

Semester: 7



ALBERTIAN INSTITUTE OF SCIENCE AND TECHNOLOGY

Approved by AICTE, New Delhi, Affiliated to APJAKTU, Thiruvananthapuram

Accredited Programmes in CE, CSE, ECE, EEE, ME ISO 9001:2015 CERTIFIED

DEPARTMENT OF CIVIL ENGINEERING

Program: B.Tech (2019 Regulation)

Course Handout

Vision

To create technically competent and industry ready Civil Engineers having innovative and leadership qualities to serve the society and nation.

Mission

- Provide technical skills par excellence to face the challenges in the field of Civil Engineering.
- Promote innovative and original thinking in the minds of budding engineers.
- Generate research opportunities by undertaking collaborative projects through institute-industry interaction.
- Create quality engineers to provide solutions to the emerging societal problems and advance entrepreneurial ventures.

Program Educational Objectives (PEOs)

Graduates of Civil Engineering shall

PEO1: Demonstrate the knowledge and skills to solve real world engineering problems.

PEO2: Exhibit professional ethics, good interpersonal and leadership skills to meet professional excellence.

PEO3: Function effectively in a team, providing optimal, innovative and facilitative solutions for the betterment of society.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

The graduates of Civil Engineering will be able to

PSO1: Identify, formulate, analyse and design civil engineering problems by applying the knowledge of mathematics, science and engineering fundamentals.

PSO2: Interact with engineers from other disciplines to provide innovative/sustainable solutions for the benefit of society.

PSO3: Apply appropriate techniques and modern engineering tools to synthesize and analyse complex civil engineering problems.

Curriculum
Semester I

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 101	LINEAR ALGEBRA AND CALCULUS	3-1-0	4	4
B	CYT 100	ENGINEERING CHEMISTRY	3-1-0	4	4
C	EST 110	ENGINEERING GRAPHICS	2-0-2	4	3
D	EST 120	BASICS OF CIVIL ENGINEERING BASICS OF MECHANICAL ENGINEERING	4-0-0	4	4
E	HUT 101	LIFE SKILLS	2-0-2	4	-
S	CYL 120	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T	ESL 120	CIVIL ENGINEERING WORKSHOP	0-0-2	2	1
	ESL 120	MECHANICAL ENGINEERING WORKSHOP			
R/M/H	ESL 120	REMEDIAL/MINOR/HONOURS COURSE	3-1-0	4*	4
TOTAL				24	17

Semester II

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 102	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0	4	4
B	PHT 110	ENGINEERING PHYSICS B	3-1-0	4	4
C	EST 100	ENGINEERING MECHANICS	2-1-0	3	3
D	EST 130	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	HUN 102	PROFESSIONAL COMMUNICATION	2-0-2	4	-
F	EST 102	PROGRAMMING IN C	2-1-2	5	4
S	PHL 120	ENGINEERING PHYSICS LAB	0-0-2	2	1
T	ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				28	21

Semester III

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
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A	MAT 201	PARTIAL DIFFERENTIAL EQUATION	3-1-0		
B	CET201	MECHANICS OF SOLIDS	3-1-0		
C	CET203	FLUID MECHANICS & HYDRAULICS	3-1-0		
D	CET205	SURVEYING & GEOMATICS	4-0-0		
E	HUT 200	PROFESSIONAL ETHICS	2-0-0		
F	MCN201	SUSTAINABLE ENGINEERING	2-0-0		
S	CEL201	CIVIL ENGINEERING PLANNING & DRAFTING LAB	0-0-3		
T	CEL203	SURVEY LAB			
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				28	21

Semester IV

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT202	PROBABILITY, STATISTICS AND NUMERICAL METHODS	3-1-0	4	4
B	CET202	ENGINEERING GEOLOGY	3-0-1	4	4
C	CET204	GEOTECHNICAL ENGINEERING – I	4-0-0	4	4
D	CET206	TRANSPORTATION ENGINEERING	4-0-0	4	4
E	EST200	DESIGN & ENGINEERING	2-0-0	2	2
F	MCN202	CONSTITUTION OF INDIA	2-0-0	2	-
S	CEL202	MATERIAL TESTING LAB– I	0-0-3	3	2
T	CEL204	FLUID MECHANICS LAB	0-0-3	3	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				26/30	21

Semester V

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CET 301	STRUCTURAL ANALYSIS -I	3-1-0	4	4
B	CET 303	DESIGN OF CONCRETE STRUCTURES	3-0-0	4	4
C	CET 305	GEOTECHNICAL ENGINEERING II	3-0-0	4	4
D	CET 307	HYDROLOGY & WATER RESOURCES ENGINEERING	3-0-0	4	4
E	CET 309	CONSTRUCTION TECHNOLOGY & MANAGEMENT	3-0-0	3	3
F	MCN 301	DISASTER MANAGEMENT	2-0-0	2	-
S	CEL 331	MATERIALS TESTING LAB II	0-0-3	3	2
T	CEL 333	GEOTECHNICAL ENGINEERING LAB	0-0-3	3	2

R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				27/31	23/27

Semester VI

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CET302	STRUCTURAL ANALYSIS – II	3-1-0	4	4
B	CET304	ENVIRONMENTAL ENGINEERING	4-0-0	4	4
C	CET306	DESIGN OF HYDRAULIC STRUCTURES	4-0-0	4	4
D	CET 322	GEOTECHNICAL INVESTIGATION	3-0-0	3	3
	CET352	ADVANCED CONCRETE TECHNOLOGY		3	3
E	HUT300	INDUSTRIAL ECONOMICS & FOREIGN TRADE	3-0-0	3	3
F	CET308	COMPREHENSIVE COURSE WORK	1-0-0	1	1
S	CEL332	TRANSPORTATION ENGINEERING LAB	0-0-3	3	2
T	CEL334	CIVIL ENGINEERING SOFTWARE LAB		3	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				25/29	23/27

Semester VII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CET401	DESIGN OF STEEL STRUCTURES	3-0-0	3	3
B	CET 423	GROUND IMPROVEMENT TECHNIQUES	3-0-0	3	3
	CET 453	CONSTRUCTION PLANNING AND MANAGEMENT	3-0-0	3	
C	MET445	RENEWABLE ENERGY ENGINEERING	3-0-0	3	3
D	MCN401	INDUSTRIAL SAFETY ENGINEERING	2-1-0	3	-
S	CEL411	ENVIRONMENTAL ENGG. LAB	0-0-3	3	2
T	CEQ413	SEMINAR	0-0-3	3	2
U	CED415	PROJECT PHASE I	0-0-6	6	2
R/M/H	VAC	Remedial/Minor/Honours course	3-1-0	4*	4
TOTAL				24/28	15/19

Semester VIII

SLOT	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	CET402	QUANTITY SURVEYING & VALUATION	3-0-0	3	3
B	CET 464	AIR QUALITY MANAGEMENT	3-0-0	3	3
	CET454	CONSTRUCTION METHODS & EQUIPMENT			
C	CET456	REPAIR AND REHABILITATION OF BUILDINGS	3-0-0	3	3
	CET476	BUILDING SERVICES			
D	CET458	SUSTAINABLE CONSTRUCTION	3-0-0	3	3
	CET468	CLIMATE CHANGE AND SUSTAINABILITY			
E	CET404	COMPREHENSIVE VIVA	1-0-0	1	1
U	CED416	PROJECT PHASE II	0-0-12	12	4
R/M/H	VAC	REMEDIAL/MINOR/HONOURS COURSE	3-1-0	4*	4
TOTAL				25/29	17/21

Course Code & Name: CET401 DESIGN OF STEEL STRUCTURES**1. Prescribed Syllabus**

Module	Topic	Hours
1	Introduction to steel and steel structures, properties of steel, structural steel sections. Introduction to design: Design loads and load combinations, limit state design concepts. Connections bolted and welded (direct loads)	7
2	Tension members-Types of sections – net area- design of tension members- concept of shear lag-use of lug angle-connections in tension members	7
3	Compression members- design of struts- solid and built up columns for axial loads-design of lacings and battens-column bases- slab base – gusseted base	7
4	Design of beams- laterally restrained and unrestrained – simple and compound beams plate girders subjected to uniformly distributed loads – design of stiffeners.	7
5	Design of roof trusses- types-design loads and load combinations-assessment of wind loads- design of purlins. Moment resistant/Eccentric connections (in plane and out of plane). Fire resistant design-criterion-fire resistance assessment-material property-design approach-passive protection for steel work-fire resistant steel-fire performance assessment	7

2. Text Books (T)

T1. Punmia B. C., Jain A. K. and Jain A. K., Design of Steel Structures, Laxmi Publications (P) Ltd, 2017

T2. Ramchandra S and Virendra Gehlot, Design of Steel Structures Vol. II, Standard Book House, 2007

3. Reference Books (R)

R1. N.Subramanian; Steel Structures, Oxford Publication

R2. V L Shah & Veena Gore, Limit State Design of steel Structures, Structures Publications, 2009

R3. P. Dayaratnam., Design of Steel Structures, Wheeler Publishing, 2003

R4. IS 800 – 2007, Code of practice for Structural steel design, BIS

R5. IS:875-Part 3-2015 Design loads for buildings Part 3: Wind loads, BIS

4. Course Objectives

Goal of this course is to expose the students to the fundamental concepts of DESIGN OF STEEL STRUCTURES. After this course, students will be able to design steel structures and to recognize practical problems in real-world situations and respond accordingly.

5. Course Pre / Co-requisite

CET302 Structural Analysis II

6. Course Outcomes

After the successful completion of course, student will be able to

CO1: Explain the behavior and properties of structural steel members to resist various structural forces and actions and apply the relevant codes of practice

CO2: Analyses the behavior of structural steel members and undertake design at both serviceability and ultimate limit states

CO3: Explain the theoretical and practical aspects of Design of composite Steel Structure along with the planning and design aspects

CO4: Apply a diverse knowledge of Design of Steel engineering practices applied to real life problems

CO5: Demonstrate experience in the implementation of design of structures on engineering concepts which are applied in field of Structural Engineering.

7. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	H	M											H		
CO2	M	H	M										H		
CO3	M	H	M										H		
CO4	M	H	H										H		
CO5	M	H	H										H		

8. Justification for CO-PO-PSO Correlation

CO	PO/PSO	Justification
CO1	PO1	Knowledge on fundamental principles of structural analysis will enable students to explain basic structural behavior of steel members
	PO2	Understanding the basic structural behaviour will enable students to analyse steel members subjected to various loads with aid of relevant IS codes
	PSO1	Knowledge about properties of steel structures will enable students to analyse and design steel members using IS code specifications.
CO2	PO1	Understanding fundamentals of limit state method will help students to design steel members using IS specification
	PO2	Knowledge on limit state method will help students to analyse steel structural members.
	PO3	Knowledge about design principles will enable students to design steel members at both serviceability and ultimate limit states adhering to IS code specifications.
	PSO1	Understanding the fundamental concepts of limit state method will enable students to analyse and design simple steel structures.

CO3	PO1	Understanding the fundamental design aspects of limit state method will help students to explain design aspects of composite steel structures.
	PO2	Knowledge about IS specification will help students to analyse steel beams and columns subjected to various loading conditions.
	PO3	Understanding the theoretical and practical aspects of design will help students to design structural beams and columns as per IS specification.
	PSO1	Knowledge about design aspects will enable students to design structural beams and column as per IS specification
CO4	PO1	Knowledge about design considerations in limit state method will help students to design various structural elements.
	PO2	Understanding the structural behaviour of steel members will enable students to analyse structural elements.
	PO3	Knowledge on IS specification will help students to design steel elements in real life problems.
	PSO1	Understanding engineering concepts will help students to analyse and design various steel members in real life situations.
CO5	PO1	Understanding the engineering concepts will help student to design structures in the field of structural engineering.
	PO2	Knowledge about design principles will help students to analyse structures in the field of engineering.
	PO3	Understanding IS specifications and recommendations will help students to design solutions for complex engineering problems adhering public health and safety.
	PSO1	Knowledge about design concepts will enable students to analyse and design civil engineering problem

9. Curricular gaps (if any)

NIL

10. Course Enrichment Activities*

Sl No	Description	Proposed Activities **	Relevance to POs and PSOs
1	Site Visit	Field Visit to Ongoing Steel Structure Construction Project	PO1, PO2, PSO1

11. Internal Assessment mark allocation (as per university curriculum)

(Provide details as mentioned in syllabus)

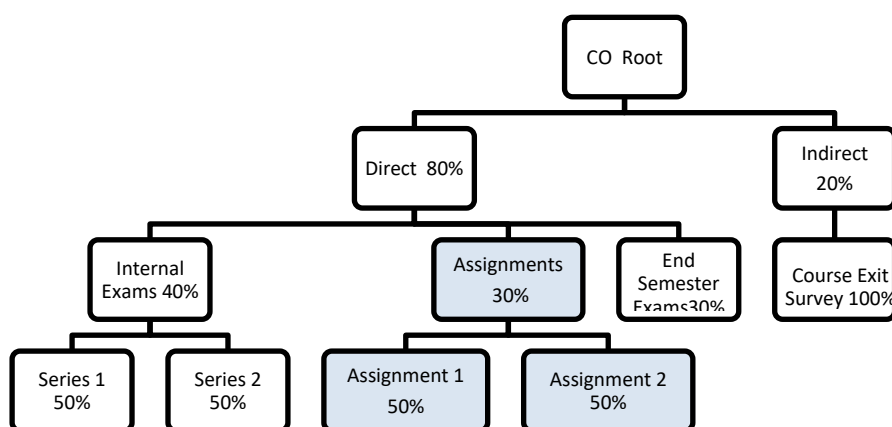
Attendance	- 10 marks
Continuous Assessment Test	- 25 marks
Assignment (s)/ Course Project	- 15 marks
<u>Total</u>	<u>- 50 marks</u>

12. Assessment – CO Mapping (Put ‘ x ’ if mapping is present)

	Tools		Weightage #	CO1	CO2	CO3	CO4	CO5
	Internal Exam(s)	Series 1	20%	x	x			
		Series 2	20%	x	x	x	x	x

Direct Assessment Tools**	40%							
	Assignment (s)/ Course Project /Quiz etc. 30%	Assignment 1	15%	x	x			
		Assignment 2	15%			x	x	x
	End Semester Exam		30%	x	x	x	x	x
Indirect Assessment Tool	Course Exit Survey		100%	x	x	x	x	x

