taylor & Francis Ltd, 2021.

2. “Ground Improvement Techniques and Geosynthetics” by Manfred R. Hausmann, 4th Edition”, 2019.

REFERENCES:

1. “Advanced Foundation Engineering” by Murthy V.N.S., 2023.
2. “Deep Foundations in Coarse-Grained Soils” by John P. Turner and Harry G. Poulos, 2021.
3. “Analysis and Design of Advanced Foundation Systems” by Charles W. Wissa, David B. Peck, and Hsai-Yang Fang, 2020.
4. “Numerical Modeling in Geomechanics with Applications in Foundation Engineering” by Paolo Utili and Michele Flora, 2019.
5. “Pile Foundations in Engineering Practice” by Shamsher Prakash and Gopal Ranjan, 2019.

ONLINE RESOURCES:

1. www.nptel.ac.in courses

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3	2	
2	3	3			1								3	2	
3	3	3											3	2	
4	3	2	3										3	3	
5	3	2	2										3	2	
Avg.	**3**	**2**	**3**		**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	GEO ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PERSPECTIVE IN GEOENVIRONMENTAL ENGINEERING 9

Scope in Geo-Environmental Engineering - role of soil in geo environmental applications-phase behaviour of soil – importance of hydrogeology- sources and type of soil contamination – case studies in soil failure.

MODULE II CONTAMINANT TRANSPORT 9

Transport of contaminant in subsurface flow - advection, diffusion, dispersion – chemical process - biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization, biodegradation - characterization of contaminated sites - soil and rock data - hydrological and chemical data - analysis and evaluation – risk assessment – case studies.

MODULE III REMEDIATION OF CONTAMINATED SITES 9

In-situ contaminant - vertical and horizontal barrier - surface cover - ground water pumping system on subsurface drain – soil remediation - soil vapour extraction, soil waste stabilization, solidification of soils, electro-kinetic remediation, soil heating, bio remediation, Phyto- remediation - ground water remediation - pump and treat, In-situ flushing, permeable reacting barrier, In-situ air sparing - case studies.

MODULE IV LANDFILLS AND SURFACE IMPOUNDMENTS 9

Source and characteristics of waste - site selection for landfills - components of landfills – liner system - soil, Geo-membrane, Geo-synthetic clay, Geo-composite liner system – leachate collection - final cover design - monitoring the geo liners in landfill.

MODULE V STABILISATION OF WASTE 9

Hazardous waste control and storage system - stabilization/ solidification of wastes - micro and macro encapsulation - absorption, adsorption, precipitation- detoxification – mechanism stabilization - organic and inorganic stabilization - utilization of solid waste for soil improvement Case studies.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Evaluate the role of soil and hydrogeology in environmental challenges, analyse case studies of soil failure, and identify potential sources and types of soil contamination.

CO2: Analyze the transport of contaminants in the subsurface and various chemical and biological processes, to characterize contaminated sites and conduct risk assessments.

CO3: Select appropriate remediation techniques for contaminated soil and groundwater, considering the environmental impact, and analyze case studies of remediation projects.

CO4: Enumerate landfill components by considering site selection, waste characteristics, and regulatory requirements, and evaluate monitoring methods for geo-liners.

CO5: Illustrate stabilization techniques for hazardous and non-hazardous waste, utilizing micro/macro encapsulation, other processes, and evaluate the utilization of stabilized waste for soil improvement.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Geo environmental Engineering" by Richard H. Giroud and David R. Bowders, 4th Edition, 2023.
2. "Recent Advances in Geo-Environmental Engineering, Geomechanics and Geotechnics, and Geohazards" by Springer International Publishing, Kallel, Amjad, etal.2019.

REFERENCES:

1. "Environmental Geotechnics: Innovative Solutions and Management Practices" by Subba Rao R. Pothini and N. Krishna Pillai, 2023.
2. "Geotechnical Aspects of Mine Site Closure" by John D. Barnhisel, 2022.
3. "Landfill Geotechnics: Design, Operation, and Closure" by Richard D. Rowe, 2019.
4. "Sustainable Remediation of Contaminated Sites" by Edward K. Nyer, 2018.
5. "Geoenvironmental Engineering Handbook" by Robert D. Holtz, William D. Kovacs, and Thomas C. Sheahan, 4th Edition, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103025

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2					1						3		
2	3	2		1									3		
3	3	2	2										3	1	
4	3	2				1	2						3	1	
5	3	2	1			1	2						3	1	
Avg.	**3**	**2**	**2**	**1**		**1**	**2**						**3**	**1**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SLOPE STABILITY AND LANDSLIDES	L	T	P	C
		3	0	0	3

MODULE I STABILITY OF SLOPES **9**

Introduction – Importance – General characteristics – Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

MODULE II STABILITY ANALYSIS **9**

Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations – Evaluation of pore water pressure.

MODULE III IRREGULAR SLOPES **9**

Non-uniform soils – Janbu's analysis – Taylor's analysis – Bishop's analysis – Total stress and effective stress approaches – Composite surfaces of sliding – Block sliding.

MODULE IV LAND SLIDES **9**

General Characteristics – Sources–Stability of Hill side slopes – Open cuts – Engineering problems involving the stability of slopes – Cuts in sand – Cuts in loess – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows – Clays containing pockets and sand masses – Slides in stiff clay slopes on shale – Slopes on weathered rock; talus slopes, slopes on over consolidated clays – Slides along coastal areas and tropically weathered residual soils – Long term stability of clay slopes.

MODULE V FIELD OBSERVATIONS AND SLOPE STABILIZATION **9**

Field instrumentation – Observation studies during construction – Post construction, piezometers – Settlement plates – Inclinometer – Case histories. Compaction of new embankments – Compaction of natural masses of soil and existing fills – Compaction of deep deposits of sand – Vibroflotation – Compaction of compressible soils – Drainage as a means of stabilization – Use of Geotextiles – Soil nailing.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Gain knowledge about the purpose of computing slope stability.

CO2: Ability to analyse stability of slopes in cohesive and cohesionless soils.

CO3: Familiar on the analysis of irregular slopes with different approaches.

CO4: Reasoning about causes of landslides in different soil conditions.

CO5: Understand the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Landslides: theory, practice and modelling" by Pradhan, Sarada Prasad, Vikram Vishal, and Trilok Nath Singh, eds. Springer International Publishing, 2019.

2. “Soil strength and slope stability” by Duncan, J. Michael, Stephen G. Wright, and Thomas L. Brandon, John Wiley & Sons, 2014.

REFERENCES:

1. “Slope analysis” by Chowdhury, D.F., Prentice Hall, 1988.
2. “Foundation Engineering Handbook” by Winterkorn, H.F. and Fang, H.Y., Van Nostrand Reinhold, 1994.
3. “The Stability of Slopes” by Bramhead, E.N., Blacky Academic and Professionals Publications, Glasgow 1986.
4. “Slope Stability” by Anderson, M.G., and Richards, K.S., John Wiley, 1987.
5. “Landslides and their contro” by Zaruba, Quido, and Vojtěch Mencl. Elsevier, 2014.
6. “Slope analysis” by Chowdury, R. Elsevier, 2012.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	3			1								3	2	
3	3	3											3		
4	3	2											3		
5	3	2		1									3	1	
Avg.	**3**	**2**		**1**	**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	EARTH RETAINING STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I EARTH PRESSURE THEORIES **9**

State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann's method) – Active and passive cases – Earth pressure due to external loads.

MODULE II STABILITY OF RETAINING STRUCTURES **9**

Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.

MODULE III SHEET PILE WALLS **9**

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.

MODULE IV SUPPORTED EXCAVATIONS **9**

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic design concepts - Slurry Supported Trenches-Basic principles – Slurry characteristics – Specifications – Diaphragm walls – stability Analysis.

MODULE V STABILITY OF SLOPES **9**

Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method etc. Special aspects of slope analysis, stability charts. Role of geosynthetics in stabilization of slopes.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Gain knowledge about the purpose of computing slope stability.

CO2: Ability to analyse stability of slopes in cohesive and cohesionless soils.

CO3: Familiar on the analysis of irregular slopes with different approaches.

CO4: Reasoning about causes of landslides in different soil conditions.

CO5: Understand the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Earth Retaining Structures, 7th Edition", Christopher J. Elias and Christopher R. I. Clayton, 2023.
2. "The engineering of foundations, slopes and retaining structures Salgado", Rodrigo. CRC Press, 2022.

REFERENCES:

1. “Gravity Retaining Walls” by David C. Onyemeluk, 2023.
2. “Ground Improvement Techniques and Geosynthetics” by Manfred R. Hausmann, 4th Edition, 2019.
3. “Design and Construction of MSE Walls and Reinforced Slopes” by David C. Bathurst and Ilan Juran, 2nd Edition, 2019.
4. “The Earthworks Handbook” by James Wright, 4th Edition 2018.
5. “Geosynthetic Engineering for Slopes” by Amarjit Singh, 2nd Edition, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105106052

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2											3		
2	3	2			1								3	2	
3	3	3	2										3	3	
4	3	2											3	1	
5	3	2		1									3	1	
Avg.	**3**	**2**	**2**	**1**	**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	FOUNDATIONS IN EXPANSIVE SOILS	L	T	P	C
		3	0	0	3

MODULE I GENERAL PRINCIPLES **9**

Origin of expansive soils – Physical properties of expansive soils –Mineralogical composition – Identification of expansive soils – Field conditions that favour swelling – Consequences of swelling.

MODULE II SWELLING CHARACTERISTICS **9**

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

MODULE III TECHNIQUES FOR CONTROLLING SWELLING **9**

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Pre wetting – Soil replacement – Sand cushion techniques – CNS layer technique.

MODULE IV FOUNDATIONS ON EXPANSIVE SOILS **9**

Belled piers – Bearing capacity and skin friction –Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

MODULE V MODIFICATION OF SWELLING CHARACTERISSTIC **9**

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze the behavior of expansive soils, predicting potential swelling and its consequences on structures.

CO2: Evaluate the swelling potential of expansive soils through laboratory testing and predict heave using appropriate methods.

CO3: Select appropriate techniques to control swelling potential based on site conditions and project requirements.

CO4: Design belled piers and under-reamed piles for expansive soils, considering their advantages, limitations, and specific design considerations.

CO5: Evaluate and select chemical stabilization techniques for expansive soils, considering their mechanisms, limitations, and construction methods.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Expansive Soils: Problems and Solutions” by M. Basarat Ali and V. Sivakumar, 2018.
2. “Soils and Geotechnology in Construction” by Lutenegger, Alan J’ CRC Press, 2019.

REFERENCES:

1. “Geotechnical Engineering in Expansive Soils” by D. Nelson and Der-Chung Donald Liu, 2019.
2. “Expansive Soils: Problems and Practice in Foundation Engineering” by Murthy V.N.S., 2021.

3. “Foundation Engineering in Expansive Soils” by B.B. Kale and S.N. Murthy, 2020.
4. “Expansive Soils: From Problem Child to Reliable Partner” by Prashant Nath and Manoj R. Dixit, 2018.
5. “Analysis and Design of Substructures: Limit State Design Saran” by Swami, Oxford and IBH Publishing, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103214

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	2			1								3		
3	3	2	2										3	1	
4	3	2	3										3	2	
5	3	2	2										3	1	
Avg.	**3**	**2**	**2**		**1**								**3**	**1**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PLANNING OF SOIL EXPLORATION 9

Exploration methods for different projects - methods of borings-penetration tests-pressure meter test, field vane shear test-field permeability test-rock boring, preservation, shipment and storage of samples.

MODULE II SHALLOW FOUNDATIONS 9

Requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes.

MODULE III PILE FOUNDATIONS 9

Methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

MODULE IV WELL FOUNDATION 9

Belled piers – Bearing capacity and skin friction –Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

MODULE V FOUNDATIONS ON PROBLEMATIC SOILS AND COFFERDAMS 9

Foundations for collapsible and expansive soil Cofferdams-various types, analysis and design Foundations under uplifting loads.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply an appropriate soil exploration program for different project types, selecting suitable methods for data acquisition, interpretation, and sample handling.

CO2: Analyze shallow foundations by considering bearing capacity, settlements, and code requirements, utilizing field test data for practical application.

CO3: Design pile foundations for axial and lateral loads, and load-settlement characteristics, implementing analytical methods.

CO4: Evaluate well foundations by considering Terzaghi's method, lateral stability, uplift, and design individual components, recognizing measures for rectification.

CO5: Select and design foundations for collapsible and expansive soils cofferdams, and evaluate foundations under uplifting loads, considering design strategies.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Advanced Foundation Engineering” by V. N. S. Murthy, 2023.
2. “Advanced Geotechnical Engineering: Soil, Rock, and Earthquake Engineering” by Donald P. Coduto, 2021.

REFERENCES:

1. "Deep Foundations in Coarse-Grained Soils" by John P. Turner and Harry G. Poulos, 2021.
2. "Analysis and Design of Advanced Foundation Systems" by Charles W. Wissa, David B. Peck, and Hsai-Yang Fang, 2020.
3. "Deep Foundations for Offshore Wind Turbines" by Brian L. Klosek and James R. Snedker, 2020.
4. "Micropile Design and Construction" by David P. Day, 2019.
5. "Ground Improvement Techniques and Geosynthetics", by Manfred R. Hausmann, 4th Edition, 2019.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/105/105105207

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	3			1								3	2	
3	3	3	2										3	2	
4	3	3	2										3	2	
5	3	3	3										3	2	
Avg.	**3**	**3**	**2**		**1**								**3**	**2**	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	REINFORCED SOIL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT 9

Historical Background – Principles - Concepts and Mechanisms of reinforced earth – Soil – Geosynthetics interaction mechanism – interface resistance – Factors influencing interaction – Strain compatibility.

MODULE II REINFORCING MATERIALS AND THEIR PROPERTIES 9

Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibers - facing elements – Influence of environmental factors on the performance of Geosynthetic materials – Physical – Mechanical – Hydraulic and Endurance properties testing.

MODULE III DESIGN FOR SOIL REINFORCEMENT AND SEPARATION 9

Reinforcing the soil - Geotextiles and Geogrids –Retaining wall – embankment - unpaved roads – paved roads – railway tracks – Shallow foundations – seismic aspects.

MODULE IV DESIGN FOR FILTRATION, DRAINAGE AND CONTAINMENT 9

Geotextile filter – Filtration Mechanism – Factors affecting filter behaviour – Filtration design – Drains – Drainage in embankments – erosion control silt fences – Containment ponds – Reservoirs and Canals – Hydraulic tunnels – River bed and bank protection.

MODULE V DESIGN OF REINFORCED SLOPES 9

Type and orientation of Geosynthetics – Function of reinforcement against slope failure – Stability analysis – Design aspects – Embankments – Basal reinforcement – seismic aspects – General construction aspects.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze the interaction between soil and geosynthetics in reinforced soil structures, identifying factors influencing their performance and ensuring strain compatibility.

CO2: Select and evaluate appropriate geosynthetic materials for specific applications in reinforced soil structures, considering their properties, parameters and testing methods.

CO3: Design reinforced soil structures for various applications using geotextiles and geogrids, considering seismic aspects and construction guidelines.

CO4: Assess the geotextile filters, drainage systems, and containment structures, considering filtration mechanisms, hydraulic properties, and erosion control measures.

CO5: Develop and design reinforced slopes, selecting appropriate geosynthetics, evaluating their reinforcement function, and incorporating seismic considerations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Reinforced Soil and Mechanically Stabilized Earth” by Christopher J. Elias, Christopher R. I. Clayton, and Peter B. Flygare, 7th Edition, 2019.

2. “Geosynthetic reinforced soil (GRS) walls” by Wu, Jonathan T H., John Wiley & Sons, 2019.

REFERENCES:

1. "Reinforced Soil Structures" by C.J.F.P. Jones & P.J. Zweifel, by CRC Press, 2019.
2. “Ground Improvement Techniques and Geosynthetics” by Manfred R. Hausmann, 2019.
3. “Design and Construction of MSE Walls and Reinforced Slopes” by David C. Bathurst and Ilan Juran, 2nd Edition, 2019.
4. "Ground Improvement Techniques" by M.J. Tomlinson, by CRC Press, 2018.
5. "Geosynthetics and their Applications" by Berndt, J.P., Adam, D., & Bell, J.R., by Wiley-Blackwell, 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/106/105106052/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2											3		
2	3	2											3		
3	3	2	2										3	1	
4	3	2	2										3	1	
5	3	3	3										3	2	
Avg.	3	2	2										3	1	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	STRENGTH AND DEFORMATION BEHAVIOUR OF SOILS	L	T	P	C
		3	0	0	3

MODULE I SHEAR STRENGTH OF COHESIONLESS SOILS 9

Introduction-Shear strength of soil-cohesion-angle of internal friction-Shear strength of granular soils - Direct shear - Triaxial Testing- Drained and undrained Stress-strain behaviour - Dilation, contraction and critical states - Liquefaction and cyclic mobility of saturated sands. Factors influencing stress – strain characteristics – shear strength.

MODULE II SHEAR STRENGTH OF COHESIVE SOILS 9

Shear strength of normally consolidated and over consolidated clays - Stress-strain behaviour - Total stress and effective stress approach - Triaxial testing and stress path plotting - pore pressure parameters of Skempton and Henkel - shear strength of partially saturated clay in terms of stress state variables. Factors influencing stress – strain characteristics – shear strength.

MODULE III FAILURE THEORIES 9

Concepts of yield and failure in soils- Failure theories of Von Mises, Tresca and their extended form, their applicability to soils - Detailed discussion of Mohr - Coulomb failure theory.

MODULE IV CONSTITUTIVE MODEL AND DEFORMATION MODULUS OF SOILS 9

Constitutive law for soil – linear, nonlinear model- hyperbolic idealization – Mohr-Columb model Hardening law-Hardening soil model- Hardening soil model with small strain stiffness- Soft soil - Soft soil model - limitation of all models- Deformation modulus for different type of loadings – Poisson's ratio.

MODULE V CRITICAL STATE SOIL MECHANICS 9

The critical state line- Roscoe's surface- Hvorslev's surface- Behavior of sand- Effects of dilation-Limitations of Taylor model- Elastic and plastic deformation-Camclay critical state model- Modified Camclay model- Parameters for design

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Select the shear strength parameters of cohesionless soil based on mode of shear, drainage conditions and differentiate the cyclic stress – strain behaviour of cohesionless soil due to earthquake loading.

CO2: Select the shear strength parameters of cohesive soil based on mode of shear, drainage conditions, degree of saturation and degree of consolidation

CO3: Apply different failure criteria and its applicability based on drainage conditions and type of soil.

CO4: Apply constitutive models for soils and their applicability for different type of drainage conditions.

CO5: Explain critical state behaviour, modelling of soils and to select the respective design parameters.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "An Introduction to Geotechnical Engineering" by Robert D. Holtz., William D. Kovacs., Thomas C. Sheahan., Dorling Kindersley India pvt. Ltd., Second edition, 2013.
2. "Advanced soil mechanics" by Braja, M, Das., CRC Press, fifth edition, 2019.

REFERENCES:

1. "Introduction to critical state soil mechanics" by Atkinson J.H. and Brandsby P.L. McGraw Hill, 1978.
2. "Soil Mechanics in S.I. Units" by Lambe, T.W. and Whitman R.V. John Wiley, India, Pvt Ltd. 2008.
3. "Soil behaviour and Critical State Soil Mechanics" by Wood, D.M., Cambridge University Press, New York, 1990.
4. "Soil Mechanics Principles and Practices" by Graham Barnes, Macmillan Press Ltd., London, 2002.
5. "Principles of Geotechnical Engineering" by Braja, M. Das, Brooks/Cole, Thomson Learning Academic Resource, Center, Fifth Edition, 2002.
6. "A guide to soil mechanics" by Malcolm D. Bolton, Universities Press (India) Private Ltd., Hyderabad, India, 2003.
7. "Elements of Soil Mechanics" by Ian Smith, John Wiley & Sons, UK, 9th edition, 2014.
8. "Fundamentals of Geotechnical Engineering" by Braja, M. Das, Brooks/Cole, Thomson Learning Academic Resource, Center, 2000.
9. "Soil Mechanics and Foundations" by Muni Budhu, John Wiley and Sons, Inc., third edition, 2011.
10. "Soil Mechanics and Foundations" by Punmia.B.C., Ashok K.Jain, Arun K.Jain., Lakshmi Publications, seventeenth edition, 2017.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2			2								3		
2	3	2			2								3		
3	3	2	2		2								3		
4	3			2	2								3		
5													3		
Avg.	3	2	2	2	2								3		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SUBSURFACE INVESTIGATION AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

MODULE I PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS 9

Scope and objectives, planning of exploration program - methods of exploration - exploration for preliminary and detailed design, spacing and depth of bores, data presentation. - Geophysical exploration and interpretation - reflection, refraction and resistivity: Spectral analysis of surface waves (SASW), Multichannel Analysis of Surface Waves (MASW), cross hole– up hole - down hole methods.

MODULE II EXPLORATION TECHNIQUES 9

Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, offshore drilling, limitations of various drilling techniques, stabilization of boreholes, bore logs.

MODULE III SOIL SAMPLING 9

Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling of samples.

MODULE IV FIELD TESTING IN SOIL EXPLORATION 9

Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, correction and data interpretation of all methods.

MODULE V INSTRUMENTATION 9

Instrumentation in soil engineering, functional components of data acquisition system - strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements - slope indicators, sensing units, case studies.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- **CO1:** Plan the subsurface investigation program for a given project also capable of extending consultancy service for real time Soil Mechanics and Foundation Engineering problems
- **CO2:** Apply the knowledge of different methods of exploration to select appropriate method of boring for investigating real field condition.
- **CO3:** Apply the knowledge of different sampling techniques to collect, store and transport soil samples from onshore and offshore to meet specified needs and also to characterise the soil.
- **CO4:** Carryout appropriate field test to arrive at required soil parameters for the design of geotechnical structures considering all the influential parameters
- **CO5:** Plan the instrumentation programme, execute the same in the field and monitor the performance of geotechnical structures to ensure its stability during its life time. Also conduct research pertinent to soil mechanics and foundation engineering as well as engage in independent life-long learning

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Geotechnical Investigation Methods” by Roy E. Hunt, CRC Press Inc; 1st edition, 2006
2. “Geotechnical Engineering Investigation Manual” by Hunt, R.E., McGraw Hill,1984.

REFERENCES:

1. “Soil Engineering in Theory and Practice” by Alam Singh and Chowdhary, G.R., Volume-2, Geotechnical testing and instrumentation, CBS Publishers and Distributors, New Delhi, 2006.
2. “Pressuremeter Testing Methods and Interpretation” by Nair, R.J. and Wood, P.M., Butter worths, 1987.
3. “Geotechnical Instrumentation for Monitoring Field Performance” by Dunnicliff, J., and Green, G.E., John Wiley, 1993.
4. “Field Instrumentation in Geotechnical Engineering” by Hanna, T.H., Trans Tech., 1985.
5. “Geotechnical and Foundation Engineering, Design and Construction” by Day, R.N., McGraw Hill, 1999.
6. “Foundation Analysis and Design” by Bowles, J.E., Fifth Edition, The McGraw-Hill companies, Inc., New York, 1995.
7. “Site Investigation” by Clayton C. R. I., Matthews M. C. and Simons N. E., Second Edition Halsted Press, 1982.
8. “Foundation Engineering Hand Book” by Winterkorn, H.F. and Fang, H.Y., a Nostrand Reinhold 1994.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2											3	1	
2	2				2								3		
3	2				2								3		1
4	2	2		2									3		
5							2					2	2		1
Avg.	2	2		2	2		2					2	3	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SHALLOW FOUNDATION	L	T	P	C
		3	0	0	3

MODULE I FOUNDATION DESIGN DECISIONS **9**

Types of foundation – Types of Shallow foundation, their applicability – Selection of type of foundation – conceptual design principles – General and additional considerations – Depth of foundations – IS codal provisions.

MODULE II BEARING CAPACITY **9**

Theories of bearing capacity – Ultimate and Safe Bearing capacities in Homogeneous - Layered soil sand Rocks - Evaluation of bearing capacity from in-situ tests– Bearing capacity of foundations in slopes – Bearing capacity under eccentric loading – partial safety factor approach - Codal provisions.

MODULE III SETTLEMENT AND ALLOWABLE BEARING PRESSURE **9**

Component of settlement – Influence of foundation stiffness approach to settlement computations - immediate, primary and secondary consolidation settlement - stress path method of settlement evaluation - layered soil. Evaluation from in-situ tests – Allowable settlement – Allowable bearing pressure - codal provisions.

MODULE IV INTERACTIVE ANALYSIS AND DESIGN OF FOUNDATIONS **9**

Analysis of foundation - isolated - strip - combined footings - Flat raft – Stiffened raft foundations. Conventional - elastic approach - Soil Structure Interaction Principles – Elastic half space approach - Winkler foundation – Structural design of Shallow foundation – Codal provisions.

MODULE V FOUNDATION FOR SPECIAL CONDITIONS **9**

Foundation design in relation to ground movements - Foundation on compressible fills, expansive soils – Foundation for tower – special considerations for foundation for seismic zones and offshore environment. - Codal Provisions.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Differentiate various type of shallow foundations, their selection, design principles for different ground conditions

CO2: Apply appropriate bearing capacity theory and factors for different type of loading and ground conditions

CO3: Decide the design bearing pressure based on settlement, mode of loading and ground conditions

CO4: Perform interactive analysis for different types of shallow foundation and ground conditions

CO5: Perform analysis for different types of special foundation and special ground conditions

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Shallow Foundations" by Braja M.Das, CRC Press; 2nd edition, 2019

2. "Foundation Analysis and Design" by Bowles, J.E., 5th Edition, McGraw Hill, New York, 1995.

REFERENCES:

1. "Design of Foundation Systems, Principles and Practices" by Nainan P. Kurian, Narosa Publishing House, Third Edition, 2006.
2. "Elements of Soil Mechanics" by Ian Smith, John Wiley & Sons, UK, 9th edition,2014
3. "Geotechnical Engineering Handbook" by BrajaM.Das, J.Ross Publishing, Cengage Learning India Pvt Ltd, 2010
4. "Analysis of Structures on Elastic Foundations" by Edward Tsudik, J.Ross Publishing, Cengage Learning India Private limited, Delhi, 2013.
5. "Theory and Practice of Foundation Design" by Som.N.N., Das.S.C., PHI learning private Ltd, Delhi, 2013.
6. "Foundation Design in Practice" by Karuna Moy Ghosh, PHI learning private Ltd, Delhi, 2009.
7. "Design of Reinforced Concrete Foundations" by Varghese, P.C., Prentice-Hall of India, New Delhi, 2009.
8. "Analysis and Design of Shallow and Deep Foundations" by Reese,L.C., Isenhower,W.M. and Wang,S.T., John Wiley and Sons, New York, 2005.
9. "Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II" by John Burland, Tim Chapman, Hilary Skinner, Michael Brown., ICE Publishing, UK., 2012.
10. "The Engineering of Foundations" by Salgado,R., Tata McGraw Hill Education Private Limited, New Delhi, 2011.
11. "Foundation Design: Principles and Practices" by Donald P. Coduto, 2nd edition, 2014
12. "Shallow foundation - Bearing capacity and settlement" by Braja M.Das., CRC Press, third edition, 2017.
13. "Design of Reinforced Concrete Foundations" by Varghese, P.C., Prentice-Hall of India, New Delhi, 2009.
14. "Soil Dynamics and Machine Foundation" by Swami Saran, Galgottia Publications Pvt. Ltd., New Delhi-110002, 1999.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3											3		
2	3	3											3	1	
3	3	3	3				1						3		
4			3										3		
5													2		
Avg.	3	3	3				1						3	1	

1 – Low, 2 – Medium, 3 – High

COURSE CODE	EARTH AND ROCK FILL DAMS	L	T	P	C
		3	0	0	3

MODULE I DESIGN CONSIDERATION **9**

Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control pore pressure.

MODULE II SLOPE STABILITY AND SEEPAGE ANALYSIS **9**

Stability of infinite and finite slopes, Method of Slices, Bishop's method, Flow nets, Stability conditions during construction, Full reservoir and drawdown - cut off walls – Trenches – Importance of drainage and filters.

MODULE III HYDRAULIC FRACTURING **9**

Introduction, Conditions and mechanisms for hydraulic fracturing, Failure criterion for hydraulic fracturing – cubic specimen with a crack – core with a transverse crack – core with a vertical crack, strike–dip of easiest crack spreading; factors affecting hydraulic fracturing, self-healing of a core crack.

MODULE IV FAILURE AND DAMAGES **9**

Failure and damages, Nature and importance of failures in embankment and foundation - Piping, Differential settlement, Foundation slides, Earthquake damage, creep and anisotropic effects, Reservoir wave action, Dispersive piping.

MODULE V SLOPE PROTECTION MEASURES **9**

Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Application of Geosynthetic materials in filtration. Treatment of rock foundation, Construction Techniques, Quality control and performance measurement

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Assess the causes of failure and damage of embankments and slopes.

CO2: Apply the knowledge of engineering and analyse the stability of slopes for various seepage conditions and apply the concept in the design of earth and rock fill dams.

CO3: Apply the knowledge of engineering and assess the stability of dam against hydraulic fracturing and suggest suitable remedial measure.

CO4: Understand the nature of failures and damages in earth and rock fill dams and apply the concept in field to avoid distress.

CO5: Recommend suitable remedial measures to protect the slopes and implement quality control and monitor its performance

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Geotechnical and Geoenvironmental Engineering Handbook" by Rowe, R.K., Kulwer Academic Publishers, 2001.

2. “Earth and Rock-Fill Dams: General Design and Construction Considerations” by U S Army Corps of Engineers, University Press of the Pacific, 2004

REFERENCES:

1. “Earth and Earth rock dam” by Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., John Wiley, 1963.
2. “Slope analysis” by Chowdhury, D.F., Prentice Hall, 1988.
3. “Essentials of Soil Mechanics and Foundations: Basic Geotechnics” by McCarthy, D.F., Sixth Edition, Prentice Hall, 2002.
4. “The Stability of Slopes” by Bramhead, E.N., Blacky Academic and Professionals Publications, Glasgow, 1986.
5. “Engineering Developments and Applications” by Chandhar, R.J., Thomas Telford, 1991
6. “Designing with Geosynthetics” by Koerner, R.M., Third Edition, Prentice Hall, 1997.
7. “Hydraulic Fracturing in Earth-rock Fill Dams” by Jun-Jie Wang, John Wiley & Sons, 2014.
8. “Slope Stability” by Anderson, M.G., and Richards, K.S., John Wiley, 1987.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3												3		
2	3												3	3	
3	3		3			2							3		
4						2							3		
5						2	2			3					2
Avg.	3		3			2	2			3			3	3	2

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I PERSPECTIVES OF SOLID WASTE 9

Definition, sources, and types of solid waste - Comparison of waste generation in India and other developed countries - Per capita generation rates - Sampling and characterization of solid waste - Composition of solid waste: physical (Individual contents, size, moisture content, and density) and chemical (energy and chemical content) - Typical composition of Indian MSW - Functional elements of SWM system -Legislation and responsibilities - Integrated solid waste management.

MODULE II COLLECTION AND TRANSPORT OF SOLID WASTE 9

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing - Collection services: municipal and commercial - Industrial services - Collection systems: hauled-container system (HCS) and stationary container system (SCS) - Vehicle and labor assessment - Assessment of collection route - Transfer and transport - Transfer station location - Means and methods of transfer.

MODULE III PROCESSING AND DISPOSAL OF SOLID WASTE 9

Definition and necessity - Volume reduction: manual separation, mechanical, and thermal - Land filling method: site selection methods and operations, leachate and gas generations, and movement and control of gas and leachate - Design and operations of landfills - Land farming, deep well injection, and ultimate disposal techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes - Vermi-composting application.

MODULE IV PERSPECTIVES OF HAZARRDOUS WASTE 9

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste - Typical hazardous wastes in MSW- TCLP test - Hazardous waste management: minimization, collection, storage, handling, transport (manifest), and compatibility – National and International legislation for hazardous waste management.

MODULE V TREATMENT AND DISPOSAL OF HAZARDOUS WAST 9

Necessity and types of treatment - Objectives, principles, operations, analysis of solidification, encapsulation, chemical oxidation, incineration, and microwave-plasma detoxification techniques - Planning, operation, design and analysis of hazardous waste landfills, landfill remediation.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze and compare the sources and types of solid waste and its regulatory framework.

CO2: Discuss the various systems of collection and transport of solid waste.

CO3: Compare and contrast volume reduction techniques, evaluate landfill design and operation methods.

CO4: Describe the identification and characterization of hazardous waste.

CO5: Apply the basic scientific principles for solving practical waste management challenges.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Environmental Engineering” by LaGrega et al. M, 2020.
2. “Environmental Engineering” by Peavy, Rowe, Tchobanoglous, McGraw Hill Publishers, New Delhi, 2017.

REFERENCES:

1. “Hazardous Waste Management” by Borthakur, A. CRC Press, 2019.
2. “Manual on Municipal Solid waste management" by CPHEEO, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2016.
3. “Solid Waste Management" by Agarwal, A., & Singh, R. K., Tata McGraw-Hill Education, 2009.
4. “Solid Waste Management in India" by Lakshmanan, S. T., 2014.
5. “Solid Waste Management" Venugopal, T., & Rao, K. S, PHI Learning Private Limited, 2013.

ONLINE RESOURCES:

1. https://www.wasterecycling.org/: https://www.wasterecycling.org/
2. https://ec.europa.eu/environment/waste/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					3							2		
2	1		1										2		
3	2		2										2		
4	2						3						1		
5	3		2										2		
Avg.	2		2			3	3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

MODULE I ENVIRONMENTAL IMPACT ASSESSMENT PERSPECTIVES 9

Definition, sources, and types of solid waste - Comparison of waste generation in India and other developed countries - Per capita generation rates - Sampling and characterization of solid waste - Composition of solid waste: physical (Individual contents, size, moisture content, and density) and chemical (energy and chemical content) - Typical composition of Indian MSW - Functional elements of SWM system -Legislation and responsibilities - Integrated solid waste management.

MODULE II ASSESSMENT AND MONITORING 9

Environmental setting - environmental impact assessment methodology- cost benefit analysis, environmental indices and indicators for describing affected environment, Life cycle assessment. Role of remote sensing and GIS in Environmental Impact Assessment.

MODULE III SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Types, steps in performing socio-economic impact assessment, analysis of public services and facilities impacts, social impacts, impacts of economic profile of the community.