13. Assessment Configuration



14. Course Plan

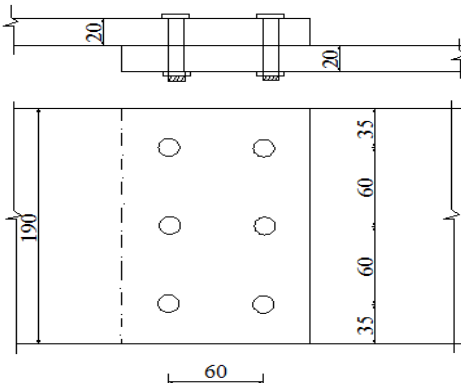
Hour	Topic	Module	Reference(s)	Teaching Pedagogy
1.	Introduction to steel and steel structures	1	T1,T2,R1,R2,4,R5	Lecture
2.	Properties of structural steel and types of Structural steel sections	1	T1,T2,R1,R2,4,R5	Lecture
3.	Introduction to design-design philosophies- Design loads and load combinations	1	T1,T2,R1,R2,4,R5	Lecture
4.	Connections: Bolted-different types-joints (lap joint, butt joint) - Lap joint-eccentric loaded connections-beam to beam connections-Prob 1,2	1	T1,T2,R1,R2,4,R5	Lecture
5.	Remedial -Design of lap joint (bolted joint)	1	T1,T2,R1,R2,4,R5	Remedial
6.	Butt Joint- eccentric loaded connections-beam to beam connections -Prob3	1	T1,T2,R1,R2,4,R5	Lecture
7.	Butt Joint- eccentric loaded connections-beam to beam connections -Prob4	1	T1,T2,R1,R2,4,R5	Lecture

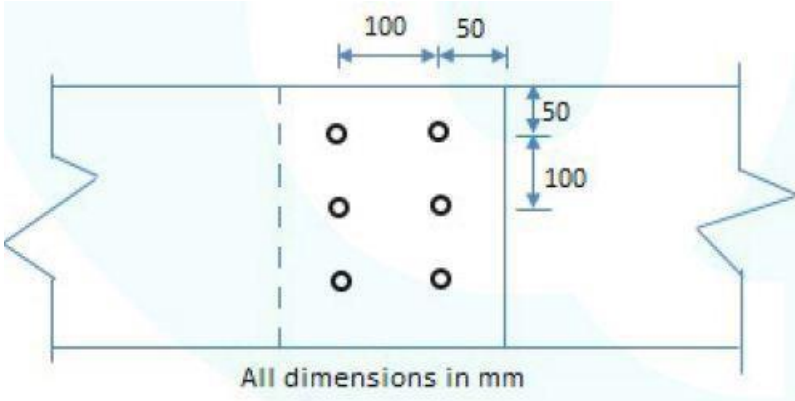
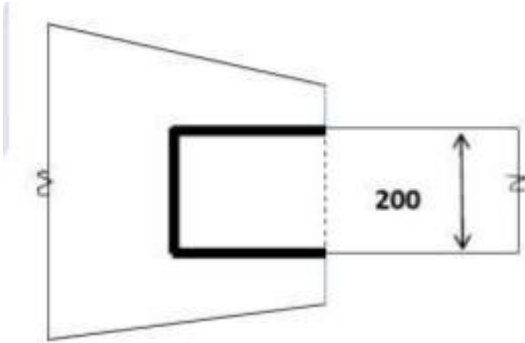
8.	Connections : Welded-different types-joints(lap joint, butt joint) - Lap joint-eccentric loaded connections-beam to beam connections-Prob 5,6	1	T1,T2,R1,R2,4,R5	Lecture
9.	Remedial -Design of butt joint (bolted joint)	1	T1,T2,R1,R2,4,R5	Remedial
10.	Butt joint-eccentric loaded connections-beam to beam connections 6,7	1	T1,T2,R1,R2,4,R5	Lecture
11.	Introduction- Types of tension members	2	T1,T2,R1,R2,4,R5	Lecture
12.	Modes of failure	2	T1,T2,R1,R2,4,R5	Lecture
13.	Factors affecting strength of tension members	2	T1,T2,R1,R2,4,R5	Lecture
14.	Design of tension members -Prob1	2	T1,T2,R1,R2,4,R5	Lecture
15.	Design of tension members-Prob 2	2	T1,T2,R1,R2,4,R5	Lecture
16.	Remedial -Design of tension Members	2	T1,T2,R1,R2,4,R5	Remedial
17.	Concept of shear lag	2	T1,T2,R1,R2,4,R5	Lecture
18.	Application of lug angle	2	T1,T2,R1,R2,4,R5	Lecture
19.	Connections in tension members -Prob 3	2	T1,T2,R1,R2,4,R5	Lecture
20.	Remedial-Connections	2	T1,T2,R1,R2,4,R5	Remedial
21.	Introduction-compression members-classification-Behavior (theory only-No equations)	3	T1,T2,R1,R2,4,R5	Experiential learning
22.	Design of struts	3	T1,T2,R1,R2,4,R5	Lecture
23.	Solid and built up columns for axial loads alone	3	T1,T2,R1,R2,4,R5	Lecture
24.	Design of lacing system-Prob1	3	T1,T2,R1,R2,4,R5	Lecture
25.	Design of lacing system-Prob 2	3	T1,T2,R1,R2,4,R5	Lecture
26.	Remedial- Design of Laced column	3	T1,T2,R1,R2,4,R5	Remedial
27.	Design of battening system -Prob 3	3	T1,T2,R1,R2,4,R5	Lecture
28.	Design of battening system -Prob 4	3	T1,T2,R1,R2,4,R5	Lecture
29.	Column base plate introduction- Simple slab base plate-only axial load-Prob 5	3	T1,T2,R1,R2,4,R5	Lecture
30.	Gusseted base-only axial load-Prob 5	3	T1,T2,R1,R2,4,R5	Lecture
31.	Gusseted base-only axial load-Prob 6	3	T1,T2,R1,R2,4,R5	Lecture
32.	Remedial- Design of Battened column	3	T1,T2,R1,R2,4,R5	Remedial
33.	Introduction- Beams, design of Laterally restrained beams -Prob 1	4	T1,T2,R1,R2,4,R5	Experiential Learning
34.	Design of Laterally Unrestrained beams-Prob 2	4	T1,T2,R1,R2,4,R5	Lecture

35.	Design of simple beams-Prob 3	4	T1,T2,R1,R2,4,R5	Lecture
36.	Remedial- Simple beam design	4	T1,T2,R1,R2,4,R5	Remedial
37.	Design of compound beams-Prob 4	4	T1,T2,R1,R2,4,R5	Lecture
38.	Plate girder design for welded connection-Prob 5	4	T1,T2,R1,R2,4,R5	Lecture
39.	Remedial-Plate girder design	4	T1,T2,R1,R2,4,R5	Remedial
40.	Design of stiffeners-end bearing and intermediate stiffeners -Prob 6	4	T1,T2,R1,R2,4,R5	Lecture
41.	Gantry girders and beam-column (introduction only-No design)	4	T1,T2,R1,R2,4,R5	Lecture
42.	Type of roof truss -design loads and load combinations	5	T1,T2,R1,R2,4,R5	Lecture
43.	Calculation of wind loads-Prob1	5	T1,T2,R1,R2,4,R5	Lecture
44.	Design of purlins-Prob 2	5	T1,T2,R1,R2,4,R5	Lecture
45.	Remedial- design of purlins	5	T1,T2,R1,R2,4,R5	Remedial
46.	Moment resistant and eccentric connections-in plane and out of plane-(No design)	5	T1,T2,R1,R2,4,R5	Lecture
47.	Introduction –Fire resistance criterion	5	T1,T2,R1,R2,4,R5	Lecture
48.	Fire resistance assessment of steel structure-material property at elevated temperature-design approaches and tools-different models-methods-procedures	5	T1,T2,R1,R2,4,R5	Lecture
49.	Passive protection-fire performance assessment	5	T1,T2,R1,R2,4,R5	Lecture

15. Question Bank

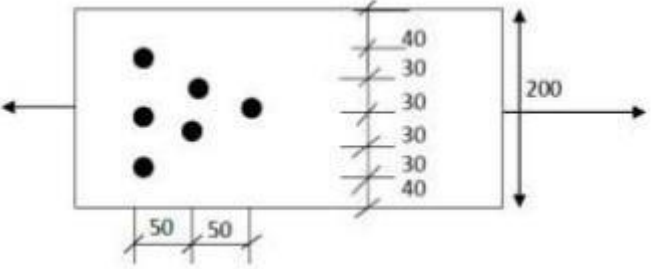
Module 1				
Sl. No.	Question	Marks	CO	BL
1.	Explain the failures of bolted joints.	3	CO1	L1
2.	Write any six features of structural steel.	3	CO1	L1
3.	Sketch different types of bolted connections.	3	CO1	L1
4.	Distinguish between Lap joint and Butt joint.	3	CO1	L1
5.	What are the advantages of bolted connections over riveted or welded connections?	3	CO1	L1
6.	Explain the fundamentals of welded connection with neat sketches.	3	CO1	L1

7.	Differentiate between bearing type connection & friction type connection.	3	CO1	L2
8.	Under what circumstances do we use slot welds and plug welds?	3	CO1	L2
9.	Discuss on the advantages and disadvantages of structural steel.	3	CO1	L2
10.	Discuss on design loads and various load combination used in the analysis of steel structures.	3	CO1	L2
11.	Describe the tensile strength of plate in bolted connections	3	CO1	L2
12.	Differentiate between Single butt and double butt cover joint.	3	CO1	L2
13.	Explain the different welded connection in steel members with neat sketches.	3	CO1	L2
14.	Design a lap joint between the two plates of width 150 mm, if the thickness of one plate is 12 mm and the other is 10 mm. The joint has to transfer a working load of 100 kN. The plates are of Fe 410 grade. Use bearing type bolts.	14	CO1, CO2	L3
15.	An ISMC 250 @ 298kg/m is used as a tie member to transmit a factored load of 800kN. The channel section is connected to a gusset plate of 10mm thickness. Design a fillet weld if the lap length is limited to 300mm. Provide slot welds if required.	14	CO1, CO2	L3
16.	Find the efficiency of the lap joint shown in Fig.1. Given M20 bolts of grade 4.6 and Fe 410 plates are used.	14	CO1 CO2	L3
	 Dimensions in mm Fig.1			
17.	The plates of a tank 8 mm thick are connected by a single bolted lap joint with 20 mm diameter bolts at 50 mm pitch. Calculate the efficiency of the joint. Assume Fe 410 plate and grade 4.6 bolts.	14	CO1 CO2	L3

18.	Design a double cover joint between the two plates of width 300 mm, if the thickness of one plate is 18 mm and the other is 10 mm. The joint has to transfer a working load of 260 kN. The plates are of Fe 410 grade. Use bolt of grade 4.6.	14	CO1 CO2	L3
19.	Determine the strength and efficiency of a bolted lap joint shown in the figure. The bolts are of 20mm diameter, grade 4:6. The plates are of 12mm thick and grade F2410  All dimensions in mm	14	CO1 CO2	L3
20.	An ISMC 250 @ 298kg/m is used as a tie member to transmit a factored load of 800kN. The channel section is connected to a gusset plate of 10mm thickness Design a fillet weld if the lap length is limited to 300mm Provide slot welds if required.	14	CO1 CO2	L3
21.	A tie member in a truss girder is 200mm x 14mm in size. It is welded to 10mm thick gusset plate by a fillet weld. The overlap of the member is 350mm and the weld size is 6mm. Determine the design strength of the joint. 	14	CO1 CO2	L3
22.	2 flat plates (Fe 410 grade steel), each 240mm x 10mm are to be jointed using 20mm diameter, 4.6 grade bolts to form a lap joint. The joint is supposed to transfer a working load of 200kN. Design the joint and also find the efficiency of joint.	14	CO1 CO2	L3

23.	Design a lap joint between the two plates of width 150 mm, if the thickness of one plate is 12 mm and the other is 10 mm. The joint has to transfer a working load of 100 kN. The plates are of Fe 410 grade. Use bearing type bolts.	14	CO1 CO2	L3
24.	Two plates 10mm & 18mm thick are to be joined by double cover butt joint. Design the joint for a factored tensile load of 700 kN. Bolts used are of 24 mm diameter, grade 4.6 and the plates are of grade Fe 410. Cover plates on each side are of 8mm thick.	14	CO1 CO2	L3
Module 2				
Sl. No.	Question	Marks	CO	BL
1.	Explain block shear failure.	3	CO1	L1
2.	Explain shear lag? How it can be reduced?	3	CO1	L1
3.	Discuss on the various modes of failure in tension members	3	CO1	L2
4.	Discuss on the modes of failure in tie members.	3	CO1	L2
5.	Define the net root area	3	CO1	L1
6.	Discuss on the factors affecting the design strength of tie members.	3	CO1	L2
7.	Explain the concept of shear lag with help of neat sketches.	3	CO1	L2
8.	Explain the concept of lug angle with neat sketches.	3	CO1	L2
9.	With the help of a suitable diagram, explain the concept of shear lag. How we can reduce it?	3	CO1	L2
10.	Explain the purpose of lug angles in tension member connection	3	CO1	L2
11.	Explain the step by step procedure to design tension members.	3	CO1	L2
12.	Enumerate the application of lug angles in tie sections.	3	CO1	L1
13.	Discuss on various connections in tension members.	3	CO1	L1
14.	Derive the expression for calculating the force F in a bolt subjected to a factored load P at an eccentricity e. The line of action of the load is in the plane of the bolted connection and the centre of gravity of the connection is the centre of rotation.	14	CO1 CO2	L3

15.	Determine the design tensile strength of the plate 120mmx80mm connected to 12mm thick gusset plate with bolt holes shown in fig. The yield strength and ultimate strength of the steel used are 250MPa and 400MPa. The diameter of the bolt used is 16mm.	14	CO1 CO2	L3
16.	Design a tension member to carry an axial factored load of 500kN. Use a double angle rolled steel section connected (at site) to each side of a gusset plate of 10mm thick using 20mm diameter bolts of grade 4.6.	14	CO1 CO2	L3
17.	A single unequal angle 100x75x8mm is connected to a 12mm thick gusset plate at the ends with 6 numbers of 20mm dia bolt to transfer tension as shown in figure. Determine the design tensile strength of the angle if the gusset is connected to the 100mm leg. The yield strength and ultimate strength of the steel used are 250MPa and 400MPa.	14	CO1 CO2	L3
18.	Design a suitable double angle section to carry a factored tensile load of 450 kN. The length of the member is 2.9m. Use M20 bolts of 4.6 grade. The grade of steel is Fe410.	14	CO1 CO2	L3
19.	A tie member used as a diagonal in a roof truss consists of two angles $75 \times 50 \times 8$ mm ($f_y = 280$ MPa) placed back to back on the each side of gusset plate. The rivets of 18 mm diameter are provided in one row and the angles are tack riveted. Determine the tensile strength of the member.	14	CO1 CO2	L3
20.	Determine the tensile strength of ISA 125 x 95 x 8 mm connected to the gusset plate of 10mm through the shorter leg by 4, M20 bolts arranged in one row. The grade of steel is Fe410. Take $p = 65$ mm, Edge & End distance = 40mm.	14	CO1 CO2	L3
21.	A tie member consisting of an angle section ISA100x75x8, designed to transfer a factored axial load of 280kN, is to be welded to a gusset plate of 10mm thick, using 6mm fillet weld. Design the weld, if the weld is provided on three sides by overlapping the angle on the gusset plate, at a shop. Also sketch the connection showing the weld lengths.	14	CO1 CO2	L3