MODULE IV ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental Management Plan - preparation, implementation and review - Mitigation and Rehabilitation Plans - Policy and guidelines for planning and monitoring programmes - Post project audit - Ethical and Quality aspects of Environmental Impact Assessment.

MODULE V SECTORAL ENVIRONMENTAL IMPACT ASSESSMENT 9

EIA related to the following sectors - Infrastructure -construction and housing Mining - Industrial-Thermal Power - River valley and Hydroelectric Projects-Nuclear Power- EIA for coastal projects.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the overall perspectives of Environmental Impact Assessment.

CO2: Design the necessary tools pertaining to assessment of various impacts.

CO3: Recognize and synthesis the diversified socio-economic impacts on the society.

CO4: Design and develop the significant protocols for Environment Management Plan.

CO5: Synthesize and discretise the various impacts originating from typical developmental projects.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Environmental Impact Assessment Methodologies” by Peter W. Rauch, CRC Press, 2020.
2. “Environmental Impact Assessment” by Ramakrishnan J.G, Oxford University Press, 2020.

REFERENCES:

1. “Environmental Impact Assessmen”, 2nd Edition by James Glasson, John R. Treweek, and Andrew Becker, 2020.
2. “Handbook of Environmental Impact Assessment” by Peter W. Frazier, 2020.
3. “Handbook of Environmental Impact Assessment” by R.K. Trivedi, 2018.
4. “Strategic Environmental Assessment” by Thomas Fischer, 2017.
5. “Environmental Law” by Roger E. Meiners and Lawrence E. Westling, 2017.

ONLINE RESOURCES:

1. https://www.iaia.org/
2. https://www.iied.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					3							2		
2			2		2								1		
3		2				3							2		
4			3				3						2		
5	2			2									2		
Avg.	2	2	3	2	2	3	3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	AIR AND WATER QUALITY MODELLING	L	T	P	C
		3	0	0	3

MODULE I MODELING CONCEPT **9**

Overview of different types of models-identification of dependent and independent variables-Deterministic and stochastic approach- Steps in model development-numerical and simulations models-calibration and validation of models- Limitations Transport phenomena- Mass balance analysis-Model development and decision making.

MODULE II AIR QUALITY MODELS **9**

Air quality parameters - air Quality Index -Types, modelling technique, modelling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models-diffusion models – Gaussian plume derivation- modifications of Gaussian plume equation- long term average-multiple cell model receptor oriented and source-oriented air pollution models- model performance, accuracy and utilization -air quality mapping.

MODULE III INDOOR AIR QUALITY MODELS **9**

Indoor Air Pollutants - Volatile Organic Compounds, Inorganic Gaseous Pollutants Respirable Particulates, Bio-aerosols, Radon and its decay products-Infectious disease transmission- A/C units in indoor- Odours and sick building syndrome-Indoor Air quality Models.

MODULE IV WATER QUALITY MODELLING **9**

Water quality parameters- water quality index- Historical development of water quality models - rivers and streams water quality modelling; Lakes and impoundments - water quality response to inputs; water quality modelling process - model sensitivity - assessing model performance.

MODULE V SOFTWARE MODELLING **9**

The principles and application of computer models for surface water quality, and air quality.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the significance and need for modelling.

CO2: Summarize the suggestions regarding the modelling to be adopted for different scenarios and also discuss the long-term uses of those models.

CO3: Assess indoor air quality risks associated with different pollutants.

CO4: Employ various modelling concepts to monitor the quality of polluted water and air in future.

CO5: Interpret and comprehend the adoptability of models for the scenario under study.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Air Quality Modelling: The Science and Application” by John Seinfeld and Spyros Pandis, John Wiley & Sons, 2023.
2. “Environmental Modelling: Integrating Ecology, Economics, and Management” by Andrew James, 2022.

REFERENCES:

1. "Atmospheric Dispersion Modelling" by Steven Hanna, John Wiley & Sons, 2023.
2. "Air Quality Modelling" by John Seinfeld and Spyros Pandis, Wiley-Interscience, 2022.
3. "Indoor Air Quality Handbook" by John Spengler, Michael Samet, and John McCarthy, (CRC Press), 2021.
4. "Water Quality Modelling: Advanced Methods" by L. Bengtsson et al, Academic Press, 2020.
5. "Water Quality Engineering" by Larry Mays, John Wiley & Sons, 2020.

ONLINE RESOURCES:

1. https://www.awma.org/
2. https://www.nalms.org/2023nmc/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						2						2		
2			2				3						2		
3	2						3						2		
4					3		3						2		
5		2			3								2		
Avg.	2	2	2		3		3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

MODULE I AIR POLLUTION SOURCES AND METEOROLOGY 9

Definitions - Sources and classification of pollutants - Natural and anthropogenic - Units and measurements - Air quality standards - Meteorology and air pollution - Atmospheric stability and inversions - Mixing height and plume behaviour - Effects of air pollution on human beings, vegetation, animals, materials, and climate.

MODULE II SAMPLING AND MODELING OF AIR POLLUTION 9

Concept and objectives of sampling - Averaging principle - Standard methods for major air pollutants in ambient air - Isokinetic sampling - Objectives of modelling - Types and uses of models - Design of stack height - Fixed-box and Gaussian dispersion models; and important considerations - Principles and application of multiple-cell model.

MODULE III CONTROL OF PARTICULATE MATTER 9

Basic devices of control - Objectives, applications, principles, process descriptions, analyses, design, essential considerations, performances, limitations, and modifications of gravity settler, cyclone separator, ESP, fabric filter, and co-flow venturi scrubber.

MODULE IV CONTROL OF GASEOUS POLLUTANTS 9

Basic devices of control - Objectives, applications, principles, process descriptions, analyses, design, essential considerations, performances, limitations, and modifications of absorption (both packed and plate columns), adsorption (only fixed-bed), combustion, and condensation processes - Typical adsorbents and scale-up procedure - Combustion kinetics - Assessment of air requirement and composition of combustion gas.

MODULE V INDUSTRIAL PROCESSES AND CONTROL STRATEGY 9

Objectives of control - Strategies and philosophies of air pollution control - typical industries and sources of pollutants from mining (both coal and copper), coal-based thermal power plant, cement industry, petroleum refineries, fertilizer industry, and iron and steel plants.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the classification of air pollutants and to understand their effects on environment and the human health.

CO2: Summarize the design concepts of various sampling techniques.

CO3: Demonstrate the working principle involved in the air pollutant control devices.

CO4: Employ the suitable air pollution prevention technologies for various particulates and gaseous pollutants.

CO5: Interpret and comprehend the general air quality monitoring and controlling practices in the various industries.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Air Pollution Control Engineering” by C.S. Rao, 5th Edition, 2022.
2. “Environmental Science and Engineering”, 5th Edition, by Gary W. Miller and Susan S. Hyatt, 2020.

REFERENCES:

1. “Environmental Pollution and Control” by K. Vesilind, A. R. Desai, and J. F. Gigliotti, Cambridge University Press, 2020.
2. “Air Quality Monitoring and Modelling” by P. Kumar and G. Singh, Elsevier, 2020.
3. “Air Pollution Control Engineering” by C. D. Cooper and F. C. Alley, Waveland Press, 2019.
4. “Fundamentals of Air Pollution” by Richard P. Pohanish, 4th Edition, 2018.
5. “Industrial Air Pollution Control” by C. E. Davis, Routledge, 2018.

ONLINE RESOURCES:

1. https://www.epa.gov/clean-air-act-overview/air-pollution-current-and-future-challenges
2. https://www.cdc.gov/nceh/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
2	2				2								2		
3	3						3						2		
4			3				3						2		
5	2						3						2		
Avg.	2		3		2		3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	INDUSTRIAL WASTEWATER TREATMENT AND MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I CONSTITUENTS IN WASTEWATER 9

Characteristics and analysis of wastewater - Physical, inorganic non-metallic, and metallic, organic, and biological - Toxicity constituents in wastewater - Advanced wastewater treatment - Unit operations and unit process.

MODULE II WASTEWATER MINIMIZATION AND REUSE 9

Waste volume reduction - Waste strength reduction - Standards for disposal of effluent on land and in inland waters - Need for zero discharge and zero damage - Wastewater reuse applications – Public health and Environmental issues in water reuse – Risk Assessment for water reuse – water reclamation technologies.

MODULE III WASTEWATER TREATMENT 9

Aerobic sequencing batch reactors - Attached growth denitrification process - Anaerobic suspended growth process - Anaerobic sludge blanket process - Attached growth anaerobic process.

MODULE IV PROCESS-BASED INDUSTRIAL WASTEWATER MANAGEMENT 9

Origin and characteristics of pollution - Process flow and treatment flow sheets of typical industries brewery, winery, distillery, dairy, textile dyeing, and oil refinery industries.

MODULE V MANUFACTURING-BASED INDUSTRIAL WASTE MANAGEMENT 9

Orgin and characteristics of pollution - Process flow and treatment flow sheets of typical industries: pulp and paper, fertilizer, pharmaceutical, sugar, iron and steel, petrochemical and tannery industries.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Outline the waste water characteristics and environmental implications of various industrial effluents.

CO2: Summarize the various pollution prevention options.

CO3: Assess the remedial technologies for removal of pollutants in industrial effluents.

CO4: Employ the design solutions for the treatment and disposal of treated effluents.

CO5: Implement and comprehend the pollution control methods for specific industries.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "IndustrialWastewater Treatment Processes Emerging Technologies and Practices" by J.N.S. Jayaweera, S. Ouki, N.M. Mubarak, 2020.
2. "Industrial Wastewater Treatment Handbook", 3rd Edition by Paul N. Cheremisinoff, 2023.

REFERENCES:

1. "Industrial Wastewater Management" by M. N. Rao and A. K. Datta, 2023.

2. “Physicochemical Treatment Processes for Water and Wastewater”, by Hua Jiang, et al., 2021.
3. “Biological Wastewater Treatment Processes” by Marcos von Sperling, 2020.
4. “Wastewater Engineering: Treatment and Reuse” by Metcalf & Eddy, 2020.
5. “Industrial Wastewater Management” by A.K. Chatterjee and S.C. Gupta, 2019.

ONLINE RESOURCES:

1. https://www.unep.org/resources/report/wastewater-turning-problem-solution
2. https://iwa-network.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2						3						2		
2			2				3						2		
3	3						3						2		
4			3				3						2		
5			3				3						2		
Avg.	3		3				3						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION **9**

Pollutants in water and wastewater–characteristics, Standards for performance - Significance of physic - chemical treatment – Selection criteria-types of reactor-reactor selection - batch-continuous type-kinetics.

MODULE II TREATMENT PRINCIPLES **9**

Physical treatment- Screening – Mixing, Equalization –Sedimentation – Filtration – Evaporation - Incineration–gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electro dialysis, distillation – stripping and crystallization– Recent Advances. Principles of Chemical treatment – Coagulation flocculation–Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, solvent extraction – advanced oxidation/reduction – Recent Trends.

MODULE III DESIGN OF MUNICIPAL WATER TREATMENT PLANTS **9**

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters–Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection-Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile ,PID - construction and O&M aspects – case studies, Residue management – Up gradation of existing plants – Recent Trends.

MODULE IV DESIGN OF INDUSTRIAL WATER TREATMENT PLANTS **9**

Design of Industrial Water Treatment Units-Selection of process–Design of softeners – De mineralisers – Reverse osmosis plants – Flow charts – Layouts – Hydraulic Profile, PID-construction and O&M aspects – case studies, Residue management – Up gradation of existing plants – Recent Trends.

MODULE V DESIGN OF WASTEWATER TREATMENT PLANTS **9**

Design of municipal wastewater treatment units – screens – detritors - grit chamber - settling tanks sludge thickening - sludge dewatering systems - sludge drying beds - Design of Industrial Wastewater Treatment Units - Equalization - Neutralization - Chemical Feeding Devices – mixers - floatation units - oil skimmer Flowcharts – Layouts – Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Up gradation of existing plants – Recent Trends.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply knowledge of water and wastewater pollutants, their characteristics, and relevant standards to select appropriate physicochemical treatment processes.

CO2: Analyze the principles and design considerations for various physical and chemical treatment unit operations like screening, mixing, sedimentation, filtration, adsorption, coagulation, and disinfection.

CO3: Design, layout, and optimize municipal water treatment plants, including unit operations, flow diagrams, hydraulic profiles, and construction considerations.

CO4: Design, layout, and optimize industrial water treatment plants, focusing on processes like softening, demineralization, and reverse osmosis, considering case studies and recent trends.

CO5: Design, layout, and optimize unit operations like screening, sedimentation, sludge thickening, and dewatering, while addressing retrofitting, residue management, and advancements in the field.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Wastewater Engineering, Treatment and Reuse", Metcalf and Eddy, Tata McGraw Hill, New Delhi, 2003.
2. "Water works Engineering – Planning, Design and Operation", Qasim,S.R., Motley, E.M and Zhu.G. Prentice Hall, New Delhi, 2002.

REFERENCES:

1. "Handbook of Environmental Engineering Calculations", Lee, C.C. and Shun dar Lin, McGraw Hill, New York, 1999.
2. "Hand Book of Water and Wastewater Treatment Plant operations", Spellman F.R., CRC Press, New York 2009.
3. "Fundamentals of Water Treatment Process", David Hendricks, CRC Press New York, 2011.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ch25/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	2	2	1	2	1	2	1	1	3	3	1
2	3	3	3	2	3	1	1	2	1	2	1	1	3	3	1
3	3	3	3	2	3	2	2	2	2	3	2	1	3	3	2
4	3	3	3	2	3	2	2	2	1	3	2	1	3	2	1
5	3	3	3	2	3	2	2	2	1	3	2	1	3	1	2
Avg.	3	**3**	**3**	**2**	**3**	**2**	**2**	2	1	3	2	1	3	2	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION 9

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment selection of process- reactors-batch-continuous type.

MODULE II AEROBIC TREATMENT OF WASTEWATER 9

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors- fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

MODULE III ANAEROBIC TREATMENT OF WASTEWATER 9

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

MODULE IV SLUDGE TREATMENT AND DISPOSAL 9

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

MODULE V CONSTRUCTION OPERATIONS AND MAINTENANCE ASPECTS 9

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Understand the principles of biological treatment processes, including aerobic and anaerobic systems, biological growth kinetics, and factors influencing growth.

CO2: Design and optimize aerobic wastewater treatment plants, encompassing various configurations like activated sludge, trickling filters, and rotating biological contactors, as well as nutrient removal and disinfection processes.

CO3: Design and optimize anaerobic wastewater treatment plants, focusing on both attached and suspended growth systems like UASBs and upflow anaerobic sludge blankets, including nutrient removal considerations.

CO4: Design and manage sludge treatment and disposal facilities, including thickening, digestion, biogas generation, dewatering methods, and ultimate residue disposal strategies.

CO5: Analyze the operational and maintenance challenges in biological treatment plants, including troubleshooting, planning, capacity building, retrofitting, and case study evaluation.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Wastewater Treatment for Pollution Control and reuse ", Arceivala S.J., and Asolekar S.R, McGraw Hill , third Edition, New Delhi, 2007.
2. "Wastewater Engineering – Treatment and Reuse", Metcalf & Eddy, INC Fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.

REFERENCES:

1. "Sewerage and Sewage Treatment", Manual, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. "Wastewater Treatment Plant, Planning, Design & Operation", Qasim. S. R., Technomic Publications, New York, 1994.
3. "Hand Book of Water and Wastewater Treatment Plant operations", F.R. Spellman, CRC Press, New York 2009.
4. "Fundamentals of Water Treatment Process", David Hendricks, CRC Press, New York 2011.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ch17/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	2	1	2	2	2	1	2	3	2	1
2	3	3	3	2	3	2	2	2	2	3	2	1	3	3	2
3	3	3	3	2	3	2	2	2	2	3	2	1	3	3	2
4	2	3	3	2	2	2	2	2	2	2	2	1	3	2	2
5	2	3	2	3	2	2	2	2	2	3	1	2	2	1	2
Avg.	3	3	2	2	2	2	2	2	2	3	2	1	3	2	2

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SUSTAINABLE DEVELOPMENT AND CLEANER PRODUCTION	L	T	P	C
		3	0	0	3

MODULE I SUSTAINABILITY 9

Industrialization and sustainable development; cleaner production (CP) in achieving sustainability; clean development mechanism; source reduction techniques: raw material substitution; process modification, process technology innovations; equipment modification; waste prevention and minimization of waste generation; reuse and recycling strategies; treatment and disposal; pollution prevention programs.

MODULE II CLEANER PRODUCTION 9

Overview of CP assessment steps and skills; fundamental analysis of material and energy flows; Green chemistry; identifying and reducing losses; new and low waste technologies; product modification; good housekeeping; resource recovery/by-product recovery from the manufacturing process by cleaner production technology (CPT).

MODULE III GREEN DESIGN 9

Green productivity - benefits and challenges; public policies and market-driven initiatives; adequate green specifications; energy-efficient design; green power; green materials, rating systems.

MODULE IV ENERGY AUDIT 9

Energy audit methodology; detail of Energy audit and energy conservation; energy conservation via cleaner technology options; use of clean fuels.

MODULE V CLEANER PRODUCTION TECHNOLOGY 9

Green Processes; implementation of CP and cleaner technology; typical case studies of cleaner production technology in chemical engineering industries.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply the principles of sustainable development and understand the role of cleaner production (CP) in achieving sustainability goals.

CO2: Analyse material and energy flows in industrial processes to identify opportunities for waste prevention and minimization through application of cleaner production techniques.

CO3: Implement green design principles and strategies in product development and manufacturing, encompassing energy-efficient design, green materials selection, and relevant rating systems.

CO4: Conduct energy audits to identify areas for energy conservation and implement cleaner technology options to improve energy efficiency.

CO5: Select appropriate cleaner production technologies for specific industrial processes, supported by case studies from chemical engineering industries.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Clean Technology and the Environment", Kirkwood RC and Longley, AJ(Eds), Chapman & Hall, 1995.

2. “Cleaner Production Audit, Course Material on Cleaner Production and Waste Minimization”, Modak P, Visvanathan C, and Parasnis M, United Nations Industrial Development Organization (UNIDP), 1995.

REFERENCES:

1. “Engineers Guide to Cleaner Production Technologies”, P. M. Randall, 1st edition, CRC Press, 1996.
2. “Green Chemistry: Environmentally Benign Reactions”, V. K. Ahluwalia, 2nd Edition, CRC Press, 2012.
3. “Clean Technology for manufacture of Specialty Chemicals”, W. Hoyleand and M. Lancaster, Royal Society of Chemistry, 2001.
4. “Energy Technology: Non-conventional; Renewable and Conventional’, Rao S and Parulekar BB, Khanna Pub. 2005

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_ch26/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	1	2	3	2	2	2	1	1	2	1	1
2	3	3	3	2	2	2	3	2	1	2	2	1	3	1	1
3	2	2	3	1	2	2	3	2	1	2	2	1	2	2	2
4	3	2	3	2	3	2	3	2	1	2	2	1	3	1	1
5	3	2	2	2	3	2	3	2	1	2	2	1	2	1	1
Avg.	3	2	2	2	2	2	3	2	1	2	**2**	1	2	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	OCCUPATIONAL HEALTH, SAFETY AND RISK ASSESSMENT	L	T	P	C
		3	0	0	3

MODULE I OCCUPATIONAL HEALTH 9

Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration, Ergonomics, constituents of ergonomics, application of ergonomics for safety & health, occupational diseases due to metals & dusts, fumes & chemical compounds.

MODULE II OCCUPATIONAL HAZARD AND CONTROL PRINCIPLES 9

Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation. Program Workers' Compensation - Unsafe Acts vs. Unsafe Conditions.

MODULE III ELECTRICAL SAFETY AND FIRE PREVENTION 9

Standard and Lockout/ Tagout - Product Safety: Technical Requirements of Product safety - Process Safety Management. Exit Routes, Emergency Action Plans and Confined Spaces & Entry.

Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers.

MODULE IV HEALTH CONSIDERATIONS 9

Types of diseases and their spread, Health Emergency. Principles of Personal Protective Equipment/Clothing, types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability. Forklift Safety/Heat Stress/Ladder Safety /Scaffold Safety.

MODULE V PRINCIPLES OF INDUSTRIAL HYGIENE 9

Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors. OSHA Record Keeping.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Identify the occupational health hazards, including chemical hazards, and understand their potential health effects on workers.

CO2: Apply occupational safety and health principles and relevant legislation (OSHA) to prevent accidents and ensure workplace safety.

CO3: Implement electrical safety practices and fire prevention strategies in industrial settings.

CO4: Recognize workplace health considerations and utilize proper personal protective equipment (PPE) to minimize exposure risks.

CO5: Utilize principles of industrial hygiene to maintain a safe and healthy work environment in various industries like water treatment, construction, and manufacturing.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Occupational Safety and Health for Technologists", Goetsch D.L, Engineers and Managers Prentice Hall, 1999.
2. "Industrial Accident Prevention-A Scientific Approach", Heinrich H.W, McGraw-Hill Book Company, 2007.

REFERENCES:

1. "Safety and Environmental Management", Della D.E. and Giustina Van Nostrand Reinhold, 1st Edition 1996.
2. "Industrial Safety Management and Technology", Colling D.A., Prentice Hall, 1990. 2.
3. "Occupational Health, a Practical Guide for Managers", by Ann Fingret & Akin Smith.
4. "Environmental Health & Technology", Y P Kudesia & Ritu Kudesia.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110105094

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	2	1	2	2	2	1	2	2	1	1
2	3	3	2	1	1	2	1	2	2	2	1	2	2	1	1
3	3	2	3	2	2	2	1	2	2	2	1	2	3	1	2
4	2	2	1	2	1	2	1	2	2	2	1	2	2	1	1
5	3	2	2	2	2	2	2	2	2	3	1	2	2	1	2
Avg.	**3**	2	**2**	**2**	1	2	1	2	2	2	1	2	2	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	BIODEGRADATION AND BIOREMEDIATION TECHNIQUES	L	T	P	C
		3	0	0	3

MODULE I BIODEGRADATION 9

Introduction to biodegradation and its role in the environment -types of environmental contaminants: organic, inorganic, and xenobiotics - microbial metabolism in biodegradation - factors affecting biodegradation: pH, temperature, oxygen, nutrient availability - principles of biodegradation: enzymatic breakdown and metabolic pathways.

MODULE II INTRODUCTION TO BIOREMEDIATION 9

Introduction to bioremediation - Historical development of environmental bioremediation, Requirements for bioremediation - Constraints and priorities of bioremediation - Applications of bioremediation technologies. Xenobiotic compounds - their structure and persistence in environment, Oil spills - oil products in environment. Biodegradation - principles and microbiology; Micro conversions of xenobiotic.

MODULE III BIODEGRADATION OF PAH IN THE ENVIRONMENT 9

Biotransformation of pesticides and hydrocarbons - Biodegradation kinetics – Bioavailability – Biomineralization - Testing for biodegradability, Numerical modelling of biodegradation. Biological processing of waste water - Bioreactors – designs used for treatment of sludge and removal of metals from waste water. Biodegradable plastic - Biodegradation of PAH in environment.

MODULE IV BIOREMEDIATION STRATEGIES 9

Bio stimulation and bio augmentation, Bioremediation techniques in-situ andex –situ - Bioremediation of organic and metal contaminated environments - Metal toxicity and bioavailability - Bio sorption and precipitation - Bioremediation technologies for heavy metaland radionuclides removal - Phytoremediation and its processes - role of phytochelatins - Applications of genetic engineering in phytoremediation - Algal and fungal based bioremediation.

MODULE V BIOSENSORS TECHNOLOGIES 9

Gaseous bioremediation - biofilms, bio scrubbers - bioventing - Soil Vapour Extraction (SVE) - Water recirculation systems - Air sparging, Bio barriers - Composting, Phytoremediation for air technologies. Role of biosensors in bioremediation technologies - Biofilms and their applications.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Understand the fundamental principles of biodegradation, including the types of environmental contaminants, microbial metabolism, and factors affecting biodegradation rates.

CO2: Explain the concept of bioremediation, its historical development, applications, and limitations in environmental cleanup.

CO3: Apply knowledge of biodegradation processes to various pollutants, including pesticides, hydrocarbons, and PAHs (Polycyclic Aromatic Hydrocarbons), and analyze their persistence in the environment.

CO4: Evaluate the different bioremediation strategies (in-situ and ex-situ) for the remediation of organic and heavy metal contaminated environments, including bio augmentation, bio stimulation, and phytoremediation.

CO5: Explore emerging bioremediation technologies like biosensors, biofilms, and bioventing, and understand their potential applications in gaseous bioremediation and environmental monitoring.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Environmental Biotechnology: Principles and Applications", Bruce E. Rittmann and Perry L. McCarty, McGraw-Hill Education, 2001
2. "Biodegradation and Bioremediation", Martin Alexander, Academic Press,1999

REFERENCES:

1. "Microbial Biodegradation: Genomics and Molecular Biology", Edward T. T. Wong, Caister Academic Press, 2009.
2. "Handbook of Bioremediation", Robert D. Norris, Robert E. Hinchee, Richard Brown, and Philip L. McCarty, CRC Press, 1993.
3. "Biotechnology for the Environment: Soil Remediation", Spiros N. Agathos and Walter Reineke, Springer, 2002.
4. "Bioremediation: Principles and Practice", Robert L. Irvine and Subhas K. Sikdar, CRC Press, 1995.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_bt57/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	1	2	2	1	2	1	2	1	2	3	2	1
2	2	2	2	1	2	2	1	2	1	2	1	2	3	2	1
3	3	2	3	2	2	2	2	2	1	2	1	2	3	2	1
4	3	3	3	3	2	2	2	2	1	2	1	2	3	2	2
5	3	2	2	2	3	2	2	2	1	3	1	2	2	1	2
Avg.	**3**	2	2	**2**	2	2	**2**	2	1	2	1	2	**3**	**2**	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ENERGY MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I ENERGY SCENARIO **9**

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – energy security - energy conservation and its importance – Energy Conservation Act.

MODULE II ENERGY MANAGEMENT **9**

Energy audit - need – types – methodology – barriers - analysis on energy costing and sharing bench marking - fuel and energy substitution – billing parameters in TANGEDCO – demand side management - instruments for energy audit – energy monitoring and targeting – CUSUM – energy labeling.

MODULE III PROJECT MANAGEMENT **9**

Four Basic Elements of Project Management - Project Management Life Cycle - Steps in Project Management Project Definition and Scope, Technical Design, Financing, Contracting, Implementation Techniques (Gantt Chart, CPM and PERT) and Performance Monitoring.

MODULE IV FINANCIAL MANAGEMENT **9**

Investment appraisal for energy conservation projects - Financial analysis techniques -Simple payback period, Return on investment, Net present value, Internal rate of return - Cash flows – Risk and sensitivity analysis: micro and macro factors - Financing options - energy performance contracts-ESCOs.

MODULE V ENERGY AND ENVIRONMENT **9**

Greenhouse effect and the carbon cycle - current evidence and future effects of climate change Global Environmental Concerns -United Nations Frame work Convention on Climate Change(UNFCC), Kyoto Protocol, Conference of Parties(COP), Emissions trading(ET), Joint implementation(JI), Clean Development Mechanism (CDM), Proto type Carbon Fund(PCF), Sustainable Development.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyse the global and Indian energy scenarios, including energy sources, consumption patterns, and the importance of energy conservation and security.

CO2: Analyse energy costs for efficient energy management practices and conduct energy audits using various methodologies and

CO3: Apply project management principles to plan, execute, and monitor energy efficiency projects using tools like Gantt charts and CPM/PERT techniques.

CO4: Evaluate the financial viability of energy conservation projects using techniques like payback period, ROI, NPV, and IRR, considering risks and financing options like ESCOs.

CO5: Explain the relationship between energy use and the environment, including the greenhouse effect, climate change, international environmental agreements and Clean Development Mechanism.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Energy Manager Training Manual” (4Volumes), Bureau of Energy Efficiency (BEE),a statutory body under Ministry of Power, Government of India.2004.
2. “Industrial Energy Management and Utilisation”, L.C. Witte, P.S. Schmidt, D.R. Brown, Hemisphere Publ, Washington, 1988.

REFERENCES:

1. “Energy Management Hand book”, W.C.turner, Wiley,NewYork,1982
2. “Energy Management”, W.R.Murphy and G.McKay, Butter worths, London 1987
3. “Energy Efficiency for Engineers and Technologists”, Eastop.T.D & Croft D.R Logman Scientific & Technical, ISBN-0-582-03184, 1990.

ONLINE RESOURCES:

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	1	1		2	2		2		1	1		
2	1	2	3	2	2		2	2		2		1	1		
3	1	1	3	1	2		2	2	2	2	2	1	1		
4	1	2	3	1	2		2	2		2	2	1	1		
5	1	2	1	1	1	2	3	2		2		1	1		
Avg.	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	L	T	P	C
		3	0	0	3

MODULE I CONCEPTS AND TECHNIQUES 9

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

MODULE II SAFETY AUDIT 9

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

MODULE III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee – cost of accident.

MODULE IV SAFETY PERFORMANCE MONITORING 9

Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

MODULE V SAFETY EDUCATION AND TRAINING 9

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Explain the evolution of safety concepts in industries and apply safety principles for optimizing productivity and quality.

CO2: Conduct safety audits using various techniques like JSA (Job Safety Analysis) and inspections, identify non-conformities, and prepare audit reports.

CO3: Analyse workplace accidents, understand reporting procedures, and identify contributing factors like unsafe acts and conditions.

CO4: Calculate and interpret safety performance metrics like accident rates and severity indices to monitor safety performance in industries.

CO5: Develop and implement safety education and training programs to promote safe work practices and create a culture of safety within the organization.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 3rd Edition 2000.
2. Dan Petersen, “Techniques of Safety Management”, McGraw-Hill Company, Tokyo, 1981.

REFERENCES:

1. “Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
2. “Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 13th Edition 2009.
3. “Safety at Work”, John Ridley, Butterworth and Co., London, 1983
4. “Loss Prevention in Process Industries” Lees, F.P., Butterworth publications, London, 2nd edition, 1990.
5. “Relevant Indian Standards and Specifications”, BIS, New Delhi.
6. “Safety and Good House Keeping”, N.P.C., New Delhi, 1985.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/114/106/114106017/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	-	-	1	2	2	3	2	2	-	2	2	2	-
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3	2	3	3	2	1	2	2	3	2	2	-	2	2	2	1
4	1	3	-	3	2	-	2	-	-	2	-	2	2	-	-
5	2	1	2	-	2	3	3	3	3	3	-	2	2	2	2
Avg.	**2**	2	**3**	2	**2**	2	2	3	2	2	1	2	2	2	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	LANDFILL ENGINEERING AND REMEDIATION TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I LANDFILL BASICS 9

Waste management Hierarchy - Need for landfills–Environmental Protection by Landfills - Landfill Classification – Sanitary and Secure Landfills - Components and Configuration - Legal framework for landfilling – Landfill Site investigation- Regional Landfills- Environmental control using site design –- Landfill Design Tasks.

MODULE II LANDFILL LINERS AND COVER SYSTEMS 9

Landfill barrier system components – Design of Compacted clay liners: Factors affecting hydraulic conductivity , Water content - density criteria, Thickness, Desiccation - Geo synthetic Clay Liners and Geo membranes; types, manufacturing, handling, seaming and testing - Asphalt Barriers and Capillary barrier - Composite Liner system design- liner construction and quality control - Leakage through Liners - vapor transmission and chemical compatibility - Installation of Geo membranes Liner Leakage Mechanism – Diffusion - Controls on advection through liners - Single phase flow advection – diffusion - Landfill cover systems - Design of Cover Systems – Daily Cover – Intermediate Cover – Final Cover - Flow through Landfill Covers - Design and Analysis of Slope Stability - Anchor Trenches- Access ramps - Erosion control.

MODULE III LEACHATE AND LANDFILL GAS MANAGEMENT 9

Waste decomposition in landfills - Factors affecting leachate and landfill gas generation – Factors affecting Leachate Quantity in active and post closure conditions - Hydrologic Evaluation of Landfill Performance (HELP) model – Leachate Drainage Layer – Geotextile and Geonet design – Leachate Collection and Removal systems -Temporal trends in leachate composition – Design of Landfill gas collection and removal systems - Gas condensate issues & knockouts - Leachate treatment methods (biological and physico-chemical) - Leachate re-circulation & bioreactor landfills - monitoring and control of leachate and Landfill gas - Landfill Settlement.

MODULE IV LANDFILL OPERATION AND CLOSURE 9

Landfill Construction and Operational Controls – Fill Sequencing Plans – Cell Construction - Dozer and Compactor operations-Selection of Landfill Equipment - Landfill Administration -Record Keeping- Topographic mapping - Environmental Controls – Odour, Vector and Litter Control – Landfill Safety- Fire Control – Ground and Surface water Monitoring – Methane Gas monitoring- Audits of landfill environmental performance and management – Post Closure care and use of landfills – Landfill Economics - landfill construction and operational cost estimation – establishing tipping fees.

MODULE V CONTAMINATED SITE REMEDIATION 9

Contaminated sites - Fate and behaviour of toxics and persistent substances in the environment Engineering Issues in Site Remediation - Site Characterization- Framework for risk assessment at landfill sites- Remediation Principles: Source Control and Management of Migration Covers, Cut-off Walls, Solidification / Stabilization - Pump - Treat Systems - Solvent Vapor Extraction, Air Sparging, Soil Flushing – Bioremediation- Natural Attenuation - Remedy Selection and Risk Assessment – Geotechnical Aspects of In Situ Remediation Technology - Specific case studies in contaminated site remediation – Rehabilitation of Open dumps - Landfill Mining.

COURSE OUTCOMES: LANDFILL ENGINEERING AND REMEDIATION TECHNOLOGY

Upon completion of this course the students will be able to

CO1: Understand the principles of landfill waste management, classification, environmental regulations, and site investigation procedures.

CO2: Design and analyze landfill liner and cover systems, including geosynthetic clay liners, geo-membranes, and composite liner systems, considering leakage mechanisms and stability.

CO3: Understand leachate and landfill gas generation, including characterization, collection, removal, treatment options, and monitoring strategies.

CO4: Apply operational controls and safety measures for landfill construction, waste placement, record keeping, odor control, and environmental monitoring during the operational phase and post-closure care.