22.	Determine the design tensile strength of plate 200 x 10mm with the holes as shown below if the yield and ultimate strength of steel are 250MPa and 410MPa. M20 bolts and 10mm thick gusset plates are used. 	14	CO1 CO2	L3
23.	Design a bridge truss diagonal carrying a pull of 200kN using double angle section. The centre to centre distance of intersections is 3m. The member is subjected to reversal of stresses.	14	CO1 CO2	L3
24.	Design a tension member to carry a pull of 900kN. The member is 3.5m between c/c of intersection. Design the member using channel section.	14	CO1 CO2	L3
25.	A plate 200x12mm is used as a tension member and is welded to gusset plate as shown in figure. Calculate the block shear strength of the gusset plate.	14	CO1	
26.	A tie member consisting of an angle section ISA 100×75×8 designed to transfer a factored axial load of 300 kN is to be welded to a gusset plate of 10 mm thick using 6 mm fillet weld. Design the weld if the weld is provided on three sides by overlapping the angle on the gusset plate at a shop. Also sketch the connection showing the weld length.	14	CO1 CO2	L3
Module 3				
1.	Explain the failure modes of axially loaded columns.	3	CO1	L2
2.	Describe the various types of foundation used for column.	3	CO1	L2
3.	Explain the main purposes of lacings and battens.	3	CO1	L2
4.	Differentiate between solid and built-up columns with neat sketches.	3	CO1	L2
5.	Explain the step-by-step procedure to design strut in steel structures.	3	CO1	L2
6.	Discuss on Lacing systems in compression members	3	CO1	L2
7.	Differentiate between lacing system and battened system	3	CO1	L2

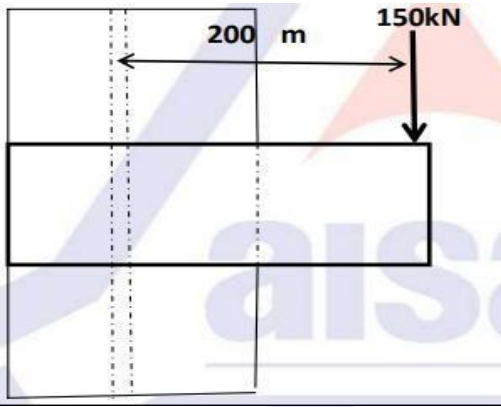
8.	Explain the laced column with neat sketches.	3	CO1	L1
9.	Discuss on Battening system in compression members	3	CO1	L2
10.	Describe the features of column base plate	3	CO1	L2
11.	Discuss the properties of gusseted column base.	3	CO1	L2
12.	Design a built-up column consisting of two channels placed back to back to carry an axial factored load of 1900kN. Design bolted single lacing system also. Length of the column is 10m and both the ends of the column are effectively restrained in direction and position.	14	CO1 CO3	L3
13.	Design a gusseted base for a column ISHB@350 with flange plates 450 x 20mm carrying a factored axial force of 3000kN. The column rests on M20 grade concrete pedestal. Design the bolted connection also. Assume Fe 410 grade steel and 4.6 grade bolts.	14	CO1 CO2 CO4	L3
14.	Design a built-up column consisting of two channels placed back to back to carry an axial factored load of 1500 kN. Length of the column is 6m and the column is restrained in position but not in direction at both ends. Provide single lacing system with bolted connection.	14	CO1 CO3	L3
15.	Design a suitable slab base for a column section ISHB 250@400N/m supporting an axial load of 500 kN. The base plate is to rest on a concrete pedestal of M20 grade concrete. The load is transferred to the base plate by welded connection.	14	CO1 CO2 CO4	L3
16.	Design a suitable slab base for a column section ISHB 200@365.9N/m supporting an axial load of 500 kN. The base plate is to rest on a concrete pedestal of M20 grade concrete. The load is transferred to the base plate by welded connection.	14	CO1 CO2 CO4	L3
17.	Design a built up column consisting of two channels placed front to front to carry an axial factored load of 1900kN. Design bolted single lacing system also. Length of the column is 10m and both the ends of the column are effectively restrained in direction and position.	14	CO1 CO3	L3
18.	Design the base plate for an ISHB 300@618N/m to carry a factored load of 1000kN. Assume Fe 410 grade steel and M25 grade concrete.	14	CO1 CO2 CO4	L3

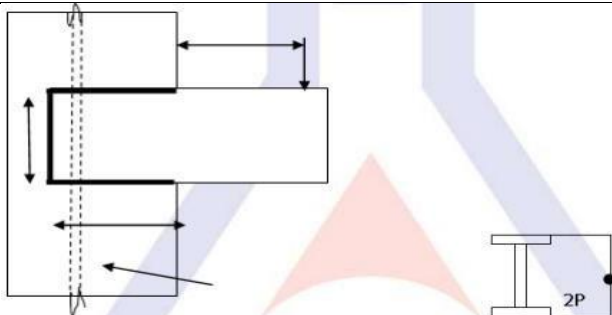
19.	Design a suitable slab base for a column section ISHB 350@ 710.2N/m supporting an axial load of 1000 kN. The base plate is to rest on a concrete pedestal of M20 grade concrete. The load is transferred to the base plate by direct bearing of column flanges. Use steel of grade Fe 410.	14	CO1 CO2 CO4	L3
20.	Design a laced column 9m to carry a factored axial load of 1200kN. The column is fixed at both the ends provide single lacing system with bolted connection.	14	CO1 CO3	L3
21.	Design a built-up column consisting of two channels placed back-to back to carry an axial factored load of 1600kN. Length of the column is 7m and the column is restrained in position but not in direction at both ends. Also design the bolted lacing system. Use grade Fe 410	14	CO1 CO3	L3
22.	Design a column to support a factored load of 1100kN. The column has an effective length of 7.0 m with respect to z-axis and 4.5 m with respect to y-axis Use steel of grade Fe 410.	14	CO1 CO3	L3
23.	Determine the design axial load on the column section ISMB 450@710.3 N/m, height of column is 4m and it is pin jointed.	14	CO1 CO3	L3
24.	Design a laced column 9m long to carry a factored axial load of 1200kN. Column is fixed at both ends. Provide single lacing system with bolted connections. The column consists of two sections back to back.	14	CO1 CO3	L3
25.	Design a built up column consisting of two channels placed toe to toe. The column carries an axial factored load of 1500kN. The effective height of the column is 10mm. Design the lacing also.	14	CO1 CO3	L3
26.	Explain the step by step design procedure of the compression members subjected to axial load alone.	14	CO1 CO2	L2
27.	Design a gusseted base plate for a column ISHB 400@759.29N/m with two plates 450x20 mm carrying a factored load of 2000kN. The column is to be supported on concrete pedestal with M25 grade concrete.	14	CO1 CO2 CO4	L3
Module 4				
1.	Distinguish between Laterally restrained and unrestrained beams	3	CO1	L2
2.	Explain the different failure modes of beams.	3	CO1	L2

3.	Differentiate between simple and compound beams	3	CO1 CO2 CO3	L2
4.	Illustrate the different elements of plate girder.	3	CO2	L2
5.	Explain lateral torsional buckling of beams.	3	CO2	L2
6.	Distinguish between end stiffeners and intermediate stiffeners.	3	CO1	L2
7.	Enumerate the loads considered in the design of Gantry girders.	3	CO1, CO4	L2
8.	Explain the structural behavior of Gantry girder with the help of neat sketches.	3	CO1, CO4	L2
9.	List out the design steps for welded connections in plate girder.	3	CO1, CO4	L1
10.	Explain the various component of plate girder with help of neat sketches.	3	CO1 CO4	L2
11.	A conference hall 8m X 12m is provided with 120mm RCC slab over rolled steel I beams spaced 4m centre to centre, The superimposed load is 4kN/m ² and floor finish of 1.5 kN/m ² . Design one of the beam as laterally supported.	14	CO1 CO4	L3 L3
12.	Design the simply supported main beam of a building supporting concrete floor slab with the following data: Centre to centre distance of beams -6m, Span of beam – 7m, Thickness of concrete slab – 240mm Finished screed – 40mm thick Weight of concrete slab and finished screed- 24kN/m ³ Imposed load – 4kN/m ²	10	CO1 CO2	L3
13.	The section of a welded plate girder consists of flange plates 600mmX 40mm and web plate 1800mmX12mm. Determine the moment capacity of the section, shear resistance corresponding to web buckling.	10	CO1 CO3	L3
14.	Design a simply supported beam of 10m effective span carrying a total factored load of 60kN/m. The depth of beam should not exceed 500mm. The compression flange of beam is laterally supported by floor construction. Assume stiff end bearing is 75mm	14	CO1 CO2	L3
15.	Design a load carrying stiffener for a load of 1200kN for ISMB 500 beams.	14	CO2	L3
16.	A conference hall 10mx12m is provided with a 120 mm RCC slab over rolled steel I beams spaced 4m centre-to-centre. The super imposed load is 4kN/m ² and floor finish of 1.5 kN/m ² . Design one of the beam as laterally supported.	14	CO1 CO2	L3

17.	The section of a welded plate girder consists of flange plates 650mmX 35mm and web plate 1800mmX12mm. Determine the moment capacity of the section, shear resistance corresponding to web buckling.	14	CO1 CO2	L3
18.	Determine the design bending strength of a beam ISMB 300@434 N/m. Assume that the factored shear force is less than the design shear strength. Use of Fe410 grade steel.	14	CO1 CO2	L3
19.	Design a laterally supported simply supported beam of 4m span, loaded for a concentrated load of 400kN at the midspan. The load is transferred through the base plate of 200mm length. Design a check for deflection using ISMB 400 section which is available.	14	CO1 CO2	L3
20.	The section of a welded plate girder consists of flange plates 600mmx40mm and web plate 1800mmx12mm. Determine the moment capacity of the section, the shear resistance corresponding to web buckling. Intermediate stiffeners are not provided.	14	CO1 CO3	L3
21.	Explain the detailed step by step procedure for the design of compound beam using IS specification.	14	CO1 CO3	L2
22.	Design a welded plate girder 20m in span and laterally supported throughout. It has to support a UDL of 80kN/m throughout the span. Exclusive of self-weight. Design the plate girder without intermediate vertical stiffeners. Assume the steel of grade Fe410.	14	CO1 CO3	L3
23.	An interior bearing stiffener consists of two flats 125ISF 10mm. one on each side of 1200x8 mm web of a plate girder. Assume steel of grade Fe 410. Determine the maximum load that can be supported by stiffener.	14	CO1 CO3	L3
24.	Design a plate girder of span 20m span carrying UDL of 100kN/m. Use steel of grade Fe 410. Assume the suitable data. Design the connections of web to flange and stiffener if any.	14	CO1 CO4	L3
MODULE 5				
1.	Discuss on the various types of roof trusses with the aid of neat sketches.	3	CO1	L2
2.	Describe the various factors affecting the design of roof trusses as per IS specifications.	3	CO1	L2
3.	Explain the calculation of wind load acting in the roof trusses.	3	CO1, CO4	L2

4.	Explain various loads and load combinations to be considered in the design of a roof truss.	3	CO1	L2
5.	Discuss on the fire resistance criterion considered in steel members	3	CO1	L2
6.	List the different fire resistance criterion.	3	CO1	L1
7.	Explain the material property of steel members in elevated temperature.	3	CO1	L2
8.	Discuss on the various model available to study the fire resistance of steel members	3	CO1	L2
9.	List the various passive protection methods for steel structures against fire.	3	CO1	L1
10.	A roof truss shed is to be built in Chennai for an industry .The size of shed is 20mx8m.The height of building is 10m at the eaves. Determine the basic wind pressure.	14	CO1 CO2	L3
11.	A purlin is to be designed to support a GI sheet as roofing material for a truss spaced at 3.5m c/c. purlin along the principal rafters are arranged at a distance of 1.35mc/c. The pitch of truss is 0.2m. Design a section for the purlin. Assume basic wind speed as 44m/s.	14	CO1 CO2	L3
12.	Design a fan type roof truss for a span of 9m, with 4m spacing, using GI sheets. Slope of rafter 30 degree. The wind pressure is 1.15kN/m ²	14	CO1 CO2	L3
13.	Design a purlin on a sloping roof truss with the dead load of 0.15kN/m ² , a live load of 2.5kN/m ² and a wind load of 0.6kN/m ² (suction). The purlins are 1.8m centre to centre and a span of 3.8m, simply supported on a rafter at a slope of 200.	14	CO1 CO2	L3
14.	A roof truss has a span of 20m and a rise of 4m is placed at 3.5m c/c. calculate the live load on the roof truss.	14	CO1 CO2	L3
15.	The details of a shed situated in Thiruvananthapuram is given below Span of truss – 15m Rise of truss – 4m Eaves height – 8m Spacing of truss – 3m Spacing of purlin – 4m Find the design wind pressure and wind load on purlin	14	CO1 CO2	L3

16.	Design the bracket connection shown below. The connection supports a load of 150kN. The column section is ISHB 150@ 300.19N/m. The thickness of bracket plate is 10mm. Use M16 bolts of grade 4.6. 	14	CO1 CO2	L3
17.	Determine the design forces in the members of a Fink type roof truss for an industrial building for the following data. Overall size of building: 48 x16m., C/c spacing of trusses: 8m , Rise of truss :1/4 of span , Self weight of purlins : 318 N/m., Height of columns : 11m. Roofing : A C sheets (171N/m2), Location : Agra	14	CO1 CO2	L3
18.	Derive the expression for calculating the force F in a bolt subjected to a factored load P at an eccentricity e. The line of action of the load is in the plane of the bolted connection and the centre of gravity of the connection is the centre of rotation.	14	CO1 CO2	L3
19.	The trusses for a factory building are spaced at 6 m c/c. and the purlin is spaced at 2m c/c. The pitch of truss is 28° and span of truss is 18m. The roof consists of asbestos sheets with 150 N/m2.Design a suitable I section purlin.	14	CO1 CO2	L3
20.	A bracket plate is used to transfer the reaction of a beam to a column flange as shown in Fig. The bracket plate is connected to the column flange by a 6 mm fillet weld. Compute the maximum load that can be placed over the bracket plates at a distance of 100 mm from the flange of the column section	14	CO1 CO2	L3

				
21.	A roof truss has a span of 12m and a rise of 2.5m is placed at 4m c/c. Calculate the live load on the roof truss.	14	CO1 CO2	L3
22.	Determine the design wind pressure on a pitched roof near Pune. Given Structure: An industrial shed situated on flat terrain with sparsely populated buildings. The span of roof truss is 18 m and rise is 3 m. Height of building at eaves: 10m	14	CO1 CO2	L3
23.	Design an I section purlin for an industrial building with Galvanised iron sheets as the roofing material. Spacing of trusses = 6m c/c Spacing of purlins = 1.5m c/c Inclination of main rafter to horizontal - 30° Wind pressure = 2 kN/m ² Live load = 1kN/m ² Weight of GI sheets =130N/m ² Grade of steel : Fe 410	14	CO1 CO2	L3
24.	A roof truss has a span of 12m and a rise of 2.5m is placed at 4m c/c. Calculate the live load on the roof truss.	14	CO1 CO2	L3

Prepared By : Ms. Rinku John, Course Faculty

Checked By : Dr. Bindumol T V, Subject Group Coordinator

Course Code & Name: CET 423 Ground Improvement Techniques**1. Prescribed Syllabus**

Module	Topic	Hours
1	Role of ground improvement in foundation engineering- Classification of ground improvement methods-different problematic soil -selection of suitable ground improvement based on the soil condition-Emerging trends in ground improvement-Different materials used for ground improvement and its property. Brief introduction to sustainable method of ground improvement, Microbial methods	6
2	In situ Densification-Deep compaction and shallow compaction, Properties of compacted soil and compaction control. Dynamic Compaction-Procedure-design considerations, soil suitability, Merit and demerit. Vibration methods-Vibro compaction techniques-Blasting, Vibrating compactors- Vibro displacement methods-Vibro-flotation. Sand pile, Stone column, Lime pile-principle, installation procedure, basic design considerations, soil suitability, Merit and demerits	8
3	Drainage methods- Methods of dewatering systems-Open sump, Well points, Vacuum and electroosmotic methods Drains-type-drainage facility after construction-Foundation drain, Blanket drain, Interceptor drains Precompression and Vertical Drain – Preloading, Vertical drain-General principle, Soil suitability, Type-sand drain, PVD-Installation procedure	7
4	Earth Reinforcement-Reinforcement materials-reinforced earth wall-design considerations construction procedure Soil nailing & Micro pile-basic concept-construction sequence-areas of application-design considerations-merit and demerit Geosynthetics - use, type-function- filtration, drainage, separation-Application of geotextile in different works	7
5	Grouting Techniques- Grouting material-groutability-stabilization with cement, lime and chemicals Classification of grouting techniques-particulate grouting, Compaction grouting, penetration grouting, jet grouting, displacement grouting-Procedure-soil suitability-merit and demerit. Thermal method-stabilization by heating, stabilization by cooling Soil stabilization- Fundamental concept of soil-cement stabilisation, Mechanism of lime Stabilisation	8

2. Text Books (T)

- T1. P. Purushothamaraj, Ground Improvement Techniques, University Science Press,
T2. Manfred. R. Hausmann, Engineering Principles of Ground Modification, McGraw Hill, 1989

3. Reference Books (R)

- R1. Manfred. R. Hausmann, Engineering Principles of Ground Modification, McGraw H

4. Course Objectives

The objective of the course is to introduce the various types ground improvement techniques that can be adopted in different site conditions and to enable the students to choose the suitable ground improvement techniques to be adopted depends on the site condition and requirements.

5. Course Pre / Co-requisite

Geotechnical Engineering-I, Geotechnical Engineering-II

6. Course Outcomes

After completion of the course, student will be able to

CO1: Classify different ground improvement methods based on the soil suitability

CO2: Outline the basic concept/ design aspects of various ground improvement methods

CO3: Identify the construction procedure of different ground improvement methods

CO4: Choose different application of geosynthetics and soil stabilisation in Ground improvement

7. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	M												M		M
CO2	M												M		M
CO3	H	H											M		M
CO4	H	H											M		M

8. Justification for CO-PO-PSO Correlation

CO	PO/PSO	Justification
CO1	PO1	Knowledge of the different ground improvement techniques and soil suitability will enable students to choose suitable methods of soil stabilization
	PSO1	Understanding on different ground improvement techniques will enable students to identify and analyse ground problems and apply suitable methods of ground improvement in field problems
	PSO3	Knowledge of the different ground improvement techniques will enable students to apply appropriate techniques in complex civil engineering problems.
CO2	PO1	Knowledge on basic concept/ design aspects of various ground improvement methods will enable students to apply them during soil stabilization applications
	PSO1	Knowledge of the basic concept/ design aspects of various ground improvement methods will help students to incorporate them during practical scenarios related to its application

	PSO3	Knowledge on basic concept/ design aspects of various ground improvement methods will enable students to apply appropriate grouting techniques in complex civil engineering problems.
CO3	PO1	Familiarization construction procedure of different ground improvement methods will enable students to apply them during soil stabilization applications
	PO2	Knowledge on construction procedure of different ground improvement methods will enable students to identify various problems related to unstable ground and arrive at solutions.
	PSO1	Fundamentals of construction procedure of different ground improvement methods will enable students to identify and apply them Civil engineering applications.
	PSO3	Fundamentals of construction procedure of different ground improvement methods will enable students to apply appropriate methods in complex civil engineering applications.
CO4	PO1	Fundamental knowledge on application of geosynthetics and soil stabilisation in Ground improvement will enable students to choose suitable methods of soil reinforcement
	PO2	Conceptual knowledge different application of geosynthetics and soil stabilisation in Ground improvement will enable students to analyse problems related to unstable ground and arrive at solutions
	PSO1	Knowledge on anchoring and nailing techniques will help students to design reinforced earth walls
	PSO3	Familiarization on soil reinforcement techniques will enable students to apply suitable methods in complex civil engineering applications.

9. Curricular gaps (if any)

Nil

10. Course Enrichment Activities*

Sl No	Description	Proposed Activities **	Relevance to POs and PSOs
1	Webinar /project etc	1 Ask the students to attend the IGS webinars related to this 2. offer projects in this area	PO 1, PO 2, PSO 1, PSO 3

11. Internal Assessment mark allocation (as per university curriculum)

(Provide details as mentioned in syllabus)

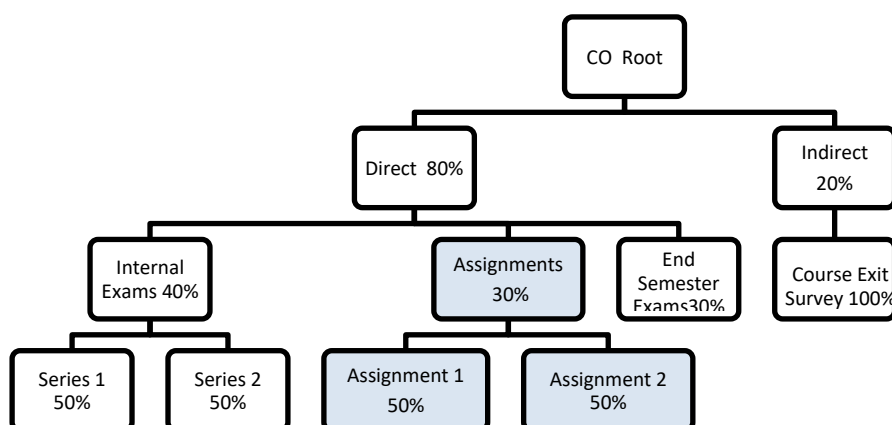
Attendance	- 10 marks
Continuous Assessment Test	- 25 marks
Assignment (s)/ Course Project	- 15 marks
<u>Total</u>	<u>- 50 marks</u>

12. Assessment – CO Mapping (Put ‘ x ’ if mapping is present)

	Tools		Weightage [#]	CO1	CO2	CO3	CO4
	Internal Exam(s) 40%	Series 1	20%	x	x	x	
		Series 2	20%	x	x	x	x

Direct Assessment Tools**	Assignment (s)/ Course Project /Quiz etc. 30%	Assignment 1	15%	x	x		
		Assignment 2	15%			x	x
	End Semester Exam		30%	x	x	x	x
Indirect Assessment Tool	Course Exit Survey		100%	x	x	x	x

13. Assessment Configuration



14. Course Plan

Hour	Topic	Module	Reference(s)	Teaching Pedagogy
1	Role of ground improvement in foundation engineering	1	T1,T2,R1	Lecture
2	Classification of ground improvement methods- different problematic soil	1	T1,T2,R1	Lecture
3	selection of suitable ground improvement based on the soil condition	1	T1,T2,R1	Lecture
4	Emerging trends in ground improvement	1	T1,T2,R1	Lecture
5	Different materials used for ground improvement and its property	1	T1,T2,R1	Lecture
6	Brief introduction to sustainable method of ground improvement, Microbial methods	1	T1,T2,R1	Lecture
7	In situ Densification-Deep compaction and shallow compaction, Properties of compacted soil and compaction control.	2	T1,T2,R1	Lecture
8	Dynamic Compaction- Procedure-design considerations	2	T1,T2,R1	Lecture
9	Dynamic Compaction- soil suitability, Merit and demerit.	2	T1,T2,R1	Lecture
10	Vibration methods-Vibro compaction techniques	2	T1,T2,R1	Lecture
11	Blasting, Vibrating compactors	2	T1,T2,R1	Lecture
12	Vibro displacement methods-Vibro-flotation.	2	T1,T2,R1	Lecture

13	Sand pile, Stone column, Lime pile-principle, installation procedure	2	T1,T2,R1	Lecture
14	basic design considerations, soil suitability, Merit and demerits	2	T1,T2,R1	
15	Drainage methods- Methods of dewatering systems-Open sump, Well points	3	T1,T2,R1	Lecture
16	Vacuum and electroosmotic methods	3	T1,T2,R1	Lecture
17	Drains-type-drainage facility after construction- Foundation drain, Blanket drain, Interceptor drains	3	T1,T2,R1	Lecture
18	Precompression and Vertical Drain	3	T1,T2,R1	Lecture
19	Preloading, Vertical drain- General principle	3	T1,T2,R1	Lecture
20	Soil suitability, Type-sand drain	3	T1,T2,R1	Lecture
21	PVD-Installation procedure	3	T1,T2,R1	Lecture
22	Earth Reinforcement- Reinforcement materials	4	T1,T2,R1	Lecture
23	reinforced earth wall-design considerations construction procedure	4	T1,T2,R1	Lecture
24	Soil nailing & Micro pile- basic concept	4	T1,T2,R1	Lecture
25	Construction sequence- areas of application-design considerations-merit and demerit	4	T1,T2,R1	Lecture
26	Geosynthetics - use, type- function	4	T1,T2,R1	Lecture
27	filtration, drainage, separation	4	T1,T2,R1	Lecture
28	Application of geotextile in different works	4	T1,T2,R1	Lecture
29	Grouting Techniques- Grouting material-groutability	5	T1,T2,R1	Lecture
30	stabilization with cement, lime and chemicals	5	T1,T2,R1	Lecture
31	Classification of grouting techniques-particulate grouting	5	T1,T2,R1	Lecture
32	Compaction grouting, penetration grouting	5	T1,T2,R1	Lecture
33	Jet grouting, displacement grouting-Procedure-soil suitability-merit and demerit	5	T1,T2,R1	Lecture
34	Thermal method- stabilization by heating, stabilization by cooling	5	T1,T2,R1	Lecture
35	Soil stabilization- Fundamental concept of soil-cement stabilisation, Mechanism of lime Stabilisation	5	T1,T2,R1	Lecture
36	Soil stabilization- Fundamental concept of soil-cement stabilisation, Mechanism of lime Stabilisation	5	T1,T2,R1	Lecture

15. Question Bank

Module 1				
Sl. No.	Question	Marks	CO	BL
1.	Explain the importance of ground improvement in foundation engineering.	3	CO1	L1
2.	Name any five materials used for ground improvement	3	CO1	L1
3.	Explain the factors that should be considered in the selection of the best ground improvement technique.	3	CO1	L1
4.	List the different problematic soils	3	CO1	L1
5.	List different trends in ground improvement techniques	3	CO1	L1
6.	Explain the role of ground improvement in foundation engineering	3	CO1	L1
7.	Classify ground improvement techniques.	3	CO1	L1
8.	Briefly explain microbial methods of ground improvement.	3	CO1	L1
9.	List the advantages of sustainable method of ground improvement.	3	CO1	L1
10.	Describe karst deposits	3	CO1	L1
11.	List the objectives of ground improvement.	3	CO1	L1
12.	. Explain the sustainable methods of ground improvement.	7	CO1	L1
13.	Describe the salient features of different problematic soils.	7	CO1	L2
14.	Discuss the microbially induced carbonate precipitation as a ground improvement technique.	7	CO1	L2
Module 2				
Sl. No.	Question	Marks	CO	BL
1.	Explain basic concept behind the blasting techniques.	3	CO2	L1
2.	List various in situ densification methods.	3	CO2	L1
3.	List various deep compaction methods.	3	CO2	L1
4.	List various shallow compaction methods.	3	CO2	L1
5.	Explain the various compaction control measures.	3	CO2	L1
6.	Explain the difference between grid rollers and sheep foot rollers	5	CO2	L2
7.	Prepare a table with various shallow compaction techniques and the corresponding soils in which they are effective.	5	CO2	L2
8.	Explain the advantages and disadvantages of dynamic compaction.	3	CO2	L1
9.	Explain dynamic compaction and its effective depth.	3	CO2	L1
10.	Explain the effect of compaction on the properties of compacted clayey soil.	7	CO2	L2
11.	Explain the method used for checking the effectiveness of a compaction technique.	7	CO2	L2

12.	Explain the procedure for dynamic compaction.	5	CO2	L2
13.	State the difference between vibro-compaction and Vibro-replacement.	6	CO2, CO3	L2
14.	Explain vibro-displacement with the help of neat sketches.	6	CO2, CO3	L2
15.	Explain the procedure for stone column installation.	7	CO2, CO3	L2
16.	Discuss the procedure for sand pile.	7	CO2, CO3	L2
17.	Discuss the design considerations of stone columns.	7	CO2, CO3	L2
18.	Explain the soil suitability of sand pile, stone column and lime pile techniques.	7	CO2, CO3	L2
19.	Write down the advantages of stone column technique over conventional pile foundations.	7	CO2, CO3	L2
20.	Discuss about stone columns and its method of construction	7	CO2, CO3	L2
Module 3				
1.	List different methods of dewatering	3	CO2, CO3	L1
2.	List any four dewatering methods	3	CO1	L1
3.	Explain open sump method.	3	CO2, CO3	L2
4.	Explain the single stage well point system of dewatering	3	CO2, CO3	L2
5.	Explain the advantage of Multi stage well point system over Single stage well point system	3	CO2	L2
6.	Explain vacuum method of dewatering	3	CO2, CO3	L2
7.	Discuss the importance of lowering the ground water in a construction site.	3	CO2, CO3	L2
8.	List the various types of drains	3	CO2, CO3	L1
9.	Explain the purpose of providing Blanket Drains	3	CO2, CO3	L2
10.	Describe the process of installation of PVDs.	3	CO3	L2
11.	Explain application of vertical drain.	3	CO2, CO3	L2
12.	Describe the process of installation of PVDs.	3	CO3	L2
13.	Differentiate between vacuum method and electro-osmosis method of dewatering.	7	CO2, CO3	L2
14.	Explain the well point system of dewatering with neat sketches	7	CO2, CO3	L2