CO5: Select appropriate remediation technologies for contaminated sites, including source control, containment, pump-and-treat systems, bioremediation, and geotechnical considerations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Waste Containment Facilities–Guidance for construction Quality Assurance and Construction Quality Control of Liner and Cover Systems", David E Daniel and Robert M. Koerner, American Socirty of Civil Engineers, ASCE Press, 2007.
2. "Remediation of Hazardous Waste Contaminated Soils", Donald L Wise and Debra J Trantolo, Marcel Dekker Inc., New York,1994

REFERENCES:

1. "Integrated Solid Waste Management", George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Mc-Graw Hill International edition, New York, 1993.
2. "Geo environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies", Hari D Sharma and Krishna R. Reddy, John Wiely, New Jersy, 2004
3. "The Handbook of Landfill Operations", Neal Bolton P.E, Blue Ridge Services Inc., Atascadro, CA– ISBN 0-9646956-0-x, 1995
4. "Geotechnology of Waste Management", Oweis, I.S. and Khera, R.P, 2nd Edition, PWS Publishing Co., Boston, MA, 1998
5. "Geotechnical aspects of Landfill Design and Construction", Robert M. Koerner and Donald H Gray, Prentice Hall, New Jersy.2002

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ce11/preview

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	-	-	1	2	2	2	-	2	-	1	3	2	1
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3	2	2	-	1	2	-	2	2	-	2	-	1	3	-	1
4	2	1	2	1	1	2	3	2	2	2	2	1	2	2	3
5	3	3	3	2	2	2	3	2	2	2	1	1	3	-	1
Avg.	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**3**	**2**	**2**

1 – Low, 2 – Medium, 3 – High

COURSE CODE	PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF PAVEMENT DESIGN 9

Types of pavement-flexible and rigid- Components of pavement and their functions, Provisions of IRC Guidelines for each component, Comparison between highway and airport pavements, Factors influencing pavement stability: Vehicle and traffic factors-ESWL and Wheel Load Factor- Moisture and climate, soil-CBR, Plate Bearing method for finding modulus of subgrade reaction stress distribution factor- Boussinesq and Burmister theories.

MODULE II DESIGN OF FLEXIBLE PAVEMENT 9

Empirical method based on classification-Group Index method- Methods based on arbitrary strength-CBR method-Provisions of IRC 37- North Dakota Cone method, Plate Bearing method (US Navy method for airfields), Theoretical and semi-theoretical methods- Burmister Design method.

MODULE III STRESSES AND JOINTS IN RIGID PAVEMENT 9

Advantages and Disadvantages of rigid pavement, Stresses in rigid pavement due to wheel load- Westergaard theory – Stresses due to change in temperature-warping stress- Critical combination of stresses. Types of joints, Types of rigid pavement based on reinforcement, Design of reinforcement in longitudinal and transverse direction, tie bars and dowel bars.

MODULE IV DESIGN OF RIGID PAVEMENT 9

Modulus of Rupture of concrete, Design of airport pavement-Portland Cement Association method and Corps of Engineers method- Design of rigid highway pavement- IRC 58 method and PCA method.

MODULE V PAVEMENT DISTRESS, EVALUATION AND REHABILITATION 9

Flexible pavement distress - rigid pavement distress - condition surveys - Types of roughness - present serviceability index - skid resistance - structural evaluation - Bituminous and flexible overlays on rigid pavements - Pavement Management System.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply fundamental principles and IRC guidelines to analyze factors influencing pavement stability.

CO2: Analyze flexible pavement structures based on traffic load, soil conditions, and other design criteria.

CO3: Apply knowledge of joint types and reinforcement design to ensure pavement integrity.

CO4: Create a comprehensive rigid pavement design for highways or airports, considering material properties, traffic loads, and construction practices.

CO5: Evaluate pavement distress mechanisms in pavements, and propose suitable rehabilitation strategies based on condition surveys and cost-benefit analysis.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Highway Engineering” by S.K. Khanna & C.E. Justo, McGraw-Hill Education, 2020.
2. “Principles of Pavement Design” by E.J. Yoder & M.W. Witczak, John Wiley & Sons, 2015.

REFERENCES:

1. “Pavement Engineering: Principles and Practice” by Rajib B. Mallick & Tahar El-Korchi, CRC Press, 2023.
2. “Modern Pavement Management” by W. Ronald Hudson & Ralph Haas & Paul Zaniewski, McGraw-Hill Education, 2023.
3. IRC: 37-2018, Guidelines for the Design of Flexible pavements, Indian Road Congress, New Delhi.
4. IRC: 58-2019, Guidelines for the Design of Rigid Pavements for Highways, Indian Road Congress, New Delhi.
5. IRC: SP: 72-2015, Guidelines for the design of flexible pavements of low volume rural roads, Indian Road Congress, New Delhi

ONLINE RESOURCES:

1. https://www.civil.iitb.ac.in/tvm/nptel/
2. https://nptel.ac.in/courses/105105107

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		2										2		
2	3		3										2		
3	2		3										2		
4	3		3										2		
5	2		2				2						2		
Avg.	3		3				2						2		

1 – Low, 2 – Medium, 3 – High

OURSE CODE	REMOTE SENSING AND GIS	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES AND CONCEPTS **9**

Definition - Historical Importance of remote sensing - Principles - and methods of remote sensing - Electromagnetic spectrum Electromagnetic Radiation and radiation sources - Interference - Atmospheric effects on remote sensing - Energy interaction with energy surface features.

MODULE II AERIAL PHOTOGRAPHY **9**

Definition - Types of air photographs - Geometry of air photo - Parallax - pair of photos - Height determination - Flight planning - Stereoscopy - Monovision - Binocular vision - Aerial photo interpretation - Basic elements - Techniques of photo interpretation - Application of aerial photo interpretation - photographs versus maps.

MODULE III IMAGERY **9**

Landsat imagery - Digital image processing - Comparison with aerial photographs - Imaging devices - Aerial camera - Panoramic camera – Satellites – Geo Stationery – Sun Synchronous Satellites – Platforms and Sensors – types - Characteristics.

MODULE IV GIS **9**

GIS – Structure of GIS – various components of GIS – vector and raster data – analysis of data – Introduction to various GIS softwares – Introduction to GPS – Principles – list of software.

MODULE V APPLICATIONS OF GIS AND REMOTE SENSING **9**

Application of Remote Sensing and GIS in water resources engineering, land use studies, soil investigations, geology, transportation networks, agriculture, forestry, coastal engineering and military services.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze the fundamental principles of remote sensing, including electromagnetic interactions, atmospheric effects, and energy interactions with surface features.

CO2: Interpret aerial photographs using stereoscopic principles and image analysis techniques to extract spatial information and solve real-world problems.

CO3: Compare and contrast various satellite imageries based on their acquisition characteristics, resolutions, and applications.

CO4: Analyze and evaluate the components, data types, and functionalities of GIS to apply them effectively in spatial data analysis and problem-solving.

CO5: Select and integrate geospatial technologies to address real-world problems in various domains.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Fundamentals of remote sensing” by Bhatia S.C, New Delhi Atlantic Publishers, 2018.

2. “Remote Sensing and Image Interpretation” by Lillesand, Thomas.M and Ralph W.Kiefer, John Wiley Sons, 2021.

REFERENCES:

1. ”Applications of Geographic Information Systems in Civil Engineering” by Niraj Kumar Thakur, Springer, 2018.
2. ”Manual of Remote Sensing: Principles and Applications” by Steven M. De Jong, John Wiley & Sons, 2023.
3. ”GIS and Remote Sensing in Hydrology, Water Resources and Environment”, by Biswajeet Pradhan, Springer, 2018.
4. ”Handbook of Satellite Remote Sensing” by Quac Pham & Jochen A. Schiller, CRC Press, 2019.
5. ”Mastering ArcGIS Pro” by Rodney Dangerfield, , ESRI Press, 2023.

ONLINE RESOURCES:

1. https://earthobservatory.nasa.gov/
2. https://www.opengeospatial.org/

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2			2									2		
2	2				2					2					
3	2			1											
4	3				3								2		
5			3		3								2		
Avg.	2		3	2	3					2			2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	TRAFFIC ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I TRAFFIC CHARACTERISTICS 9

Physical, Physiological, Psychological, Environmental Characteristics, PIEV Theory – Traffic Stream Characteristics, Vehicle Characteristics – Urban Road and Road Characteristics – Geometric Design - Overview.

MODULE II SURVEYS AND STUDIES IN TRAFFIC ENGINEERING 9

Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – LOS for uninterrupted traffic flow – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accident – Level of Service (LoS).

MODULE III DESIGN OF TRANSPORT INFRASTRUCTURE 9

Design of roads – Design Speed, Terrain, Gradient curves – Horizontal and Vertical, Super elevation, Sight Distance –Traffic Sign, Road Markings, Traffic Control Aids, simple problems.

MODULE IV INTERSECTION DESIGN AND CONTROL 9

Design of Intersection – At grade intersection – Uncontrolled, Channelization, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Intersection - Types, Design and Analysis.

MODULE V TRAFFIC MANAGEMENT 9

Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, Intelligent Transport System for traffic management.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Analyze and evaluate the factors affecting traffic flow, applying PIEV theory to develop strategies for safer and more efficient transportation systems.

CO2: Evaluate and apply appropriate traffic survey and study methods to collect and analyze data, utilizing Level of Service (LOS) concepts to assess traffic flow efficiency.

CO3: Apply principles of safety and efficiency while designing road elements and incorporating traffic signs, markings, and control aids.

CO4: Evaluate and propose intersection design solutions along with optimized traffic signal timing and coordination, considering traffic volume and geometric constraints.

CO5: Estimate the effectiveness of various traffic management strategies, proposing comprehensive plans and promote sustainable transportation practices.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Traffic Engineering and Transport Planning" by Kadiyali.L.R., Khanna Publishers, Delhi, 2020.
2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management, 2018.

REFERENCES:

1. "Fundamentals of Traffic Engineering" 17th Edition by Wolfgang S. Homburgeret. al., Institute of Transportation Studies, University of California, Berkely, 2023.
2. "The Handbook of Highway Engineering" by Myint Thaik Aung, CRC Press, 2021.
3. "Geometric Design Guide" by American Association of State Highway and Transportation Officials, 2018.
4. "Traffic and Highway Engineering" by Nicholas J. Garber and Lester A. Hoel, John Wiley & Sons, 2015.
5. "Highway Capacity Manual" by Transportation Research Board, USA, 2016.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105
2. https://nptel.ac.in/courses/105105107

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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Avg.	3		3	2	2	3	2						2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	URBAN TRANSPORTATION PLANNING	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF TRANSPORTATION PLANNING 9

Introduction - Interdependence of land use and traffic – transportation planning – different stages – various surveys – difficulties in planning - Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques

MODULE II TRIP GENERATION AND DISTRIBUTION 9

Purpose of Trip – Trip Generation – Trip Distribution – factors – various models – analysis – traffic assignment – modal split - simple problems

MODULE III DESIGN OF VARIOUS ELEMENTS 9

Design of intersections – at grade – grade separated interchanges – Parking – Demand – type of parking – Design of Multi Storied and Surface Parking facility - traffic signal design – methods – simple problems

MODULE IV URBAN TRANSPORTATION MODES 9

Public transport – planning - fares and subsidy – Intermediate public transport – types – characteristics – other urban transportation modes

MODULE V URBAN TRANSPORTATION PROBLEMS 9

Problems in Present Traffic conditions –– Pedestrian Facilities - traffic and Environment – Air Pollution – Noise Pollution - fuel crisis – remedial measures

COURSEOUTCOMES

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

CO1: Evaluate and plan data collection strategies for urban transportation studies, and analyze diverse data sources by the application of zoning principles.

CO2: Apply trip generation and distribution models to forecast travel demand in urban areas, considering relevant factors and evaluate the model choice for effective transportation planning.

CO3: Analyze and design key urban transportation elements considering traffic demand, safety, and efficiency with relevant standards and regulations.

CO4: Evaluate and propose appropriate public and intermediate public transport options for an urban context, considering ridership, operational efficiency, environmental impact, and social equity.

CO5: Diagnose and propose solutions to major urban transportation problems by integrating knowledge of transportation systems, environmental impacts, and policy measures.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Traffic Engineering and Transport Planning" by Kadiyali.L.R., Khanna Publishers, Delhi, 2020.

2. “Transportation Engineering” by Khisty C.J. and Kent B Lall, Prentice Hall, 2018.

REFERENCES:

1. “Transportation Engineering and planning” by Tassos A. Papacostas, Tata McGraw Hill, 2019.
2. “Introduction to Transportation Planning” by Bruton M.J., Routledge, 2014
3. “Metropolitan Transportation Planning” by John W. Dickey, Taylor & Francis, 2019.
4. “Principles of Urban Transport Planning” by Hutchinson, B.G, Routledge, 2016.
5. “Urban Transportation Planning: A Decision-Oriented Approach” by Michael D. Meyer and Eric J. Miller, “Urban Transportation Planning: A Decision-Oriented Approach” by McGraw-Hill Education, 2014.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/124/107/124107158/
2. https://nptel.ac.in/courses/105105107

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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AVg.	3		3	2	2	2	2						2		

COURSE CODE	TRANSPORTATION SYSTEMS PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I TRANSPORTATION AND SOCIETY 9

Role of Transport in Society and Economy - Functions and Problems in Transportation Planning - Economic, Geographical, Political, Technological, Social and Cultural Factors in Planning of Transportation System. Transport Technology: System Classification and their Variation; Conventional Systems and Unconventional Systems - Air, Water and Ground Modes

MODULE II MODES OF TRANSPORT AND THEIR CHARACTERISTICS 9

Propulsion Forces - Factors in Operation - Levels of Service and Performance Criteria - Quality of Service: Capacity and Levels of Service of different Transportation Systems; mobility and accessibility – Flexibility - Speed, Acceleration, Deceleration - Comfort and Environmental Effects - Time Spent and Cost – Integration of modes.

MODULE III A BRIEF HISTORICAL DEVELOPMENT OF TRANSPORTATION SYSTEMS 9

Growth of Transport - Road Development Plans - Imbalances in Transport System - National Transport Policy Recommendations - Optimum Inter Model Mix-Study - Vision 2021, NHDP, PMGSY, Rural Roads Vision 2025 - IRC, CRRI etc. - Inland waterways in India

MODULE IV PLANNING OF PASSENGER AND GOODS TERMINAL FACILITIES 9

Planning of passenger and goods terminal facilities of Air, Water, Railway and Highway Transportation Systems – requirements and typical layouts - passenger facilities - parking configuration - terminal requirements – goods facilities and containerization

MODULE V OPERATIONAL CONTROLS 9

Operational Controls of Air, Water, Railway and Highway Transportation Systems: Functions of Control & Communications - Signals and Traffic Control Devices - Navigational Aids of the different Transportation Systems. Air Traffic Control; Navigational Control. Automatic Signaling Systems of Railway and Highway Movements.

COURSEOUTCOMES

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

CO1: Evaluate the economic, social, and environmental impacts of various transportation systems, advocating for sustainable and equitable solutions.

CO2: Compare and contrast various transportation modes based on performance, service quality, and environmental impact, by selecting appropriate options for specific needs

CO3: Evaluate the historical evolution of transportation systems in India by analyzing current policies and initiatives for achieving an optimal multimodal mix

CO4: Design and evaluate passenger and goods terminal facilities for different transportation modes, considering user needs, operational efficiency, and sustainability principles.

CO5: Analyze and explain operational control systems for air, water, rail, and highway transportation systems, their effectiveness in ensuring safety, efficiency, and traffic management.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Traffic Engineering and Transport Planning” by Kadiyali.L.R. Khanna Publishers, Delhi, 2020.
2. “Transportation Engineering” by Khisty C.J. and Kent B Lall, Prentice Hall, 2018.

REFERENCES:

1. “Transportation Engineering and Planning” by Tassos A. Papacostas, McGraw-Hill Education, 2019.
2. “Transportation Engineering: Planning and Design” by C.S. Papacostas and Panayiotis Prevedouros, John Wiley & Sons, 2023.
3. “Airport Planning & Design” by Walter J. Horonjeff and Kenneth M. Linster, McGraw-Hill Education, 2019.
4. “Airport Systems: Design, Planning, and Management” by Richard H. Stinson, J. Ross Publishing, 2019.
5. “Handbook of Transportation Systems Engineering” by Andrew J. Graham, Wiley-Blackwell, 2021.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105105107
2. https://archive.nptel.ac.in/courses/105/106/105106058/

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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AVg.	3		3	2	2	3	3						2		

COURSE CODE	TRANSPORTATION ECONOMICS AND FINANCE	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTORY CONCEPTS IN TRANSPORTATION DECISION MAKING 9

Overall transportation project development, budgeting, financial planning, the process of transportation project development, models associated with transportation impact evaluation.

MODULE II TRANSPORTATION COSTS 9

Classification of transportation costs, transportation agency costs, transportation user costs, general structure and behavior of cost functions and road pricing. Estimating Transportation Demand and Supply - supply equilibration, dynamics of transportation demand and supply, elasticity of travel demand and supply, classification of elasticity.

MODULE III VEHICLE OPERATING COSTS 9

Fuel costs - Maintenance and spares, Depreciation - Crew costs - Value of travel time savings - Accident costs. Economics of traffic congestion - Pricing policy.

MODULE IV ECONOMIC ANALYSIS OF PROJECTS 9

Methods of evaluation - Cost-benefit ratio, first year rate of return, net present value, and internal-rate of return methods; Indirect costs and benefits of transport projects.