15.	Illustrate the procedure for installation of Multistage Well Points system with neat sketch.	7	CO3	L3
16.	Explain electro-osmotic method of dewatering for ground improvement with a neat sketch.	7	CO2, CO3	L2
17.	Explain dewatering method using open sump and ditches with neat sketch.	7	CO2, CO3	L2
18.	Differentiate between single stage and multi-stage well point system with the help of suitable diagrams.	7	CO2, CO3	L2
19.	Discuss the situations in which different types of drains are used.	7	CO2	L3
20.	A few storage tanks need to be constructed on cohesive soil layer of 10m depth. The soft ground needs to be improved before the construction. Suggest a suitable ground improvement method with detailed procedure for execution.	7	CO2	L2
21.	As a geotechnical engineer you are tasked with the execution of a precompression. The soil profile at the site consists of 8 m thick soft clayey soil underlain by lateritic layer of very low permeability. The client is adamant on using preloading technique without the use of sand drains. Elaborate on how you will convince the client that the use of closely spaced sand drains is beneficial during the precompression.	7	CO2	L3
Module 4				
1.	Explain the classification of Geosynthetics.	3	CO1	L1
2.	Explain the classification of geotextiles.	3	CO1	L1
3.	List various materials used for soil reinforcement.	3	CO2, CO3	L1
4.	List safety checks while designing reinforced earth wall.	3	CO2, CO3	L1
5.	Explain the concept of earth reinforcement.	3	CO2, CO3	L2
6.	Explain the filtration function of geotextiles.	3	CO4	L2
7.	Explain the separation function of geotextiles.	3	CO4	L2
8.	Explain the various application of geotextiles.	3	CO4	L2
9.	Write short note of advantages of reinforced earth wall over conventional retaining walls.	3	CO2, CO3	L2
10.	Explain various types of soil nailing.	3	CO3	L2
11.	Describe any three types of Nails used for soil nailing.	3	CO4	L1
12.	Differentiate between a Grouted Nail and a Launched Nail.	3	CO4	L3
13.	Explain various applications of soil nailing.	3	CO3	L2
14.	Explain the advantages of Micro piles over conventional piles.	3	CO4	L2
15.	Describe the procedure of installation of Micro piles	3	CO3	L2

16.	Explain the merits and demerits of micro piles.	3	CO2, CO3	L2
17.	Describe various geotextiles with respect to their functions and applications	7	CO4	L2
18.	Illustrate the different components of a reinforced earth wall with a sketch.	7	CO4	L3
19.	Illustrate with a neat sketch the construction sequence of an RE wall.	7	CO3	L3
20.	Discuss the design consideration of a reinforced earth wall.	7	CO2, CO3	L2
21.	Discuss the design considerations of a soil nailing wall.	7	CO3	L2
22.	Illustrate the construction of a soil nail wall with the help of a neat sketch.	7	CO3	L3
23.	Illustrate with a neat sketch the construction of a soil nail wall and mention its advantages over other types of Retaining walls	7	CO3	L3
24.	Discuss the design considerations of micro piles.	7	CO3	L2
Module 5				
1.	List the various purposes of grouting.	3	CO2, CO3	L1
2.	List various grouting materials used for ground improvement.	3	CO2, CO3	L1
3.	List various materials used for stabilization.	3	CO4	L1
4.	Classify grouting methods.	3	CO2, CO3	L2
5.	Explain the term groutability.	3	CO2, CO3	L2
6.	Explain the permeation grouting.	3	CO2, CO3	L2
7.	Explain the particulate grouting.	3	CO2, CO3	L2
8.	Explain penetration grouting.	3	CO2, CO3	L2
9.	Explain the compaction grouting.	3	CO2, CO3	L2
10.	Explain displacement grouting.	3	CO2, CO3	L2
11.	Explain the merits and demerits of grouting.	3	CO2, CO3	L2
12.	Explain procedure used for thermal stabilisation by cooling.	3	CO1, CO2	L2
13.	Describe the various grouting techniques.	7	CO2, CO3	L2
14.	Describe the procedure for Jet grouting	7	CO2, CO3	L2

15.	Discuss the concept of soil stabilisation using cement.	7	CO4	L2
16.	Discuss the mechanism of soil-cement stabilisation.	7	CO4	L2
17.	Discuss the concept of soil stabilisation using lime.	7	CO4	L2
18.	Discuss the mechanism of soil-lime stabilisation.	7	CO4	L2
19.	Explain procedure used for thermal stabilisation.	7	CO1, CO2	L2
20.	Describe the procedure used for soil stabilisation using lime and cement.	7	CO4	L2

Prepared By : Dr Benny Mathews Abraham, Course Faculty

Checked By : Prof Vilbin Varghese, Subject Group Coordinator

Course Code & Name: CET453 Construction Planning and Management

1. Prescribed Syllabus

Module	Topic	Hours
1	Introduction: Objectives of construction planning and management. Importance of Management in Construction, Construction team-Roles, responsibilities and skills. Organisation and Hierarchy in Construction Projects – Types, Characteristics, Functions and Flow charts. Construction scheduling: Review of CPM and PERT (AoN network), Time-cost trade-off – Cost optimization through the crashing of a network, Resource smoothing and resources levelling – concept only.	7
2	Introduction to BIM Technology: Define BIM and BIM model, Describe workflow in using BIM in the building lifecycle, Model-Based cost estimating, Perform Simulations, Apply BIM to reduce error and change orders in projects, Evaluate and communicate ideas related to the use of BIM in the building life cycle, BIM Benefits: Case Studies, Organizational Maturity and Dimensions, Construction Management and Planning using BIM Labour Legislations pertaining to the construction industry, Payment of Wages Act, Minimum Wages Act, Contract Labour Act, Labour Welfare Fund Act, Workmen's Compensation Act.	7
3	Human Resource Management: manpower estimation at various stages, recruitment, training, under and overmanning. Materials Management: Materials of construction, classification codification, ABC analysis, estimation of materials procurement, inventory/stock control, Economic Order Quantity, purchase procedure, stores management Quality control in Construction: Importance of quality, elements of quality, organization for quality control, quality assurance technique. Construction Safety Management: Important causes of accidents on construction sites, safety measures, safety benefits to employees, employees and customers.	6
4	Economics of Project Management: Economic analysis of projects – NPV, Rate of return analysis, cost-benefit analysis. Tendering – E Tendering / Electronic Process. Contract – Contract documents and conditions of Contract, Contract agreement Technical terms only - Administrative approval, Technical Sanction, Secured Advance, Mobilization Advance, Heads of accounts in government organization, Earnest money deposit (EMD) and Security deposit (SD). Accounting- Terms only- Work Abstract, Cash book, Work register, Accounting for the materials, Measurement book, Muster roll and Record of Bills	7
5	Budgetary Control Systems: Types of budgets, new approaches for budgeting, responsibility of accounting, profit centre approach. Financial Management: Meaning and scope, financial statement analysis, financial ratio analysis, funds flow analysis. Working Capital Management: Meaning, policy for working capital, estimating working capital needs. Capital investment decision, long	8

	term financing working of financial institutions in India and abroad, self-financing, financing mechanisms.	
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2. Text Books (T)

- T1. Srinath, L.S. PERT and CPM Principles and Applications, 3rd ed. Affiliated East-West Press, New Delhi 2015.
T2. Kumar Neeraj Jha, Construction Project Management, 2nd ed Pearson, Dorling Kindersley (India) pvt. Ltd 2015
T3. K. K. Chitkara, Construction Project Management Planning Scheduling & Controlling, Tata McGraw Hill, New Delhi 2014.

3. Reference Books (R)

- R1. Gupta, B.L. and Gupta, Amit. Construction Management, Machinery and Accounts, 3rd ed. Standard Pub, 2005.
R2. Loraine, R.K. Construction Management in Developing Countries. Thomas Telford, London, 1993.
R3. Gahlot and Dhir, Construction Planning and Management, New Age International, 1992
R4. Singh, Harpal. Construction Management and Accounts 14th ed. Tata McGraw-Hill Pub., New Delhi, 1981.
R5. S Gould, E. Frederick and Joyce, E. Nancy. Construction Project Management. Prentice Hall, New Jersey, 2000.
R6. Shrivastava, U.K. Construction Planning and Management, 3rd ed. Galgotia Pub., New Delhi, 2004
R7. Brad Hardin, Dave McCool . BIM and Construction Management: Proven Tools, Methods, and Workflows Paperback – 2017
R8. S. Seetharaman Construction Engineering & Management, Umesh Publications, Delhi.

4. Course Objectives

To help students to develop the required skills to plan and manage various types of construction projects effectively and efficiently using the latest technologies like BIM.

5. Course Pre / Co-requisite

CET 309 Construction Technology and Management

6. Course Outcomes

After completion of the course, student will be able to

- CO1: Apply knowledge of Planning and Management for planning and execution of Construction Projects.
CO2: Explain techniques for Project Planning, Scheduling, Construction Administration and Management.
CO3: Identify the criteria for selecting the appropriate method and tools as per the requirement of each project or site.
CO4: Discuss the latest industry standards and technologies used in construction projects for planning and management.
CO5: Explain the financial and legal aspects involved in a construction project.

7. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO/ CO	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
CO1	M				M				M		H	M	M	M	
CO2	M	M		M			L		M		H	M	M		
CO3	M	M	M		M	M	L		M	L	H	M	M		
CO4	M	L		L	L	M	L		M	H	H	M	M		
CO5	M	M	M	L	M		L	H	M		H	M	M		

8. Justification for CO-PO-PSO Correlation

CO	PO/PSO	Justification
CO1	PO1	Understanding the principles of construction management will help students in planning and scheduling a project without time and cost overruns.
	PO5	Applying conventional and modern methods of planning and scheduling helps students in executing construction projects.
	PO9	Applying the knowledge of construction management in planning and execution of projects will enable students to function effectively in multi-disciplinary projects.
	PO11	Applying the principles of construction management will enable students to manage projects and work in multidisciplinary environments.
	PO12	Planning and scheduling construction activities using different methods will aid students in real time engineering activities.
	PSO1	Understanding the concept of planning and scheduling construction activities with time cost analysis will help students following the principles of construction management
	PSO2	Planning various activities involved in a construction project will enable students to communicate with multi-disciplinary teams to provide sustainable solutions.
	PSO3	Understanding the concept of planning and scheduling will help students to gain ability to apply different techniques to organise construction activities.
CO2	PO1	Understanding the different methods of resource allocation will help the students to allot various resources for different activities in construction projects.
	PO2	Preparing schedule for activities in construction projects will help students to analyse complex civil engineering field problems
	PO4	Acquiring knowledge on project management will enable students to interpret challenges and analyse scenarios when managing projects, and propose solutions.
	PO7	Knowledge on contract management and following safety practices in construction will enable students to work in multidisciplinary projects and provide sustainable solutions.
	PO9	Understanding the concept of construction administration and management will enable students to work as a team.
	PO11	Preparing schedules for different resources in construction project will help students to manage project in an effective manner.

	PO12	Knowledge on different techniques of planning and scheduling will help students to effectively engage in real time construction activities.
	PSO1	Knowledge on different techniques of project planning and scheduling will help students to propose solutions for complex construction projects.
CO3	PO1	Understanding the principles of quality management in construction projects will enable students to apply in civil engineering projects
	PO2	Knowledge on human resource management and safety in construction will help students to analyse construction work schedules.
	PO3	Ability to schedule a project by applying different techniques will enable students to develop solutions for complex civil engineering problems.
	PO5	Understanding conventional and modern methods of planning and scheduling projects helps students in applying appropriate techniques to complex construction activities.
	PO6	Knowledge on quality control and inspection methods for construction will enable students to find out the safety issues in construction projects.
	PO7	Knowledge on identifying appropriate methods of managing projects will help students propose sustainable solutions.
	PO9	Understanding the requirement of different modern tools required for a particular construction project will help students to work effectively in a project team.
	PO10	Organising construction activities will help students to build communication skills to complete the project within the stipulated time and budget.
	PO11	Knowledge on preparing quality management plan will help students to manage projects without any lapse in quality.
	PO12	Knowledge on identifying appropriate methods required for a project will help students to apply it in a real time construction project.
	PSO1	Acquiring knowledge on different methods of management principles will enable students to manage construction projects following quality practice.
CO4	PO1	Knowledge on latest technologies in construction projects will help students to solve complex civil Engineering problems.
	PO2	Understanding the current industry standards will enable students to identify and analyse the needs of construction industry.
	PO4	Knowledge on BIM technology will enhance the ability of students to detect clashes and construction scheduling.
	PO5	Understanding emerging industry standards will help students in applying appropriate techniques to complex building projects.
	PO6	Familiarisation on BIM concept will help students to assess the issues in construction industry and their responsibilities to follow professional engineering practice.
	PO7	understanding of BIM concept will enable students to propose sustainable solutions for the challenges faced in the infrastructure projects.
	PO9	Familiarisation on BIM technology based software will enhance students to work effectively in collaboration with a design team.
	PO10	Knowledge on choosing appropriate technology for a particular project will help students to communicate with their teammates and share project documents and information.
	PO12	Acquiring knowledge on BIM will help students to manage projects for real time collaboration.

	PSO1	Knowledge BIM technology in construction projects will help students to describe the benefits, risks, and barriers to the use of BIM applications.
CO5	PO1	Knowledge on different types of labour legislation acts will help students to apply the legal procedures involved in construction projects.
	PO2	Knowledge on legal aspect in construction will help students to identify and understand practical problems that arise in contracts
	PO3	Understanding the provisions in contract law will enable students to solve complex civil engineering problems.
	PO4	Familiarisation of contractual obligation will help students to select viable solutions for problems that arise in construction contracts.
	PO5	Knowledge of financial and legal aspects in construction projects will help students to select appropriate techniques and practices in all types of building and infrastructure projects.
	PO7	Knowledge on the preparation of labour contract documents will help students to measure the legal issues that can be faced during construction.
	PO8	Understanding the ethical issues in construction industry will enable students to solve the lapses in a construction project.
	PO9	Understanding the financial and legal implications of construction contracts will help students to work effectively with others in multi-disciplinary environment.
	PO11	Students will recognize their responsibilities for approaching legal issues that are being faced while managing a construction project.
	PO12	Knowledge on principles of construction contract procedures enables the students to prepare contract document for real time construction projects.
	PSO1	Understanding the construction laws in civil engineering projects will enable students to apply the contract laws in civil engineering projects.