MODULE V FINANCING OF ROAD PROJECTS 9

Methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Design-Build-Operate-Transfer Schemes – Risk Analysis – Value for Money analysis - Case Studies.

COURSEOUTCOMES

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

CO1: Analyze and apply economic principles to the entire transportation project development process, including financial planning, impact evaluation, and relevant models.

CO2: Interpret different transportation costs and apply cost functions and road pricing concepts to inform decision-making

CO3: Evaluate the key components of vehicle operating costs and their implications for policy decisions.

CO4: Enumerate the economic viability of transportation projects using various methods and considering both direct and indirect costs and benefits.

CO5: Assess transportation projects using economic analysis tools and public-private partnerships thereby ensuring value for money.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Kenneth A. Small, “Transportation Economics” ,2023.
2. Susan Perkins and William H. Schneider, “Transportation Planning Handbook”, 2021.

REFERENCES:
1. W.G. Waters, “Handbook of Transport Modelling”, 2023.
2. David A. Henshe, “Transportation Impact Assessment”, 2022.
3. Richard B. Dial, “Handbook of Road Pricing: Theory, Practice, and Case Studies” 2020.
4. Umar Zafar, “Sustainable Transportation Engineering: An Introduction”, 2020.
5. Edward S. Beimborn, “Handbook of Transport Economics”, 2018.

ONLINE RESOURCES:
1. https://nptel.ac.in/courses/105105107
2. https://archive.nptel.ac.in/courses/105/106/105106058/

CO-PO&PSOMAPPING

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AVg.	3		2		2	2							2		

COURSE CODE	INTELLIGENT TRANSPORT SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I INTELLIGENT TRANSPORTATION SYSTEM AND DEFINITIONS 9

Introduction to Intelligent Transportation System (ITS) – Definition of ITS and Identification of ITS-Need for ITS, Objectives, Historical Background, Benefits of ITS

MODULE II DATA COLLECTION TECHNIQUES 9

ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection

MODULE III FUNCTIONAL AREAS 9

Telecommunication in ITS - functional areas of ITS – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS)

MODULE IV TRAFFIC MANAGEMENT AND AUTOMATION 9

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management, Mobile Applications; Automated Highway Systems - Overview of ITS implementations in developed countries, ITS in developing countries.

MODULE V INTELLIGENT TRANSPORT SYSTEM IN INDIAN CITIES 9

Incorporation of ITS technologies in Indian cities – Transportation Planning applications – Metro rail systems – user friendly apps – case studies

COURSEOUTCOMES

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

CO1: Analyze and explain the need, objectives, benefits, and historical context of Intelligent Transportation Systems (ITS).

CO2: Apply various data collection techniques used in ITS, including detectors, and video data to analyze and manage transportation systems.

CO3: Evaluate the core functionalities of ITS, including ATMS, ATIS, CVO, AVCS, APTS, and ARTS, and evaluate their potential impact on various transportation stakeholders.

CO4: Assess the potential of ITS technologies for travel and traffic management, while considering automated highway systems and global implementation trends.

CO5: Interpret the incorporation of ITS technologies in Indian cities, analyzing their applications, user impacts, and case studies, and suggesting potential improvements.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Intelligent Transport Systems” by Srinivasa R Kumar, Orient Blackswan Pvt Ltd, 2021
2. “Intelligent Transport Systems” by Pradip Kumar Sarkar & Amit Kumar Jain, PHI Learning, 2018.

REFERENCES:

1. "Intelligent Transportation Systems Handbook" by Robert Bosch GmbH, 2023.
2. "Transportation Systems Engineering: Theory and Practice" by Ioannis S. Sifakis, 2023.
3. "Intelligent Transportation Systems Standards" by John C. Morris, 2021.
4. "Introduction to Intelligent Transportation Systems (ITS)" by Joseph C. Herrera, 2020.
5. "Handbook of Intelligent Transport Systems" by Mahbub Alam and Richard Curran, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-32.pdf

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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AVg.	3				2	2	1						2		

COURSE CODE	ROAD SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I ROAD SAFETY AND ITS FACTORS 9

Road accidents, Trends, causes, Collision diagrams; Highway safety; Human factors and road user limitations; Speed and its effect on road safety; Vehicle factors; Highway safety in India. Multi-causal dynamic systems approach to safety; Crash Vs Accident; Road safety improvement strategies; Elements of a road safety plan, Safety data Needs; Safe vehicle design.

MODULE II STATISTICAL INTERPRETATION AND ANALYSIS OF CRASH DATA 9

Before-after methods in crash analysis, Recording of crash data; Accident Investigation and Analysis; Statistical testing and the role of chance; Black Spot Identification and Investigations, Case Studies.

MODULE III ROAD SAFETY AUDITS 9

Key elements of a road safety audit, Road Safety Audits & Investigations, Work zone safety audit; Crash investigation and analysis, Methods for identifying hazardous road locations, Case Studies.

MODULE IV CRASH RECONSTRUCTION 9

Describe the basic information that can be obtained from the roadway surface, understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case Studies

MODULE V MITIGATION MEASURES 9

Mitigation Measures: Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry and safety; Safety in urban areas; Public transport and safety; Road safety policy making, Stakeholders involvement; Road safety law.

COURSEOUTCOMES

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

CO1: Evaluate the multi-dimensional factors contributing to road accidents and propose evidence-based safety improvement strategies within the framework.

CO2: Apply statistical methods to analyze crash data, identify black spots, and draw informed conclusions for targeted safety interventions

CO3: Contrast road safety audits using recognized methodologies, identify potential hazards, and recommend effective countermeasures

CO4: Illustrate the scientific principles and engineering analysis to reconstruct crash scenarios, determine contributing factors, and support legal proceedings

CO5: Propose evidence-based mitigation measures to address various road safety challenges, considering engineering interventions, policy frameworks, and stakeholder engagement

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Traffic Engineering and Transport Planning" by Kadiyali.L.R. Khanna Publishers, Delhi, 2020.
2. "Transportation Engineering" by Khisty C.J. and Kent B Lall, Prentice Hall, 2018.

REFERENCES:

1. "Road Safety Inspections and Audits" by Rune Elvik, 2022.
2. "Human Factors in Road Safety" by Jens Rasmussen, Kinga M. Wisniewski, and Rune Elvik, 2020.
3. "Statistical Methods for Road Safety Analysis" by W.C. Mannering and Kenneth L. Caves, 2019.
4. "Handbook of Transportation Safety" by Robert J. Haver, 2019.
5. "Road Safety: An Introduction" by David Jamieson, 2020.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ce35/preview

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
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2	3			3									2		
3	3												2		
4	3			2											
5	3		3			3							2		
AVg.	3		3			3							2		

COURSE CODE	TOWN PLANNING AND ARCHITECTURE	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF TOWN PLANNING 9

Evaluation of planning – Objects of town planning – principles of town planning- origin of towns – growth of towns – origin – direction – various forms of planning

MODULE II ELEMENTS OF ARCHITECTURE 9

Introduction of architecture - definition - Evaluation of geometric forms - function and history - Sphere, Cube, Pyramid, Cylinder and Cone - aesthetic qualities of Architecture - Proportion, Scale, Balance, Symmetry, Rhythm and axis - Contrast in Form - Harmony.

MODULE III PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS 9

Factors affecting orientation - Sun-Wind-Rain - Orientation criteria for Indian conditions - Principles governing the theory of planning - Planning of residential buildings.

MODULE IV DEVELOPMENT PLANS 9

Principles of city planning - levels of planning- scope and contents of regional plan, master plan, detailed development plan and structure plan - preparation and implementation - planning of new towns – slum clearance and urban renewal.

MODULE V PLANNING LEGISLATION AND DEVELOPMENT CONTROL RULES 9

Planning legislation and administration - Tamil Nadu Town and Country planning Act, Tamil Nadu Housing Board Act, Tamil Nadu slum clearance and Improvement Act. Zoning regulations - sub division regulations – building regulations - Floor Space Index - minimum plot sizes and building frontage - open spaces - minimum standard dimensions of building elements

COURSEOUTCOMES

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

CO1: Define town planning objectives, principles, origins, growth, and various planning forms

CO2: Comprehend architecture's definition, geometric forms, history, and aesthetic qualities, including proportion, scale, balance, symmetry, rhythm, and contrast

CO3: Analyze factors influencing orientation like sun, wind, rain, and apply criteria for Indian residential building planning

CO4: Grasp city planning principles, levels, and content of regional, master, development, and structure plans, including implementation strategies

CO5: Comprehend planning legislation, including Tamil Nadu Town and Country Planning Act, Housing Board Act, and Slum Clearance Act, and zoning regulations.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Sustainable Urban Planning: Theory and Practice" by Douglas Crawford, Routledge, 2023.
2. "Urban Land Use Law: Cases and Materials" by David Getches, Thomson Reuters, 2022.

REFERENCE BOOKS:

1. "The Practice of Local Government Planning" by Frank S. So, & David Johnstone, John Wiley & Sons, 2019.
2. “Urban Planning for Public Health” by Edward Ng, 2023.
3. “The city in the Age of Climate Change: Planning Livable Urban Settlements” by Kees Ornstein, David Satterthwaite, and Harriet Bulkeley, 2022.
4. “Equity in the Built Environment” by David Harvey, 2023.
5. "Architecture: Form, Space & Order" by Francis D Ching, John Wiley & Sons, 2019.

ONLINE RESOURCES:

1. https://smartcities.gov.in/

CO-PO&PSOMAPPING

CO	PO												PSO		
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COURSE CODE	METRO SYSTEMS AND ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF TRANSPORTATION SYSTEMS 9

Transportation systems in India – various modes of transport – public transport – Intermediate public transport – types – characteristics – other urban transportation modes – drawbacks- various transit systems

MODULE II MRTS 9

Definition – Mass Rapid Transit System – History of MRTS - Need for MRTS – connectivity in Indian conditions – cities having MRTS – infrastructure – operations – fares and ticketing - case study.

MODULE III BRTS and LRTS 9

Bus Rapid Transit System – terminology – history -features - performance – cost - drawbacks – Light Rail Transit System – necessity – types – gauge- capacity integration with cycles – comparison to other rail modes

MODULE IV METRO RAIL SYSTEMS 9

History of Metro trains - Need for Metro rail – connectivity in Indian conditions – cities having Metro - construction techniques adopted in Metro Rail stations - Case study – Delhi Metro (DMRC) – Chennai Metro (CMRL)

MODULE V INTELLIGENT TRANSPORT SYSTEM (ITS) 9

Definition – Intelligent Transport System – Principles - Application of ITS technologies in various countries – smart transportation – mono rail - case studies

COURSEOUTCOMES

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

CO1: Analyze transportation systems in India, including modes, public, intermediate transport, urban modes, drawbacks, and transit systems

CO2: Comprehend Mass Rapid Transit System definition, history, necessity, Indian context, cities with MRTS, infrastructure, operations, fares, and case studies

CO3: Understand Bus Rapid Transit System terminology, history, features, performance, costs, drawbacks, Light Rail Transit System, and comparisons

CO4: Grasp Metro trains' history, necessity, Indian context, cities with Metro, construction techniques, and case studies

CO5: Understand Intelligent Transport System definition, principles, global applications, smart transportation, monorail, and case studies

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Urban Transportation Planning and Policy” by Shakya, R, CRC Press, 2022.
2. “Planning and Operation of Metro Rail Systems” by D'Souza, S. A, John Wiley & Sons 2021.

REFERENCE BOOKS:

1. “Urban Public Transportation Systems: Principles and Application” by Vuchic, L. R, John Wiley & Sons, 2020
2. “Metro Rail Transit Systems in India: Planning, Design, and Operation” by. Gupta, S. K., & Kumar, K, Springer, 2019.
3. “Transportation Planning Handbook” by Hall, R. W., & Lumsdaine, R. L, CRC Press, 2019.
4. “Urban Transportation Planning” by Sivakumar, R, New Age International Publishers 2020.
5. “Transportation Engineering.” by Agarwal, V. K., & Sharma, T. N, S. Chand Publishing, 2022.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_me75/preview

CO-PO&PSOMAPPING

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COURSE CODE	AIRPORT AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I AIRPORT PLANNING **9**

Regional planning - Planning Consideration- Airport Site evaluation - factors affecting airport location - Surveys - Drawings - Role of ICAO, FAA, DGCA and AAI - Airport capacity - Terminal area - Building and building area - facilities in terminal area-Vehicular circulation - Parking area - Apron - Hanger - other components

MODULE II GEOMETRIC DESIGN OF RUNWAY AND TAXIWAY **9**

Design of runway - Factors affecting setting - Orientation of Runway - windrose diagram - number of runways - factors affecting runway length - length of runway - stop ways - clear ways - take off length requirement - landing length requirement. Design of taxiways, aprons, holding bays- functional requirement - taxiway- width - curve - junction – intersection**.**

MODULE III AIR TRAFFIC CONTROL AND PAVEMENT MAINTENANCE **9**

Aircraft Characteristics - Future trends in aircrafts design- Visual Aids - Airport Marking - Airport Lighting - Need for Air traffic control - Air traffic control network - Air traffic control Aids - ILS - Need for maintenance of pavement - Airfield Pavement failures - Maintenance - Strengthening of airfield pavements - Drainage - Characteristics and requirements

MODULE IV HARBOUR **9**

Definitions: Harbour, port, marine terminal, offshore mooring, anchorage area, turning basin, length, beam, draft, load line, dead weight tonnage, warehouse, Transit shed - Planning, site selection - layout of harbours - classification of harbours

MODULE V DOCKS **9**

Break water - classification and sections of different types of break waters - Docks – Classification- Jetty, quay, quay wall - Dolphins - fenders - navigational aids- necessity and types.

COURSEOUTCOMES

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

CO1: Identify the parameters required for planning and constructing an airport.

CO2: Design the runway and taxiway in airport as per geometrical standards.

CO3: Explain the air traffic controls, failures and maintenance for safe functioning of airport.

CO4: Outline the elements and components related to Harbour.

CO5: Identify the components and structures related to docks.

TOTAL: 45 PERIODS

TEXT BOOKS

1. "Airport Planning and Design" by Khanna.S.K., Arora M.G., and S. S. Jain, Nem Chand, Roorkee, 2017
2. “Airport Engineering Planning and Design” by Saxena S. C, CBS Publications, 2020

REFERENCES

1. "The Planning and Design of Airports" by Robert Horonjeff., McGraw Hill Book Co., 1994.

2. "Design and Construction of Port and Marine Structures" by Quinn, McGraw Hill, 1972.
3. "Dock and Harbour Engineering" by Hasmukh P. Oza and Gautam H. Oza., Charotar Publishing House, Anand, Gujarat, 2016.
4. “Dock and Harbour Engineering” by S.P. Bindra, Dhanpar Rai Publishers, 2010

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					2							2		
2	3					3							2		
3	3												2		
4	3														
5	3					2									
AVg.	3					2							2		

COURSE CODE	THEORY OF TRAFFIC FLOW	L	T	P	C
		3	0	0	3

MODULE I TRAFFIC STREAM **9**

Traffic stream parameters - Fundamental diagram of volume-speed-density surface. Discrete and continuous probability distributions. Merging manoeuvres - critical gaps and their distribution.

MODULE II MACROSCOPIC MODELS **9**

Macroscopic models - Heat flow and fluid flow analogies - Shock waves and bottleneck control approach.

MODULE III MICROSCOPIC MODELS **9**

Microscopic models - Application of queuing theory - regular, random and Erlang arrival and service time distributions - Queue discipline - Waiting time in single channel queues and extension to multiple channels.

MODULE IV LINEAR AND NON-LINEAR MODELS **9**

Linear and non-linear car following models - Determination of car following variables- Vehicle trajectories - Acceleration noise.

MODULE V INTERPRETATION OF GIS IN TRAFFIC FLOW **9**

Geographical Information System – Global Positioning System – Intelligent Transportation Systems - Area Traffic Control – Automatic Toll Collection – Smart Cards – Collision Detection System – Big data – collection and analysis.

COURSEOUTCOMES

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

CO1: analyze the traffic stream parameters.

CO2: apply macroscopic models, especially fluid flow analogy

CO3: apply the queuing theory

CO4: analyze vehicle interactions

CO5: define the significance of ITS under Indian conditions.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Traffic Flow Theory and Control” by Drew, D.R., McGraw Hill., 1978.
2. “Traffic Flow Theory - A Monograph” by TRB, SR165, 1975.

REFERENCES:

1. “Principles of Geographical Information Systems” by Burrough P.A. and Rachel A. McDonell, Oxford Publication, 2004.
2. “Perspective on ITS” by Sussman, J. M., Artech House Publishers, 2005.

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2					2							2		
2	3					3							2		
3	3												2		
4	3														
5	3					2									
AVg.	3					2							2		

COURSE CODE	PROJECT MANAGEMENT FOR CONSTRUCTION	L	T	P	C
		3	0	0	3

MODULE I CONSTRUCTION PROJECT PERSPECTIVES 9

Construction Project Life Cycle - Types of Construction - Selection of Professional Services - Stake-holders in Construction Project - Structure of Project Organization - Perspectives of Owners & Builders -Role of Project Managers - Financing of Constructed Facilities -Design and Construction as an Integrated Process - Design Concepts.

MODULE II CONSTRUCTION PROJECT COST ESTIMATIES 9

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Estimation of Operating Costs.

MODULE III RESOURCE PLANNING AND MANAGEMENT 9

Labour Productivity - Factors Affecting Job-Site Productivity -Labour Estimation, Allocation and Control - Materials Estimation - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management - Construction Equipment -Choice of Equipment and Standard Production Rates -Estimation of Equipment Requirement - Construction Processes Queues and Resource Bottlenecks.

MODULE IV CONSTRUCTION PLANNING, MONITORING AND CONTROL 9

Types of Project Plans - Work Breakdown Structure - Resource Levelling - Resource Allocation Interface Management aspects -Project Scheduling -Types of Project Scheduling - Project Progress Control - Measuring and Updating of Project Progress using Bar Chart, Progress Reports to aid Progress Review - Stage-wise Completion Cost - Earned Value Analysis.

MODULE V PROJECT CLOSURE 9

Project Closure - Construction Closure - Financial Closure - Contract Closure - Project Managers' Closure - Lessons Learnt from the Project - Profit/Loss at Completion - Disputes and Claims - Settlement of Disputes and Claims - Final Project Closure Reports.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Determine the project objectives and prepare a project schedule for time, cost and resources.

CO2: Prepare an estimate of the project Cost and plan the cost budget.

CO3: Plan for the various resources on real-time required for the construction activities.

CO4: Update Project Progress and prepare reports for review and to control the project.

CO5: Prepare a final project closure report.

TEXT BOOK:

1. “Construction Project Management - Theory and Practice”, Kumar Neeraj Jha, Pearson Publications - Dorling Kindersley (India) Pvt. Ltd., 2012.

2. “Construction Project Management: Planning, Scheduling and Control”, K.K. Chitkara, Tata McGraw-Hill Publishing Company, New Delhi, 1998.

REFERENCES:

1. “Construction Project Management”, Frederick E. Gould and Vary E. Joyce, Wentworth Institute of Technology and Massachusetts Institute of Technology, 2000.
2. “Project Management”, S. Choudhury, Tata McGraw-Hill Publishing Company, New Delhi, 1988.
3. “Total Construction Project Management”, George J. Ritz, McGraw-Hill Inc, 1994.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	3	2	2	3	2	3	3	3	3	3	3
2	3	3	2	2	3	2	2	3	2	3	3	3	3	3	3
3	3	3	2	2	3	2	2	3	3	3	3	3	3	3	3
4	3	3	2	2	3	2	2	3	2	3	3	3	3	3	3
5	3	3	2	2	3	2	2	3	2	3	3	3	3	3	3
Avg.	3	3	2	2	3	2	2	3	2	3	3	3	3	3	3

1 – Low, 2 – Medium, 3 – High

COURSE CODE	PROJECT FORMULATION AND APPRAISAL	L	T	P	C
		3	0	0	3

MODULE I PROJECT FORMULATION **9**

Project - Phases of Project - Capital investments - Generation and Screening of Project Ideas - Project identification - Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report - Different Project Clearances required.

MODULE II PROJECT COSTING **9**

Project Cash Flows - Basic principles of cash flow estimation - Time Value of Money - Time lines and notations - Future value of single amount - Present value of single amount-Future value of an annuity-Present value of an annuity- Concept of average Cost of capital - Cost of debt and preference - cost of equity and depreciation.

MODULE III PROJECT APPRAISAL **9**

NPV - BCR - IRR - ARR - Urgency - Pay Back Period - Assessment of Various Methods - Indian Practice of Investment Appraisal - International Practice of Appraisal - Analysis of Risk - Sensitivity analysis -Scenario analysis - Break even analysis - Hillier Model - Simulation analysis - Decision tree analysis - Project selection under risk.

MODULE IV PROJECT FINANCING **9**

Project financing - Public and Private sources of capital - Equity - Equity capital - Preference capital - Internal accruals - Debt - Term loans - Debentures - Working capital advances - Miscellaneous sources - Key financial indicators - ratios.

MODULE V PRIVATE SECTOR PARTICIPATION **9**

Private sector participation in Infrastructure Development Projects - Features of BOT model, BOL model and BOOT model - Key Project parties - Financing of Infrastructure projects with case studies - Technology transfer and foreign collaboration - Scope of technology transfer.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Design and implement an integrated project formulation & business planning framework, defining relevant processes, tools, information needs and reports.

CO2: Estimate time value of money, cash flows and project costing.

CO3: Apply the project appraisal techniques and analyze risks in construction projects.

CO4: Assess the various sources of finance, key financial indicators and its merits.

CO5: Recognize the implication of private sector participation and technology transfer in construction projects.

TEXT BOOK:

1. "Handbook of Management Consulting Services", S.W. Barcus and J.W. Wilkinson, McGraw Hill, New York, 1986.

2. “Projects - Planning, Analysis, Selection, Implementation Review”, Prasanna Chandra, Eighth edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2014.

REFERENCES:

1. “Total Project Management - The Indian Context”, Joy P.K., Macmillan India Ltd., New Delhi, 2006.
2. “Manual for the Preparation of Industrial Feasibility Studies”, United Nations Industrial Development Organisation (UNIDO), (IDBI Reproduction), Bombay, 1987.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	1	3	3	3	3	2	3	3
2	3	1	3	3	3	3	3	1		3	3	3	2	1	
3	3	3	2	2	1			1	2	2	3	2	2		
4	3	2		3	3	3	3	1		3			2	1	2
5	3	3	3	3	3		3	1	3		3	3	2		
Avg.	3	2	2	3	3	2	2	1	2	2	2	2	2	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	PLANNING, SCHEDULING AND CONTROL OF CONSTRUCTION PROJECTS	L	T	P	C
		3	0	0	3

MODULE I CONSTRUCTION PLANNING 9

Basic Concepts in the Development of Construction Plans - Choice of Technology and Construction Method - Defining Work Tasks - Defining Precedence Relationships among Activities - Estimating Activity Durations - Estimating Resource Requirements for Work Activities - Coding Systems.

MODULE II SCHEDULING PROCEDURES AND TECHNIQUES 9

Construction Schedules - Critical Path Method - Scheduling Calculations - Float - Presenting Project Schedules - Scheduling for Activity-on-Node and with Leads, Lags, and Windows - Scheduling with Resource Constraints and Precedences - Use of Advanced Scheduling Techniques - Scheduling with Uncertain Durations - Calculations for Monte Carlo Schedule Simulation - Crashing and Time/Cost Tradeoffs - Improving the Scheduling Process.

MODULE III COST CONTROL, MONITORING AND ACCOUNTING 9

The Cost Control Problem - The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Schedule Control - Schedule and Budget Updates -S Curve - Earned value method -Relating Cost and Schedule Information.

MODULE IV QUALITY CONTROL AND SAFETY DURING CONSTRUCTION 9

Quality and Safety Concerns in Construction - Organizing for Quality and Safety - Work and Material Specifications - Total Quality Control - Quality Control by Statistical Methods - Statistical Quality Control with Sampling by Attributes - Statistical Quality Control with Sampling by Variables - Safety.

MODULE V ORGANIZATION AND USE OF PROJECT INFORMATION 9

Types of Project Information - Accuracy and Use of Information - Computerized Organization and Use of Information - Organizing Information in Databases - Relational Model of Databases - Other Conceptual Models of Databases - Centralized Database Management Systems - Databases and Applications Programs - Information Transfer and Flow.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Develop effective construction plans with right selection of technologies, estimation of duration and resources of construction projects.

CO2: Prepare work break down structure and schedule the activities of construction projects using network analysis.

CO3: Evaluate the project budget required for the particular construction project and monitor the projects through effective cost control techniques and procedures.

CO4: Apply the elements of quality control and safety of construction projects and recognize quality control tools in the construction industry.

CO5: Organize the project information in databases and use the right information at right time for projects.

TEXT BOOK:

1. "Construction Project Management: Planning, Scheduling and Control", K.K. Chitkara, Third edition, Tata McGraw-Hill Publishing Company, New Delhi, 2014.
2. "Construction Project Management - Theory and Practice", Kumar Neeraj Jha, Pearson Education India, 2011.

REFERENCES:

1. "Project Planning, Scheduling and Control in Construction: An Encyclopedia of Terms and Applications", Calin M. Popescu and Chotchai Charoenngam, Wiley, New York, 1995.
2. "Project Management for Construction - Fundamental Concepts for Owners, Engineers, Architects and Builders", Chris Hendrickson and Tung Au, Prentice Hall, Pittsburgh, 2000
3. "Statistical Quality Control: A Modern Introduction", Douglas C. Montgomery, Sixth edition, Wiley student edition, 2010.
4. "Scheduling Construction Projects", E. M. Willis, John Wiley & Sons, 1986.
5. "Financial and Cost Concepts for Construction Management", D. W. Halpin, John Wiley & Sons, New York, 1985.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	1	2	3	3	3	3	3	3
2	3	2	3			3	3	1	2	3	3		3	3	3
3	3	2	3		2	3	3	1	2	3		3	3	3	3
4	3		3		3	3	3	1	2	3	3		3	3	3
5	3	3	3	3	3	3	3	1	2	3		3	3		
Avg.	3	2	3	1	2	3	3	1	2	3	2	2	3	2	2

1 – Low, 2 – Medium, 3 – High

COURSE CODE	CONTRACT MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I CONSTRUCTION CONTRACTS **9**

Elements of Contracts - Types of Contracts - Features - Suitability - Salient Features of Indian contract Act 1872 as Relevant to Construction Contracts - Design of Contract Documents - International Contract Document - Standard Contract Document - Law of Torts- Contract for Engineering and Architectural Services- Contract between Owner and Contractor.

MODULE II TENDERS **9**

Types of Tenders - Notice Inviting Tender - Prequalification - Preparation and Submission of -Bid Documents & Tenders - Bidding - Acceptance/Rejection of Tenders - Evaluation of Tender from Technical, Contractual and Commercial Points of View - Contract Formation and Interpretation - Potential Contractual Problems - World Bank Procedures and Guidelines - Tamilnadu Transparency in Tenders Act - Local and International Competitive Bidding - Global Tendering.

MODULE III CONTRACT ADMINISTRATION AND MANAGEMENTS **9**

Selection of Project Management Team - Possession of Construction Site - Duties of Employers - Duties of Contractors - Settlement of Variations & Clarifications in Construction - Documentation and Maintenance of Construction Progress Records.

MODULE IV LEGAL REQUIREMENTS **9**

Legal Requirements for Planning - Property Law - Agency Law - Local Government Laws for Approval - Statutory Regulations - Social Security - Welfare Legislation - Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration - Insurance and Safety Regulations

MODULE V ALTERNATE DISPUTE RESOLUTION **9**

Claims and Disputes in Construction contracts - Various Methods of Settlement of Disputes - Alternate Dispute Resolution - Negotiation, Mediation, Conciliation and Arbitration - Salient Features of The Arbitration and Conciliation Act 1996 - Formation of Arbitration Tribunal - Interim Award - Conduct of Arbitration Proceedings - Award Writing and Setting aside of Award.

COURSEOUTCOMES

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

CO1: Select appropriate construction contract types based on project needs and legal requirements, ensuring compliance with the Indian Contract Act and international standards.

CO2: Prepare tender documents according to international and local bidding procedures, applying technical, contractual, and commercial criteria for effective contract formation.

CO3: Manage contract administration processes by defining roles and responsibilities, tracking variations, and maintaining proper documentation for optimal project control.

CO4: Identify and comply with relevant legal regulations related to planning and labor welfare.

CO5: Choose appropriate alternative dispute resolution methods to resolve contractual conflicts efficiently.

TOTAL: 45 PERIODS

TEXT BOOK:

1. “Black's Contract Law” by Michael J. Trebilcock and Douglas G. Stuart, 10th Edition, 2023.
2. “Construction Contracts: Law and Management” by Peter Hirst & Andrew Stones, Wiley Blackwell, 2020.

REFERENCES:

1. “Complex Procurement Contract Management” by David Brown, Routledge, 2023.
2. “Construction Law in India” by P.L. Malik, Viraj Publications, 2022. (8th Edition)
3. “International Construction Contracts: Law and Practice” by M. Lew and Patrick G. Coyne, Julian Routledge, 2022.
4. “Handbook of Contract Management in Construction” by Ali D. Haidar, Springer Cham, 1st Edition, 2021
5. “Construction Tendering and Bidding” by Michael O'Regan, Routledge, 2021.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105103093

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2					2							1	3	
2	2				1									3	
3	3										2				
4	2					3									
5	2							2							
AVg.	2				1	3		2			2		1	3	

COURSE CODE	FUNCTIONAL PLANNING, BUILDING SERVICES AND MAINTENANCE MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I URBAN FORMS, STREET SYSTEMS AND NEIGHBOURHOOD 9

Components of urban forms, methods of measurement, case studies. Planning of urban forms-ULB's-JNNURM, Smart City. Urban street system, street forms-Concepts-Neighborhood Module-Layout of a neighborhood.

MODULE II PLANNING 9

Development Control Guidelines, Functional planning of buildings, Circulation - Optimization of space - Spatial Synthesis graphical techniques, heuristic procedures - Formulation of linear and non-linear optimization problems.

MODULE III FIRE RESISTANCE 9

Standard for fire safety - Fire resistance/ Firefighting and extinguishing systems - Classification of buildings -Means of escape, alarms, etc - Space requirements and relationships for typical buildings like residential, offices, hospitals, etc.

MODULE IV ENGINEERING SERVICES 9

Engineering services in building system- Lighting, Ventilation and Psychometric charts, Air Conditioning Introduction, Lifts & Escalators, Cold and Hot water systems - Waste water systems - Electrical systems.

MODULE V MAINTENANCE MANAGEMENT 9

Building Maintenance/ Facilities Management -Planning-Handover, Scheduled and contingency maintenance - M I S for building maintenance - Maintenance standards and maintenance contracts -Economic maintenance decisions.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Review the development of modern urban form, street and neighbourhood pattern.

CO2: Explain the current development and regulatory guidelines applicable to local urban bodies.

CO3: Evaluate fire protection and resistance systems for multi-storied buildings as per regulatory guidelines.

CO4: Apply engineering principles to evaluate building services applicable to multi-storied buildings.

CO5: Develop maintenance plans post-handover and subsequent maintenance programme. Understand facility management aspects.

TEXT BOOK:

1. "Dimensions of the Sustainable City", Mike Jenks, Colin Jones, Springer, 2009.
2. "Creating Neighbourhoods and Places in the Built Environment", D. Chapman, 1996.

REFERENCES:

1. “Streets and Patterns”, Stephen Marshall, 2005.
2. “Building Services Engineering”, David V. Chadderton, 5th edition, 2007.
3. “Practical Optimization Methods - With Mathematica Applications”, M. Bhatti, Springer, 2000
4. “Optimization Modelling: A Practical Approach”, Ruhul Amin Sarker, Charles S. Newton, 2007.
5. “Building Maintenance Management”, Barrie Chanter, Peter Swallow, Wiley-Blackwell, 2007.
6. “National Building Code”, NBC 2016 - Vol 1, Vol II
7. “Lighting and Ventilation”, SP 32, 1986
8. “National Electrical Codes”, SP 30, 2011
9. “Handbook on Water Supply and Drainage”, SP 35

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	2	3	2	1	2	3	2	2	2	2	3
2	2	2			2	3	2	1	2	3	2	2	2	2	3
3	1	1	2	2		3	2	1	2	3		2	2	2	3
4	2	2			2	3	2	1	2	3	2		2		3
5	2	2	2	2	2	3	2	1	2	3	2	2	2	2	3
Avg.	2	2	1	1	2	3	2	1	2	3	2	2	2	2	3

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ADVANCED CONSTRUCTION METHODS AND TECHNIQUES	L	T	P	C
		3	0	0	3

MODULE I SUB STRUCTURE CONSTRUCTION 9

Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

MODULE II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS 9

Concrete paving technology - Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections - Erection techniques of tall structures, Large span structures - launching techniques for heavy decks - in- situ prestressing in high rise structures, Post tensioning of slab - Construction techniques of long span prestressed concrete bridges - aerial transporting - Handling and erecting lightweight components on tall structures.

MODULE III CONSTRUCTION OF SPECIAL STRUCTURES 9

Erection of lattice towers - Rigging of transmission line structures - Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges - Launching and pushing of box decks - Construction of jetties and break water structures - Construction sequence and methods in domes - Support structure for heavy equipment and machinery in heavy industries - Erection of articulated structures and space decks. Construction techniques of prefabricated tall structures.

MODULE IV REHABILITATION AND STRENGTHENING TECHNIQUES 9

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation - Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

MODULE V DEMOLITION 9

Planning, Building Appraisal and Demolition Plan, Utilities, Hazardous Material, precautionary measures, Demolition Techniques- Interior Demolition- Selective Demolition-Total Demolition, Mechanical Method by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, special structures - Prestressed Concrete Structures - Composite Structures and Steel Structures - Hanging Structures-Underground Structures- Structures Supporting Ground or Sitting on Slopes, site supervision and inspection, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Develop competence for selection of suitable construction technique/methods for substructure and superstructure.

CO2: Propose and evaluate alternative construction systems and methods in response to given building performance requirements.

CO3: Appreciate and prepare for the management of innovative practice in the field of construction technology.

CO4: Demonstrate a high level of technological understanding of the design of buildings and associated construction processes and solutions.

CO5: Critically analyse and resolve ad-hoc construction related problems.