9. Curricular gaps (if any)
Nil

10. Course Enrichment Activities*

Sl No	Description	Proposed Activities **	Relevance to POs and PSOs
1	nil		

11. Internal Assessment mark allocation (as per university curriculum)
(Provide details as mentioned in syllabus)

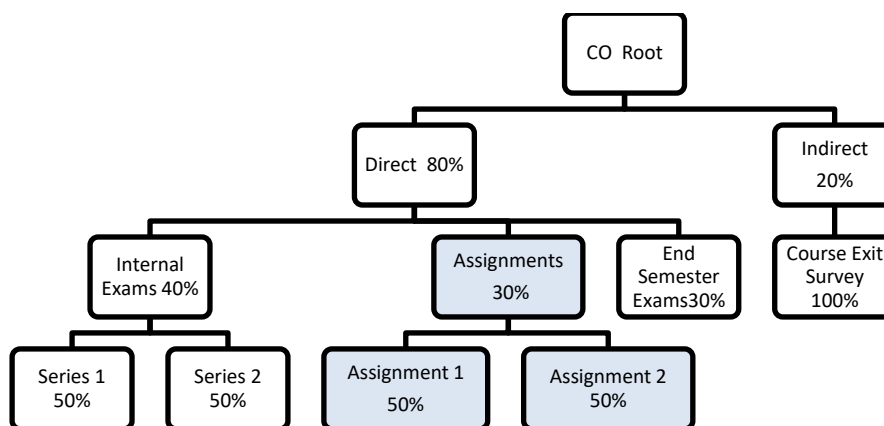
Attendance	- 10 marks
Continuous Assessment Test	- 25 marks
Assignment (s)/ Course Project	- 15 marks
<u>Total</u>	<u>- 50 marks</u>

12. Assessment – CO Mapping (Put 'x' if mapping is present)

	Tools	Weight age [#]	CO1	CO2	CO3	CO4	CO5

Direct Assessme nt Tools**	Internal Exam(s) 40%	Series 1	20%	x	x	x		
		Series 2	20%				x	x
	Assignment (s)/ Course Project /Quiz etc. 30%	Assignm ent 1	15%	x	x			
		Assignm ent 2	15%			x	x	x
	End Semester Exam		30%	x	x	x	x	x
Indirect Assessme nt Tool	Course Exit Survey		100%	x	x	x	x	x

13. Assessment Configuration



14. Course Plan

Hour	Topic Name	Module	Reference	Teaching Pedagogy
1	Introduction: Objectives of construction planning and management. Importance of Management in Construction, Construction team- Roles, responsibilities and skills.	1	T1, T2, R1, R2, R3, R6, R8	Lecture
2	Organisation and Hierarchy in Construction Projects Types, Characteristics	1	T1, T2, R1, R2, R3, R6, R8	Lecture
3	Organisation and Hierarchy in Construction Projects - Functions and Flow charts	1	T1, T2, R1, R2, R3, R6, R8	Lecture
4	Construction scheduling: Review of CPM (AoN network)	1	T1, T2, R1, R2, R3, R6, R8	Lecture
5	Construction scheduling - Review of PERT	1	T1, T2, R1, R2, R3, R6, R8	Lecture
6	time-cost trade-off Cost optimization through the crashing of a network	1	T1, T2, R1, R2, R3, R6, R8	Lecture

7	Resource smoothing and resources levelling concept only	1	T1, T2, R1, R2, R3, R6, R8	Lecture
8	Introduction to BIM Technology: Define BIM and BIM model	2	T3, R1, R2, R5, R7, R8	Lecture
9	Describe workflow in using BIM in the building lifecycle, Model-Based cost estimation	2	T3, R1, R2, R5, R7, R8	Lecture
10	Perform Simulations, Apply BIM to reduce error and change orders in project	2	T3, R1, R2, R5, R7, R8	Lecture
11	Evaluate and communicate ideas related to the use of BIM in the building life cycle,	2	T3, R1, R2, R5, R7, R8	Lecture
12	BIM Benefits: Case Studies, Organizational Maturity and Dimensions, Construction Management and Planning using BIM	2	T3, R1, R2, R5, R7, R8	Lecture
13	Labour Legislations pertaining to the construction industry, Payment of Wages Act, Minimum Wages Act,	2	T3, R1, R2, R5, R7, R8	Lecture
14	Contract Labour Act, Labour Welfare Fund Act, Workmen's Compensation Act.	2	T3, R1, R2, R5, R7, R8	Lecture
15	Human Resource Management: manpower estimation at various stages, recruitment, training, under and overmanning	3	T3, R1, R2, R3, R6, R8	Lecture
16	Materials Management: Materials of construction, classification codification, ABC analysis, estimation of materials procurement,	3	T3, R1, R2, R3, R6, R8	Lecture
17	inventory/stock control, Economic Order Quantity, purchase procedure, stores management	3	T3, R1, R2, R3, R6, R8	Lecture
18	Quality control in Construction: Importance of quality, elements of quality, organization for quality control, quality assurance technique.	3	T3, R1, R2, R3, R6, R8	Lecture
19	Construction Safety Management: Important causes of accidents on construction sites, safety measures,	3	T3, R1, R2, R3, R6, R8	Lecture
20	safety benefits to employees, employees and customers.	3	T3, R1, R2, R3, R6, R8	Lecture
21	Economics of Project Management: Economic analysis of projects	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
22	NPV, Rate of return analysis, cost-benefit analysis	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
23	Tendering E Tendering / Electronic Process	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture

24	Contract Contract documents	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
25	Conditions of Contract, Contract agreement	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
26	Technical terms only - Administrative approval, Technical Sanction, Secured Advance, Mobilization Advance, Heads of accounts in government organization, Earnest money deposit (EMD) and Security deposit (SD).	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
27	Accounting- Terms only- Work Abstract, Cash book, Work register, Accounting for the materials, Measurement book, Muster roll and Record of Bills	4	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
28	Budgetary Control Systems: Types of budgets, new approaches for budgeting	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
29	responsibility of accounting, profit centre approach	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
30	Financial Management: Meaning and scope, financial statement analysis	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
31	financial ratio analysis, funds flow analysis	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
32	Working Capital Management: Meaning, policy for working capital	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
33	Estimating working capital needs. Capital investment decision	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
34	long term financing working of financial institutions in India and abroad	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture
35	self-financing, financing mechanisms.	5	T2, T3, R1, R3, R4, R5, R6, R8	Lecture

15. Question Bank

Module 1				
Sl. No.	Question	Marks	CO	BL
1	Define project management.	3	CO2	L1
2	List the functions of construction management.	3	CO2	L1
3	Explain the actions that you would take if a project is falling behind schedule or exceeding the project's budget.	3	CO2	L2
4	List out the various network techniques in construction management	3	CO2	L1
5	Explain the different methods used in scheduling of construction projects.	8	CO2	L2

6	List the importance of construction planning.	3	CO2	L2
7	Elucidate the methods to prioritize the necessary tasks for a project.	7	CO2	L3
8	Explain the characteristics of construction management.	4	CO2	L1
9	Define activity, event, and network.	3	CO1, CO2	L1
10	Discuss the objectives of construction management.	4	CO2	L2
11	Differentiate between PERT and CPM	6	CO1, CO2	L3
12	Describe the three time estimates which are used in PERT for determining the expected time duration for individual activities in a project.	6	CO1, CO2	L1
13	Explain in relation to network analysis the terms critical activity, Total float, Independent float and free float.	3	CO1, CO2	L2
14	Define the terms direct cost, indirect cost, total cost , normal cost, optimum cost, crash cost, cost slope, normal duration, crash duration and optimum duration.	4	CO1, CO2	L1
15	Differentiate between direct cost and indirect cost.	3	CO1, CO2	L3
16	Explain the procedure for determining optimum cost and optimum completion time for a project using CPM.	8	CO1, CO2	L1
17	State the differences between smoothing and leveling of resources.	6	CO1, CO2	L1
18	Name the resource allocation methods and give the steps involved in any one	4	CO1, CO2	L1
19	Explain the role of each member of the construction team.	8	CO1, CO2	L2
20	Explain with an example the use of functional organization in a construction company.	8	CO1, CO2	L2
21	Describe the different types of organisation structures for construction projects.	8	CO1, CO2	L1
22	Explain the procedure for the time-cost tradeoff.	8	CO1, CO2	L2
23	Explain crashing the network with its significance.	3	CO1, CO2	L2
24	Explain the various steps involved in crashing a network.	7	CO1, CO2	L2
25	Construction estimators are one of the most crucial players in the construction process. Elaborate.	7	CO2	L3

Module 2				
Sl. No.	Question	Marks	CO	BL
1	Explain BIM Technology.	3	CO2, CO3, CO4	L1
2	Explain Organizational Maturity of BIM.	6	CO1, CO3, CO4	L2
3	Define BIM model	3	CO2, CO3, CO4	L1
4	Explain the benefits of BIM technology in construction projects	6	CO1, CO3, CO4	L2
5	Explain the role of BIM in construction planning and management.	3	CO1, CO3, CO4	L2
6	Describe the workflow of using BIM in the building lifecycle.	8	CO2, CO3, CO4	L2
7	Explain Model Based Cost Estimating.	6	CO2, CO3, CO4	L2
8	Explain how BIM can be use to reduce error and change orders in projects.	6	CO2, CO3, CO4	L2
9	Explain dimensions of BIM.	3	CO1, CO3, CO4	L1
10	Explain the significance of clash detection in BIM	7	CO2, CO3, CO4	L2
11	Explain the necessity of labour legislation. Explain any two labour laws	8	CO2 CO5	L1
12	Explain any two labour legislations pertaining to the construction industry	7	CO2 CO5	L2
13	Explain five major provisions of Payment of Wages Act .	8	CO2 CO5	L2
14	Explain the provisions of Minimum Wages Act.	7	CO2 CO5	L2
15	Explain the major provisions of Workmens's Compensation Act.	7	CO2 CO5	L2
16	Describe the five major provisions of Contract Labour Act.	7	CO2 CO5	L2
17	Elaborate on the situation under 'employers liability for compensation' in the workmen's compensation act 1923.	7	CO2 CO5	L3
18	Elaborate on the deductions that may be made from wages, as per the Payment of Wages Act 1936.	7	CO2, CO5	L3

Module 3				
Sl. No.	Question	Marks	CO	BL
1	Define Human Resource Management	3	CO1	L1
2	Describe the objectives of HR management	3	CO1	L1
3	List the scope of HRM.	3	CO1	L1
4	Explain the functions of HR management	3	CO1	L2
5	Explain the methods and process of recruitment and selection in an organisation.	7	CO1	L2
6	Explain the manpower estimation at various stages in an organisation.	7	CO1	L2
7	Explain the importance of training in an organisation.	7	CO1	L2
8	Discuss the suitable levels of training for construction workers	7	CO1	L2
9	Explain the function of a materials management department	5	CO1	L2
10	Explain economic order of quantity.	5	CO1	L2
11	Explain the steps involved in classifying items using ABC analysis	10	CO1	L3
12	Define Lead time analysis.	3	CO1	L1
13	List out the importance of material management.	3	CO1	L1
14	Explain the following:- (i) ABC analysis. (ii)VED analysis (iii)SDE analysis (iv) FSN analysis	5	CO1	L2
15	Discuss the measures to ensure safety in construction.	10	CO2	L2
16	Describe the safety measures and codal requirements for drilling and blasting jobs.	7	CO2	L2
17	Explain precautionary measures required to be adopted in hot bituminous works.	7	CO2	L2
18	Explain various precautions required to be adopted for scaffolding and formwork	7	CO2	L2
19	State codal requirements and important safety measure in any demolition work.	3	CO2	L1
20	Describe the methods of avoiding fire hazards in building during and after construction.	5	CO2	L2
21	List important IS codes for safety against fire.	3	CO2	L1
22	Explain the following: (a) Safety policy (b) Safety inspection (c) Safety audit	7	CO2	L2
23	Explain the role of supervisor in maintaining safety at construction site.	7	CO2	L2
24	Identify the major causes of accidents at site and the effects.	7	CO2	L2
25	State the need for inspection and quality control in construction works.	7	CO1	L1

26	Discuss the importance of quality in construction.	5	CO1	L2
27	Explain the important points to be checked during the inspection of (i) plain cement concrete (ii) reinforcement (iii) masonry (iv) earthwork (v) water supply and sewage lines	5	CO1	L2
28	State briefly the methods to achieve quality control on concrete.	3	CO1	L1
29	State the role of TQM in construction.	3	CO1	L1
30	Explain the various elements of TQM.	7	CO1	L2

Module 4

Sl. No.	Question	Marks	CO	BL
1	Outline all types of contracts.	10	CO2	L2
2	Differentiate between earnest money deposit and security deposit.	5	CO2	L2
3	Discuss the use of a measurement book.	3	CO2	L2
4	Explain the information that has to be included in contract documents.	10	CO2	L2
5	Describe the details to be given in a Tender Notice.	10	CO2, CO4	L2
6	Discuss the different types of tenders.	7	CO2, CO4	L2
7	Indicate the information provided in the tender notice with example.	10	CO2, CO4	L2
8	Define tender.	3	CO2, CO4	L1
9	Explain tender documents and the general information that should be furnished in such documents.	5	CO2, CO4	L2
10	Prepare a tender notice for a civil Engineering work.	3	CO2	L1
11	Explain the contents of a typical contract document	5	CO2	L2
12	Define administrative approval.	3	CO2	L1
13	Define rate of return analysis.	10	CO2	L1
14	State the necessary items in work abstract	3	CO2	L1
15	Define Muster roll.	3	CO2	L1

16	Explain the following (i) cash book (ii) work Register(iii) record of bills	6	CO2	L2
17	Explain the following (i)economic analysis of Projects. (ii) NPV (iii) Rate of return analysis (iv) cost benefit analysis.	3	CO2, CO4	L2
18	Discuss the clauses for penalty for contractor due to delay in works.	7	CO2	L2
19	Differentiate open and selective tendering	7	CO2, CO4	L2
20	Elaborate the method and suitability of cost-benefit analysis of project	7	CO2, CO4	L2
Module 5				
Sl. No.	Question	Marks	CO	BL
1	Explain Project Master Budget.	7	CO2, CO5	L2
2	List the scope of financial management in construction.	3	CO2, CO5	L1
3	Explain the different types of budget and write an explanatory note on project budget.	7	CO2, CO5	L2
4	Explain legal and financial aspects of accidents in construction projects.	10	CO2,CO5	L2
5	Describe the actions that need to be taken if a project is falling behind schedule or exceeding the project's budget.	3	CO2,CO5	L1
6	Explain the sources of long-term financing of construction projects.	7	CO2,CO5	L2
7	Define Fund Flow Analysis Financial Ratio Analysis	3	CO2,CO5	L1
8	Define Financial Ratio Analysis	3	CO2,CO5	L1
9	Explain the important benefits of Financial Ratio Analysis	5	CO2,CO5	L2
10	Explain, with examples, the different Methods for Estimating Working Capital Requirement.	5	CO2,CO5	L2

11	Explain the new approaches for project budgeting in construction.	5	CO2,CO5	L2
12	Explain the important benefits of Fund Flow Analysis Financial Ratio Analysis	9	CO2,CO5	L2
13	Explain the advantages of profit centre approach.	5	CO2,CO5	L2
14	List the components of working capital.	3	CO2,CO5	L1
15	Explain the different types of capital investment decisions.	5	CO2,CO5	L2
16	Differentiate between fixed and Flexible budgets.	3	CO2,CO5	L2
17	Mention the important financial statements in accounting.	3	CO2,CO5	L2
18	Differentiate between balance sheet and cash flow statement.	3	CO2,CO5	L2
19	Discuss the finance mechanism for infrastructure projects in the country.	7	CO2,CO5	L2
20	Differentiate between aggressive and conservative policies of working capital management	7	CO2,CO5	L2
21	Explain the significance of liquidity ratios in finance management.	7	CO2,CO5	L2

Prepared By : Ms. Sheeja M K, Course Faculty

Checked By : Ms. Sheeja M K, Subject Group Coordinator

16. Prescribed Syllabus

Module	Topic	Hours
1	Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.	5
2	Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces	7
3	Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.	7
4	Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.	8
5	Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis, Hazard and Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up. Control of Chemical Hazards, Hazardous properties of chemicals, Material Safety Data Sheets (MSDS).	8

17. Text Books (T)

- a. R.K Jain (2000) Industrial Safety, Health and Environment management systems, KhannaPublications.