TEXT BOOK:

1. “Advanced Construction Techniques”, Jerry Irvine, CA Rocketr, 1984.
2. “Construction Dewatering: New Methods and Applications”, Patrick Powers J., John Wiley & Sons, 1992.

REFERENCES:

1. “Concrete Repair and Maintenance Illustrated”, Peter H. Emmons, Galgotia Publications Pvt. Ltd., 2001.
2. “Practical Foundation Engineering Handbook”, Robert Wade Brown, McGraw Hill Publications, 1995.
3. “Construction Technology”, Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi, 2008.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2	2	2	1	2	3	3	3	1	2	3
2	3	2	3		2	2		1	2			2	1	2	3
3	2	1	2			3				3	3	3	1	2	3
4	3	2	3	2		2	2	1	2			2	1	2	3
5	2	1	2	3	2	2						1	1	2	3
Avg.	3	2	3	1	1	2	1	1	1	1	1	2	1	2	3

1 – Low, 2 – Medium, 3 – High

COURSE CODE	CONSTRUCTION RISK MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I RISK CONCEPTS **9**

Definitions of risk - Importance and types of risk - Elements of risk management - Causes of risk - Principles of risk management -Risk management process - Risk identification and assessment – Aspects of risk management - Risk management plan and evaluation - Risk treatment - Role of Human Resource Management in risk Management.

MODULE II PLANNING FOR RISK **9**

Components of risk management - Planning for risk management - Project charter - Risk management policies - roles and responsibilities - examining stakeholder tolerance - risk management plan template - revisiting the work breakdown structure - risk management plan - risk registers - creating the risk management plan - risk analysis – tracking.

MODULE III RISK IDENTIFICATION **9**

Identifying risk - preparing for risk identification - risk categories - referring to historical information - identifying the project risks - reviewing project documents - brainstorming - the Delphi technique - analyzing SWOT - diagrammatic techniques.

MODULE IV RISK RESPONSE **9**

Preparing for risk response - creating risk response - result of risk response planning - risk monitoring and control - risk communication - informing public about risk and responding to express concerns – education.

MODULE V RISK MANGEMENT ASPECTS **9**

Risk planning and management case studies - engineering contracts, project delivery -strategies and international project risk - management of risk in construction industry - dealing with uncertainties - risk mitigation - by elimination, reducing, transferring, avoiding, absorbing or pooling.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Discover various risk management principles and to implement risk management program in construction projects.

CO2: Identify the various issues associated with construction risk.

CO3: Adapt techniques to identify and quantify construction risks.

CO4: Develop risk containment and risk reduction policies.

CO5: Manage risk effectively for better decision making.

TEXT BOOK:

1. “PMP Project Management Professional Study Guide”, Joseph Phillips, McGraw-Hill.
2. “Project Risk Management”, Bruce Barkley.

REFERENCES:

1. “Risk and Decision Analysis in Projects”, John R. Schuyler, Cases in Project and Program Management Series.
2. “Project Risk Management: Process, Techniques and Insights”, Chris Chapman and Stephen Ward.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2	2	2	1	2	3	3	3	1	2	3
2	3	2	3		2	2		1	2			2	1	2	3
3	2	1	2			3				3	3	3	1	2	3
4	3	2	3	2		2	2	1	2			2	1	2	3
5	2	1	2	3	2	2						1	1	2	3
Avg.	3	2	3	1	1	2	1	1	1	1	1	2	1	2	3

1 – Low, 2 – Medium, 3 – High

COURSE CODE	SHORING, SCAFFOLDING AND FORMWORK	L	T	P	C
		3	0	0	3

MODULE I PLANNING SITE EQUIPMENT & PLANT FOR FORMWORK 9

Introduction - Formwork as a temporary structure - Requirements for formwork - classification of formwork- Formwork elements - Key areas of cost reduction of formwork - Economical planning of form materials- Planning for Safety - Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Scaffold frames.

MODULE II FORMWORK MATERIALS, ACCESSORIES, PROPRIETARY PRODUCTS & PRESSURES 9

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood -Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of forms - Uplift on shores - Laterals loads.

MODULE III DESIGN OF FORMS AND SHORES 9

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length - Form lining - Design Tables for Wall formwork - Slab Formwork - Column Formwork - Tubular steel shores patented shores - Steel Tower Frames - Safety practices.

MODULE IV BUILDING AND ERECTING THE FORM WORK 9

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Flying system forms- Prefabricated panel systems -Giant forms- curved wall forms- Beam or girder forms - suspended forms - Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

MODULE V FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS 9

Formwork for domes - Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method. Slip Forms – Principles -Types - advantages - Functions of various components - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - timber scaffolds, metal scaffolds and some proprietary scaffolds - possible causes for collapse of scaffold systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Identify the various formwork systems and prepare cost effective overall and detailed planning of formwork, plant and site equipment.

CO2: Select material accessories for formwork connection and analyze pressures on formworks.

CO3: Apply the design principles of formwork for various elements such as slabs, beams, columns, and walls.

CO4: Apply the knowledge of erecting forms for beams, slabs, columns, walls, and assess the causes of failures.

CO5: Apply the knowledge of forms and their erection for domes and tunnels, types of slip forms, and scaffolds.

TEXT BOOK:

1. "Formwork for Concrete Structures", Robert L. Peurifoy and Garold D. Oberlender, McGraw-Hill, 1996.
2. "Formwork for Concrete", Hurd, M.K., Special Publication No.4, American Concrete Institute, Detroit, 1996.

REFERENCES:

1. "Formwork for Concrete Structures", Kumar Neeraj Jha, McGraw Hill Education (India) Private Limited, New Delhi, 2017.
2. "Formwork for Concrete", Austin, C.K., Cleaver-Hume Press Ltd., London, 1996.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	2	2	1	2	3	3	2	1	2	3
2	2		2	2		2		1	2	3	2	2	1		
3	2	2		2	2		2	1	2	3	2		1	2	
4	2			3		2		1	2		2		1		3
5	2	2	2	2	3		2	1	2	3	2	2	1	2	
Avg.	2	1	1	2	1	1	1	1	2	2	2	1	1	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	VALUATION OF IMMOVABLE PROPERTIES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF VALUATION AND VALUATION OF LAND & BUILDING 9

Definition - Cost, Price and Value - Types of Properties under Valuation - Various Purposes of Valuation- Different types of Value - Factors affecting Value - Different Methods of Valuation.

Types of Land - Location of Land and its Value - Belting Method of Valuation - Market Value and Guideline Value of Land - Building FSI - Plot Coverage - Types of Structure - Life of Various types of Building - Methods of Calculating Depreciation - Valuation by Land and Building Method.

MODULE II FREE HOLD AND LEASE HOLD PROPERTIES AND FIXATION OF FAIR RENT 9

Free hold and Lease hold Properties - Lease, Rent and License - Different forms of Lease - Lessor - Lessee - Sub-lessee - Reversion - Lessor' Rights - Lessee's Rights - Meaning of Different Rents - Fixation of Fair Rent - Principles of fixation of fair rent-Amenities to be considered - Rent fixation for Residential & Non-Residential purposes, Commercial Buildings, Apartments

MODULE III VALUATION OF APARTMENTS 9

FSI - Super Built-up Area - Undivided Share of Land - Different Methods of Valuation - Procedure of Valuation by Composite Rate Method - Valuation by Other Methods - Procedure for Valuation of Flat under Construction - Stage Value of a flat - Valuation of an existing flat - Joint Venture Agreement

MODULE IV VALUATION FOR BANKS 9

Purposes - Security - Primary and Collateral - Present, Market, Forced Sale and Auction Value - Valuation of Building under Construction - Valuation of Ready Built House - Valuation of Ready built Flats - Valuation of Flats under construction - Valuation of Properties offered as Collateral Security - How to become a Panel Valuer of Banks - Problems involved in Bank Valuation - Precautions to be taken in Bank Valuation - Points to be remembered in Bank valuation.

MODULE V VALUATION FOR TAXATION 9

Direct and Indirect Taxes - Valuation for Income Tax - Estimation of Cost of Construction by Plinth area rate method - Valuation by CPWD and State PWD Rates - Cost of Construction by accounting method - Valuation for Capital Gains Tax - Fair Market Value as on 01.04.1981 and 01.04.2001 - Section 50C of Income Tax Act - Valuation for individual Property - Valuation of Apartment

COURSEOUTCOMES

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

CO1: Analyze and apply fundamental valuation principles to land and buildings, considering various purposes and methods, demonstrating a clear understanding of key terminology and factors impacting value

CO2: Integrate between freehold and leasehold properties and effectively calculate fair rent, applying legal principles and considering amenities and property type.

CO3: Interpret the valuation methods, including the composite rate method, to accurately assess the value of apartments considering FSI, super built-up area, and stage of construction.

CO4: Demonstrate expertise in bank valuation, accurately assessing property value for security purposes and understanding the role of panel valuers, while adhering to ethical and legal guidelines.

CO5: Apply valuation principles for tax purposes, including income tax and capital gains tax, considering relevant legislation and methods for estimating construction costs and fair market value.

TOTAL: 45 PERIODS

TEXT BOOK:

1. "Valuation of Urban and Rural Land" by A.M. Michael & John G. Wilkins, Routledge, 2023.
2. "Valuation of Apartments" by S.K. Agarwal, Khanna Publishers, 2022.

REFERENCES:

1. "Modern Law of Real Property" by Michael Bridge, Cavendish Publishing, 2023.
2. "Fundamentals of Real Estate Appraisal" by Richard Ratcliff, American Institute of Real Estate Appraisers (AIREA), 2021.
3. "The Law of Leasehold Reform, Housing and Urban Development Acts" by Stephen Furmston, Sweet & Maxwell., 2021.
4. "Valuation of Real Properties" by Rangwala, Charotar Publishing House, 2020.
5. "Property Valuation" by Peter Wyatt, Wiley-Blackwell, 2018.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/109107115

CO-PO&PSOMAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				1								2		
2	2					1							2		
3	3												2		
4	3					2							2		
5	3												2		
AVg.	3				1	2							2		

1 – Low, 2 – Medium, 3 – High

COURSE CODE	CONSTRUCTION SAFETY AND HEALTH MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I CONSTRUCTION ACCIDENTS 9

Accidents and their Causes - Human Factors in Construction Safety - Costs of Construction Injuries - Occupational and Safety Hazard Assessment - Legal Implications.

MODULE II SAFETY PROGRAMMES 9

Problem Areas in Construction Safety - Elements of an Effective Safety Programme - Job-Site Safety Assessment - Safety Meetings - Safety Incentives - Contractual Obligations - Safety Clauses in Construction Contracts - Substance Abuse - Safety Record Keeping.

MODULE III DESIGNING FOR SAFETY 9

Safety Culture - Safe Workers - Safety and First Line Supervisors - Safety and Middle Managers - Top Management Practices, Company Activities and Safety - Safety Personnel - Sub contractual Obligation - Project Coordination and Safety Procedures - Workers Compensation.

MODULE IV HEALTH MANAGEMENT IN CONSTRUCTION SITES 9

Occupational Health - Effects of Material Handling on Health - Health Hazards in Construction Site - Disease Prone Environment in Construction Site - Precautionary Measures - Health Monitoring and Treatment - Safety Measures during Material Handling.

MODULE V OWNERS' AND DESIGNERS' OUTLOOK 9

Responsibilities of owners - Precautions to be taken - Insurance for Workers and Materials – Commitments in case of Accidents - Legal Requirements from Owners' Perspective - Design for Safety in Constructions - Designers Commitments in Design with Safety Perspectives.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Interpret and explain the various safety concepts, requirements applied to construction projects.

CO2: Explain the importance of managing health and safety in construction and the related key legislation.

CO3: Develop a safe working environment in construction industry by implementing safety procedures.

CO4: Inference on construction accidents and their causes.

CO5: Perceive towards responsibility of owners and designers in construction projects.

TEXT BOOK:

1. “Construction Safety”, Jimmy W. Hinze, Prentice Hall Inc., 1997.
2. “Construction Safety and Health Management”, Richard J. Coble, Jimmie Hinze, and Theo C. Haupt, Prentice Hall Inc., 2001.

REFERENCES:

1. “Tamilnadu Factory Act”, Department of Inspectorate of Factories, Tamil Nadu.
2. “BIS Code of Practice for Safety Management”.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	1	1	2	1	2	2	2	2	2	1	1	1
2	2				1	2	1	2				2	1	1	1
3	2		2	1	1		1		2	2	2		1		1
4	2	2				2	1			2	2	2	1	1	
5	2	2	2	1	1		1	2	2					1	1
Avg.	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	ENVIRONMENTAL IMPACT ASSESSMENT FOR CONSTRUCTION ENGINEERS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION **9**

Sustainable Development challenges and needs - Key approaches for Impact Assessment – EIA approach: historical development - Legal and Regulatory aspects in India - Types and Objectives, Components, Process of EIA.

MODULE II PREDICTION AND ASSESSMENT **9**

Prediction and Assessment: tools - impact on air, water, soil & Noise - Role of Biodiversity impact Assessment - Identification, Prediction and Evaluation of Impacts on Biodiversity - Techniques of Biodiversity impact assessment - EIA Report Preparation - Environmental Management Plan: Preparation and implementation - Mitigation and Rehabilitation plans - Post Project Audit.

MODULE III HEALTH AND SOCIO-ECONOMIC IMPACT ASSESSMENT **9**

Health Assessment: Impact of Environment on Health - Developing framework for Health impact analysis, tools, and techniques - Socio-Economic Impact Assessment: Overview and Scope of Social Impact Assessment - SIA model and the planning process - Land acquisition: Legal aspects, Resettlement & Rehabilitation, and Development.

MODULE IV INTEGRATED ANALYSIS **9**

Integrated Analysis of Environmental, Social, and Health Impacts - Challenges for Integrated Approach - Scope for Integrated approach in economic analysis - CBA, Social CBA, and Cost-effectiveness Analysis - Analytic Hierarchy process-based Approach - Emerging Dimensions and Future Directions.

MODULE V IMPACT OF INFRASTRUCTURE AND ENVIRONMENTAL SERVICES **9**

Case Studies: EIA for Mining, extraction of natural resources and power generation - Primary Processing and Material Production - Material Processing, Manufacturing/Fabrication - Service Sectors - Physical Infrastructure including Environmental Services - Building and Construction Projects - Area Development Projects and Townships - Strategic Environmental Assessment, Technological Assessment, and Risk Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Apply the knowledge of science and engineering fundamentals to sustainable development challenges.

CO2: Explain the identification, prediction, and evaluation of impacts that will be caused by projects or industries on biodiversity.

CO3: Identify the legal requirements of environmental impact assessment for projects.

CO4: Develop the ability to perform integrated analysis by considering environmental, social, and health impacts.

CO5: Select appropriate methods for environmental impact assessment for Infrastructure and environmental service.

TEXT BOOK:

1. "Environmental Impact Assessment Methodologies", Anjaneyulu, Yerramilli, and Valli Manickam, Third Edition, BS Publications, Hyderabad, 2022.
2. "Environmental Impact Assessment – Practical Solutions to Recurrent Problems", Lawrence, D.P., Wiley-Interscience, New Jersey, 2003.

REFERENCES:

1. "Handbook of Environmental Impact Assessment", Petts, J., Vol. I and II, Blackwell Science, London, 1999.
2. "Environmental Impact Assessment", Canter, L.W., McGraw Hill, New York, 1996.
3. World Bank – Source Book on Environmental Impact Assessment, 2010

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	2	3	2	2	2	2	3	1	1	1
2	2		2	2	2	2	3				2	2	1	1	1
3	1		1			2	3	2	2	2	1	2	1	1	1
4	2	2	2	2	2						2		1	1	1
5	2	1	1	2	2	2	3	2	2	2	2	2	1	1	1
Avg.	2	1	2	2	2	2	2	1	1	1	2	2	1	1	1

1 – Low, 2 – Medium, 3 – High

COURSE CODE	DESIGN OF ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION **9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

MODULE II PASSIVE SOLAR HEATING AND COOLING **9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds – Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

MODULE III DAYLIGHTING AND ELECTRICAL LIGHTING **9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

MODULE IV HEAT CONTROL AND VENTILATION **9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters - Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation - Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation - Calculation of probable indoor wind speed.

MODULE V DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: Assess the principles for designing energy-efficient buildings, considering climate adaptation and sustainable construction.

CO2: Apply key design elements for passive solar heating, cooling, and efficient lighting strategies.

CO3: Discuss the various aspects of day-lighting and electrical lighting in a building.

CO4: Predict and design building ventilation and heat control for indoor comfort.

CO5: Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations.

TEXT BOOK:

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2018.
2. "Sun, Wind and Light - Architectural Design Strategies", Brown, G.Z. and DeKay, M., 3rd Edition, John Wiley and Sons Inc., 2014.

REFERENCES:

1. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 (S and T), 1995.
2. "Residential Energy: Cost Savings and Comfort for Existing Buildings", John Krigger and Chris Dorsi, Saturn Resource Management, 2013.
3. "Energy-Efficient Buildings in India", Majumdar, M. (Ed), Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

CO - PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	2			2	2	2	3	1	1	1
2	2		3	2	2		3	1	2	2		2	1	1	1
3	2	1	2	1	1	2		1			2	2	1	1	1
4	2	2					1	1	2	2		2	1	1	1
5	3	2		2	2	2		1			2	3	1	1	1
Avg.	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1

1 – Low, 2 – Medium, 3 – High