18. Reference Books (R)

- a. Paul S V (2000), Safety management System and Documentation training Programmehandbook, CBS Publication.
- b. Krishnan, N.V. (1997). *Safety management in Industry*. Jaico Publishing House, NewDelhi.
- c. John V. Grimaldi and Rollin H.Simonds. (1989) *Safety management*. All India TravellerBook Seller, Delhi.
- d. Ronald P. Blake. (1973). *Industrial safety*. Prentice Hall, New Delhi.
- e. Alan Waring. (1996). *Safety management system*. Chapman & Hall, England.
- f. Vaid, K.N., (1988). Construction safety management. National Institute of ConstructionManagement and Research, Mumbai.
- g. AIChE/CCPS. (1992). *Guidelines for Hazard Evaluation Procedures*. (Second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.

19. Course Objectives

The general objective of this course is to give knowledge of various safety management principles, various safety systems, various machine guarding devices, hazard identification techniques, energy sources, systems & applications and the need in the present context. Students will be able to compare different hazard identification tools and choose the most appropriate based on the nature of industry. It aims to equip students in working with projects and to take up research work in connected areas.

20. Course Pre / Co-requisite

Nil

21. Course Outcomes

After completion of the course, student will be able to

CO1: Describe the theories of accident causation and preventive measures of industrial accidents.

CO2: Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping.

CO3: Explain different issues in construction industries.

CO4: Describe various hazards associated with different machines and mechanical material handling.

CO5: Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards.

22. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO/ CO	P O1	P O2	P O3	P O4	PO 5	P O6	P O7	P O8	P O9	P O 10	P O 11	P O 12	PSO1	PSO2	PS O3
CO1	M	M				M	M	M				H			
CO2	M	M	M		M	M	M	M				H			
CO3	M	M	M		M	M	M	M	M	M		M			
CO4	M	M	M		M	M	M	M	M	M		M			
CO5	M	M	M	M	M	M	M	M	M	M		M			

23. Justification for CO-PO-PSO Correlation

CO	PO/PSO	Justification
CO1	PO1	Having knowledge in engineering fundamentals helps the students in understanding the theories of accident causation and thereby helps to prevent industrial accidents
	PO2	Understanding the theories of accident makes the students to analyze the causes of such accidents and helps to prevent industrial accidents.
	PO6	As an engineer, by understanding the causes of an accident helps a student in preventing such mistakes in near future and thereby increasing the social commitment of an engineer.
	PO7	By understanding the environmental impacts of an industrial accident helps the students in preventing such accidents and create a safe and sustainable environment.
	PO8	Understanding the theories of accidents helps the students in applying ethical methods of safety practices thereby preventing accidents in industry.
	PO12	By recalling the theories of accident causation will help the students in gaining lifelong knowledge of the causes of accidents and forge them to take safe decisions thereby preventing of an industrial accident.
CO2	PO1	Understanding the significance of personal protection will help students to solve the problem of increased accident rates in industries.
	PO2	Analyzing the relation between safety performance in an industry and usage of personal protective equipment can help to reach substantiated conclusions regarding safety
	PO3	Design solutions for safety related problems in industries with appropriate consideration for the public health and safety, societal, and environmental considerations.
	PO5	Select and use appropriate personal protection equipment based on the working environment.
	PO6	Understanding the concepts of safety performance will enable students to suggest measures taken to mitigate and contain accidents in industries for the safety and health of society.
	PO7	Understanding the impact of industrial personal protection in societal and environmental contexts for sustainable development.
	PO8	By understanding the importance of personal protection and safety performance, students will be able to apply ethical principles and commit to professional ethics and responsibilities.

	PO12	Life-long learning about the selection of different personal protective equipment based on the work environment will enable the students to ensure the safety of those involved.
CO3	PO1	Knowledge of different issues in construction industries will help students to solve problems related to the same
	PO2	By understanding major issues in construction industries, students will be able to analyze the issues and reach substantiated conclusions.
	PO3	Design of suitable solutions to different issues in construction industries by identifying the causes of major safety issues in construction industry.
	PO5	Students will be able to select and apply appropriate techniques to solve different issues in construction industry.
	PO6	Knowledge of different issues in construction industries enable the students to assess societal, health, safety, legal issues related to construction industry
	PO7	By learning issues in construction industries the students will be able to understand the impact of the engineering solutions in societal and environmental contexts, and the need for sustainable development
	PO8	Students will be able to commit to professional ethics and responsibilities while dealing with various issues related to construction industries
	PO9	Having insight on different issues related to construction industry, students can effectively work as an individual, and as a member or leader in diverse team.
	PO10	Knowledge of issues in construction industry will enable the students to communicate effectively with the engineering community and with the society in large on construction activities and enable them to give and receive clear instructions.
	PO12	Knowledge of issues in construction industry help the students to engage in lifelong learning which gives in the broadest context of technological
CO4	PO1	Knowledge of various principles in machine guarding help students to solve issues related to mechanical material handling.
	PO2	By understanding various issues in mechanical material handling, students will be able to analyze the machine related hazards and should be able to reach substantiated conclusions.
	PO3	The students will be able to design suitable solutions to issues related to mechanical material handling by identifying the causes of various hazards in machines.
	PO5	Students will be able to apply various mechanical material handling techniques to handle hazard related to the machines in construction industry.
	PO6	Knowledge of different issues in mechanical material handling enable the students to assess societal, health, safety, legal issues related to construction industry.
	PO7	By understanding the issues of mechanical material handling in construction industries, the students will be able to understand the impact of the engineering solutions in societal and environmental contexts, and the need for sustainable development
	PO8	Understanding various principles in machine guarding, the students will be able to apply ethical principles and commit to professional ethics and responsibilities.
	PO9	Understanding various principles in machine guarding and issues related to mechanical material handling, the students will be able to work as an individual or as a member/leader in a team.

	PO10	Knowledge of issues related to mechanical material handling in construction industry will enable the students to communicate effectively with the engineering community and with the society in large on construction activities and enable them give and receive clear instructions.
	PO12	Knowledge of various principles in machine guarding and material handling help the students to engage in lifelong learning which gives in the broadest context of technological change in the industry.
CO5	PO1	Knowledge of different hazard identification tools and chemical hazards in different industries will help students to apply in complex engineering problems related to industries.
	PO2	Concepts of different hazard identification tools and chemical hazards will help the students to analyze and formulate different engineering problems from different dimensions.
	PO4	Students will use the risk assessment, inventory analysis, HAZOP, MSDS to analyze, interpret data, and synthesis of information to provide valid conclusions.
	PO5	By understanding hazard identification tools and chemical hazards, students will be able to apply appropriate techniques to handle industrial hazards.
	PO6	Insight on types of hazard identification tools and chemical hazards will enable the students to assess safety issues to professional engineering practice and ensure societal health
	PO7	By learning hazard identification and analysis, students will understand the impact of the engineering solutions in societal and environmental contexts, and the need for sustainable development.
	PO8	Understanding the types of hazards, risks, HAZOP, corrective action, control, etc. will help students to apply ethical principles to engineering practice.
	PO9	By utilizing different hazard identification tools and understanding different aspects of chemical hazards, the students will be able to function better as an individual or as a member/leader in a team.
	PO10	Knowledge of hazard identification and analysis tools will enable the students to communicate effectively with the engineering community on complex engineering activities and enable them give and receive clear instructions.

24. Curricular gaps (if any)

Can include electrical hazards in syllabus.

25. Course Enrichment Activities*

Sl No	Description	Proposed Activities **	Relevance to POs and PSOs
1	Expert talk on “Importance of Industrial safety”	Expert talk	PO1, PO6, PO7, PO12

26. Internal Assessment mark allocation (as per university curriculum)

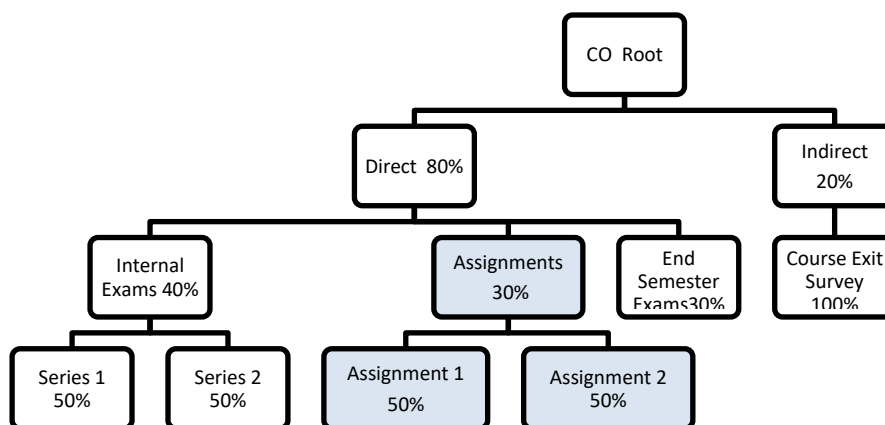
(Provide details as mentioned in syllabus)

Attendance	- 10 marks
Continuous Assessment Test	- 25 marks
Assignment (s)/ Course Project	- 15 marks
Total	- 50 marks

27. Assessment – CO Mapping (Put 'x' if mapping is present)

	Tools		Weightage [#]	CO1	CO2	CO3	CO4	CO5
Direct Assessment Tools**	Internal Exam(s) 40%	Series 1	20%	x	x	x		
		Series 2	20%			x	x	x
	Assignment (s)/ Course Project /Quiz etc. 30%	Assignment 1	15%	x	x	x		
		Assignment 2	15%				x	x
	End Semester Exam		30%	x	x	x	x	x
Indirect Assessment Tool	Course Exit Survey		100%	x	x	x	x	x

28. Assessment Configuration



29. Course Plan

30.

Hour	Topic	Module	Reference(s)	Teaching Pedagogy
1	Need for safety. Safety and productivity. Definitions: Accident, Injury,	1	R1, R2	Lecture
2	Unsafe act, Unsafe Condition, Dangerous Occurrence. Reportable accidents	1	R1, R2	Lecture
3	Theories of accident causation. Safety organization.	1	R1, R2	Lecture

4	Role of management, supervisors, workmen, unions, government and voluntary agencies in safety.	1	R1, R2	Lecture
5	Role of management, supervisors, workmen, unions, government and voluntary agencies in safety.	1	R1, R2	Remedial
6	Safety Officer-responsibilities, authority.	1	R1, R2	Tutorial
7	Safety committee-need, types, advantages.	1	R1, R2	Lecture
8	Types of PPEs, respiratory and non-respiratory equipment.	2	R1, R2	Lecture
9	Standards related to PPEs	2	R1, R2	Remedial
10	Standards related to PPEs	2	R1, R2	Tutorial
11	Monitoring Safety Performance: Frequency rate, severity rate	2	R1, R2	Lecture
12	Monitoring Safety Performance: incidence rate, activity rate.	2	R1, R2	Lecture
13	Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping.	2	R1, R2	Tutorial
14	Work permit system- objectives, hot work and cold work permits.	2	R1, R2	Lecture
15	Typical industrial models and methodology. Entry into confined spaces.	2	R1, R2	Lecture
16	Monitoring Safety Performance	2	R1, R2	Remedial
17	Excavation and filling Under-water works “Under- pinning & Shoring	3	R5	Lecture
18	Ladders & Scaffolds Tunneling	3	R5	Lecture
19	Blasting Demolition Confined space	3	R5	Lecture
20	Blasting Demolition Confined space	3	R5	Remedial
21	Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.	3	R5	Tutorial
22	Relevance of ergonomics in construction safety.	3	R5	Lecture
23	Ergonomics Hazards	3	R5	Lecture
24	Ergonomics Hazards	3	R5	Remedial
25	Musculoskeletal Disorders and Cumulative Trauma Disorders.	3	R5	Tutorial
26	Point-of-Operation, Principle of machine guarding	4	R5	Lecture
27	Types of guards and devices.	4	R5	Lecture

28	Safety in Power Presses, primary & secondary operations - shearing - bending - rolling drawing.	4	R5	Tutorial
29	Safety in turning, boring, milling, planning and grinding.	4	R5	Lecture
30	Welding and Cutting-Safety Precautions of Gas welding and Arc Welding,	4	R5	Lecture
31	Welding and Cutting-Safety Precautions of Gas welding and Arc Welding,	4	R5	Remedial
32	Cutting and Finishing.	4	R5	Tutorial
33	Material Handling-Classification-safety consideration manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking.	4	R5	Lecture
34	Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps	4	R5	Lecture
35	Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps	4	R5	Remedial
36	Hazard and risk, Types of hazards Classification of Fire	5	R7	Lecture
37	Types of Fire extinguishers fire, explosion and toxic gas release.	5	R7	Lecture
38	Inventory analysis, Fire and explosion hazard rating of process plants	5	R7	Lecture
39	Types of Fire extinguishers fire	5	R7	Remedial
40	The Dow Fire and Explosion Hazard Index.	5	R7	Tutorial
41	Preliminary hazard analysis, Hazard and Operability study (HAZOP)	5	R7	Lecture
42	Hazardous properties of chemicals	5	R7	Tutorial
43	Material Safety Data Sheets (MSDS).	5	R7	Lecture
44	Material Safety Data Sheets (MSDS).	5	R7	Remedial

31. Question bank

Module 1				
Sl. No.	Question	Marks	CO	BL
1	Define Industrial Safety, Accident and Injury?	3	CO1	L1

2	Differentiate Unsafe act and Unsafe conditions with suitable examples	3	CO1	L2
3	Describe the personal factors that lead to accidents	3	CO1	L1
4	Discuss the significance of a safety committee in improving the safety performance of an industry	3	CO1	L2
5	Describe the objectives of industrial safety.	3	CO1	L1
6	Discuss the significance of safety policy in reducing the accidents.	4	CO1	L2
7	Explain Domino Theory of accident causation	7	CO1	L2
8	Explain the personal factors that lead to accidents	6	CO1	L2
9	Define terms: Accident, Reportable accident, Dangerous occurrence.	4	CO1	L1
10	List out the objectives of Industrial Safety	4	CO1	L1
11	Explain environmental causes of accidents. What are the corrective actions to eliminate them?	10	CO1	L2
12	List the various accident causation theories and explain any one in details.	14	CO1	L1
13	Safety and productivity are the two sides of a coin'. Are you agreeing with this statement? Explain with your arguments.	10	CO1	L3
14	"Safety is the need of this century". Do you agree with this .If so explain	10	CO1	L2
15	Discuss the need of Safety committee- types, and advantages.	14	CO1	L2
16	Define an industrial accident. Write a note on economic aspects of accidents.	7	CO1	L1
17	Discuss the Role of management, supervisors, workmen, unions, government and voluntary agencies in safety.	14	CO1	L2
18	Discuss on authorities and roles of a safety officer?	10	CO1	L2
19	Explain objectives and functions of Safety organization	8	CO1	L1
20	Discuss various Theories of accident causation	14	CO1	L2
Module 2				
Sl. No.	Question	Marks	CO	BL
1.	Define (i) Frequency rate, (ii) severity rate, (iii) incidence rate	3	CO2	L1
2.	List the advantages of good housekeeping?	3	CO2	L1
3.	What is PPE? Give examples	3	CO2	L1
4.	List the different types of personal protective equipment	3	CO2	L1
5.	Explain the 5 s of housekeeping.	10	CO2	L2
6.	What do you mean by confined space? Give examples.	4	CO2	L1
7.	Classify the personal protective equipment. List the suitability of at least fifteen types of PPEs.	10	CO2	L2
8.	How will you calculate the frequency rate? Explain with an example.	4	CO2	L2

9.	How will you compare the safety performance of two industries? Explain with suitable example.	10	CO2	L2
10.	List the steps to be followed in confined space entry to protect the life of a worker?	4	CO2	L1
11.	Discuss the significance of work permit system in accident prevention.	4	CO2	L2
12.	Give the different types of permit? Highlight its suitability.	4	CO2	L2
13.	Briefly explain the standards related to PPE?	6	CO2	L1
14.	Describe the responsibility of management and employees in housekeeping?	3	CO2	L1
15.	Explain the equipments that can be used for protecting the workers from breathing poisonous gases.	3	CO2	L2
16.	Explain the protective equipments that can be used in a noisy environment.	3	CO2	L2
17.	Explain any one protective equipments that could be selected during welding work.	3	CO2	L2
18.	Explain the equipments that can be used for protecting the workers from falling objects.	3	CO2	L2
19.	Define (i) Activity rate, (ii) incidence rate	3	CO2	L1
20.	Explain any 3 equipment that can be used for protection of finger, hand and arm.	3	CO2	L2
Module 3				
Sl. No.	Question	Marks	CO	BL
1	List the various safety features of ladders.	3	CO3	L1
2	How safety of the workers can be ensured during a demolition operation.	3	CO3	L2
3	How safety of the workers can be ensured during excavation and filling	3	CO3	L2
4	List the various safety features of scaffolds.	3	CO3	L1
5	Discuss the safety requirement for a confined space entry	3	CO3	L2
6	How safety of the workers can be ensured during tunnelling	3	CO3	L2
7	Discuss the safety requirement for Under-pinning & Shoring	3	CO3	L2
8	Explain Musculoskeletal Disorders and Cumulative Trauma Disorders in detail	7	CO3	L2
9	Explain the Relevance of ergonomics in construction safety	7	CO3	L2
10	Discuss the important types of ergonomic hazards associated with industries.	7	CO3	L2
11	Identify the various hazards during the different stages of building construction.	7	CO3	L2
12	Discuss the safety and fire protection facilities required for a high rise building as per National building code.	14	CO3	L2
Module 4				

Sl. No.	Question	Marks	CO	BL
1	Define type of Safeguards used in construction industry.	3	CO4	L1
2	Define point of operation devices used for safeguard of machinery	3	CO4	L1
3	Define Slings used for Material handling in industry.	3	CO4	L1
4	Define palletizing and stocking technique in material handling	3	CO4	L1
5	Explain the advantage of Chain sling over a wire rope	3	CO4	L2
6	Explain the classification of Material Handling	3	CO4	L2
7	Explain Safety Precautions followed in Gas welding	3	CO4	L2
8	Explain Safety precautions followed in Arc Welding	3	CO4	L2
9	Discuss the safety issues of Gas welding operations.	3	CO4	L2
10	Explain the hazards associated with manual material handling?	3	CO4	L2
11	Explain the various principles used in machine guarding.	9	CO4	L2
12	Explain the issues in mechanical material handling.	9	CO4	L2
13	Explain the various types of machine guarding devices used in industries. Discuss the suitability of each machine guarding devices.	9	CO4	L2
14	With suitable sketches briefly explain seven defects of wire ropes.	9	CO4	L2
15	Explain Hearing Conservation Program in Production industries.	9	CO4	L2
16	Explain various Material Handling equipment, its operation & maintenance.	14	CO4	L2
17	Explain various material handling assessments and techniques used in industry.	14	CO4	L2
18	Explain various classifications and safety considerations in Machine handling	14	CO4	L2
19	Explain the principles of machine guarding and types of guards and devices used for machine safety.	14	CO4	L2
20	Explain Safety Precautions followed in Gas welding and Arc Welding	14	CO4	L2
Module 5				
Sl. No.	Question	Marks	CO	BL
1	List the types of Fire extinguishers.	3	CO5	L1
2	MSDS is mandatory for chemical products. Give reasons	3	CO5	L1
3	Differentiate Hazard and Risk.	3	CO5	L2
4	Name the company who developed the F& EI (Fire & explosion Index)	3	CO5	L1
5	Classify Chemical hazards.	3	CO5	L2
6	How do you identify chemical hazards.	3	CO5	L1
7	List the hazardous properties of chemicals.	3	CO5	L1
8	Enumerate the industries which uses HAZOP analysis	3	CO5	L1
9	Define(i)Hazard (ii) Risk	3	CO5	L1
10	Classify different types of Fire.	3	CO5	L2
11	Explain ABC analysis of inventory control.	6	CO5	L2

12	Describe the Dow Fire and Explosion Hazard Index.	7	CO5	L2
13	Explain the structure of hazard identification and risk assessment.	7	CO5	L2
14	Describe the Selection of different types of fire extinguishers accordance to type of fire.	10	CO5	L2
15	Illustrate the Fire and explosion hazard rating of process plants	10	CO5	L3
16	Explain chemical risk assessment steps in industries.	10	CO5	L2
17	Describe corrective action and follow-up in HAZOP analysis.	10	CO5	L2
18	Show with a case study example, the Control of Chemical Hazards in industries.	10	CO5	L3
19	What is Hazard and Operability Analysis? How do you conduct a HAZOP analysis?	14	CO5	L2
20	Discuss about different types of chemical hazards.	14	CO5	L2

Prepared By : Prof. Vilbin Varghese, Course faculty

Checked By : Ambily Joseph, Course Committee Coordinator

1. Prescribed Syllabus

List of Experiments: (Minimum 12 experiments are mandatory)

1. Determination of pH, Electrical Conductivity and Turbidity*
2. Determination of TS, TDS and TSS, TVS *
3. Determination of Alkalinity and Acidity *
4. Determination of Hardness *
5. Determination of Chlorides
6. Determination of Total Iron
7. Determination of Biochemical Oxygen Demand*
8. Determination of Chemical Oxygen Demand*
9. Optimum Coagulant dosage*
10. Break point Chlorination *
11. Determination of Available Chlorine in a sample of bleaching powder
12. Determination of Sulphates
13. Determination of Fluoride
14. Determination of Dissolved Oxygen*
15. Determination of nitrates
16. Determination of phosphates
17. Determination of any two Heavy Metal concentration
18. Total coliforms *

2. Text Books (T)

T1. International standards of Drinking water by WHO

3. Reference Books (R)

- R1. Standard Methods for the Examination of Water and Wastewater, 23rd edition, American Public Health Association, American Water Works Association, Water Environment Federation, 2017
- R2. Water Supply Engineering, 33rd edition, Santhosh Kumar Garg, Khanna Publishers
- R3. Sewage Disposal and Air Pollution Engineering, 39th edition, Santhosh Kumar Garg, Khanna publishers.
- R4:IS: 10500:2012 Drinking Water - Specification, Second revision, Bureau of Indian Standards, 2012.

4. Course Objectives

This lab provides the knowledge on tests used to analyse the physio-chemical and bacteriological properties of water and explains the various method followed in the test along with its suitability as a drinking water.

5. Course Pre / Co-requisite

CET 304 Environmental Engineering

6. Course Outcomes

After completion of the course, student will be able to

CO1: Analyse various physico-chemical and biological parameters of water

CO2: Compare the quality of water with drinking water standards and recommend its suitability for drinking purposes

7. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	L		H	H			H		H	H		M
CO2	H	H	H	L		H	H	M		H		H	H		

8. Justification for CO-PO-PSO Correlation

CO1	PO1	Knowledge on the principle, procedure and equipment's used in finding water characteristics will enable the student in inferring the quality of water by standard tests.
	PO2	Knowledge on characteristics of water will enable the students to understand how it can be used for various purposes.
	PO3	Determining the characteristics of water will help the students to design a water treatment plant based on the characteristics of water sample.
	PO4	By analysing various water samples students can interpret the characteristics of samples and to provide valid conclusions
	PO6	Understanding the quality of water by standard test procedure will help the students to assess the societal health and safety by analysing the quality of consumable water.
	PO7	Improving water quality by analysing the physico-chemical and biological parameters of water parameters is essential for sustainable development
	PO10	Preparation of report and continuous assessment during each lab class will develop the communication skill of a student.
	PO12	An understanding and usage of instrumental techniques can be applied in the lifelong learning process of technological change.
	PSO1	Understanding water quality will enable the students to apply the knowledge to estimate water quality.
	PSO3	Knowledge on various standard tests will enable students to apply appropriate techniques for different types of water.
	PO1	Knowledge on water quality standards will enable the student to apply in complex civil engineering field problems such as degree of treatment of water.
	PO2	By comparing the quality of water sample with standard limits will enable the students to analyse the suitability of water for drinking purpose.

CO2	PO3	Determining the quality of water will help the students to design a water treatment plant based on the characteristics of water sample.
	PO4	Knowledge on standard methods for water quality analysis will enable the students to select appropriate tools to analyse the quality.
	PO6	Comparing the quality of water with standard limits will help the students to assess the societal health and safety by analysing the quality of consumable water.
	PO7	Understanding the quality standards will enable the students to check the quality of water based on the Indian Standards and can determine the impact of low quality water in environment.
	PO8	By inferring the characteristics of water based on standard specifications, students will be enforced to apply ethical principles in civil engineering practice.
	PO10	Preparation of report and continuous assessment during each lab class will develop the communication skill of a student.
	PO12	Knowledge in water quality standards will enable the students to apply suitably in real field problems.
	PSO1	Understanding the water quality standards will enable the student to calculate the degree of treatment to be given for water.

9. Curricular gaps (if any)

Nil

10. Course Enrichment Activities*

Sl No	Description	Proposed Activities **	Relevance to POs and PSOs
1		NIL	

11. Internal Assessment mark allocation (as per university curriculum)

(Provide details as mentioned in syllabus)

Continuous Internal evaluation - 75 marks

End Semester Examination - 75 marks

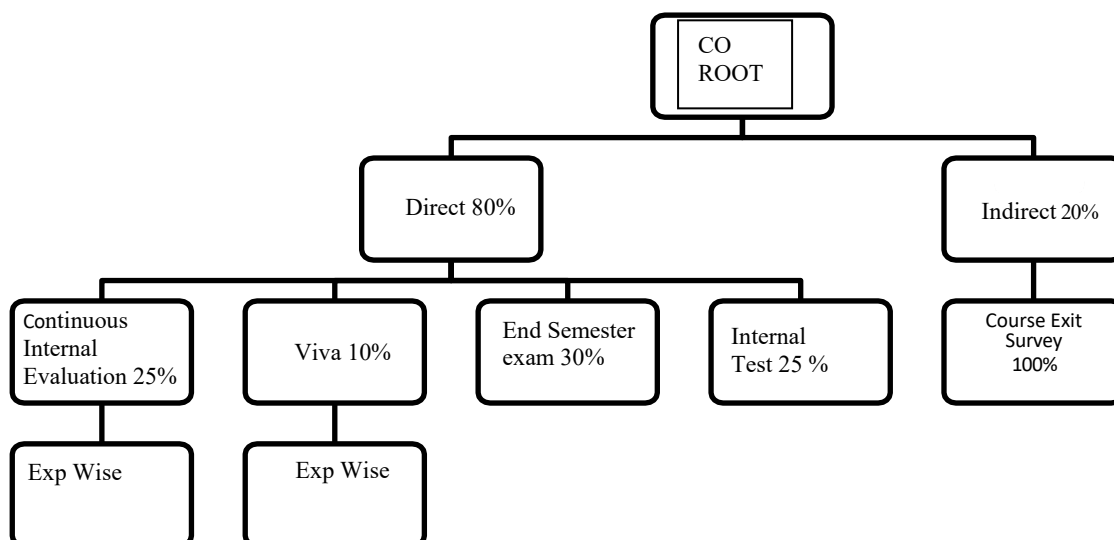
Total -150 marks

12. Assessment – CO Mapping (Put 'x' if mapping is present)

	Tools**	Weightage [#]	CO1	CO2	CO3	CO4
Direct Assessment Tools	Continuous Evaluation Experiment wise CO mapping	25%	x	x	x	x
	Viva – Voce Experiment wise CO mapping	10%	x	x	x	x
	Internal lab exam	35%	x	x	x	x
	End Semester Exam-50%	30%	x	x	x	x

Indirect Assessment Tool	Course Exit Survey	100%	x	x	x	x
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13.Assessment Configuration



14.Course Plan / Schedule of experiments

- List of Experiments.

Experiment no	Name of the experiments
1	Determination of Ph
2	Determination of Electrical Conductivity
3	Determination of Turbidity
4	Determination of TS, TDS and TSS, TVS
5	Determination of Alkalinity
6	Determination of Acidity
7	Determination of Hardness
8	Determination of Chlorides
9	Determination of Total Iron
10	Determination of Biochemical Oxygen Demand

11	Determination of Chemical Oxygen Demand
12	Optimum Coagulant dosage
13	Break point Chlorination
14	Determination of Available Chlorine in a sample of bleaching powder
15	Determination of Sulphates
16	Determination of Dissolved Oxygen
17	Determination of nitrates
18	Determination of phosphates
19	Total coliforms

Weeks(W)	Experiments	Relevance to COs
W1	All batches – Ex: 1,2,3	CO1,CO2
W2	All batches – Ex: 5,6	CO1,CO2
W3	All batches – Ex: 7,8	CO1,CO2
W4	All batches – Ex: 10,16	CO1,CO2
W5	All batches – Ex: 19,11	CO1,CO2
W6	Sub batch 1 – Ex:, 9,15 Sub batch 2 – Ex:13,14 Sub batch 3 – Ex:12,4	CO1,CO2
W7	Sub batch 2 – Ex:12,4 Sub batch 3– Ex: 9,15 Sub batch 1– Ex: 13,14	CO1,CO2
W8	Sub batch 3 – Ex:, 13,14 Sub batch 1 – Ex:12,4 Sub batch 2 – Ex: 9,15	CO1,CO2
W9	Lab exam	CO1,CO2
Total No. of Hours		

Prepared By : Ms. Nithya John, Course Faculty

Checked By : Ms.Sherine Justine, Subject Group Coordinator

Course Code & Name: CEQ 413 Seminar**1. Prescribed Syllabus**

Each student shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide.

2. Text Books (T)

Not specified in KTU syllabus

3. Reference Books (R)

R1. Minimum 3 SCI Indexed journals

WEBSOURCEREFERENCES:

W1 <http://www.sciencedirect.com>

W2 <https://www.springer.com/in>

W3 <https://www.asce.org/>

W4 <https://www.researchgate.net>

4. Course Objectives

- To do literature survey in a selected area of study.
- To understand an academic document from the literature and to give a presentation about it.
- To prepare a technical report.

5. Course Pre / Co-requisite

NIL

6. Course Outcomes

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

CO1: Identify academic documents from the literature which are related to her/his areas of interest

CO2: Read and apprehend an academic document from the literature which is related to her/his areas of interest

CO3: Prepare a presentation about an academic document.

CO4: Give a presentation about an academic document

CO5: Prepare a technical report

7. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	M	M	L	L		M	L					H	H		
CO2	H	H	M	H		M	L					H	H		
CO3	H	M			H			L		M		H	H		
CO4	H				M			L		H		H	H		
CO5	H	H	H	H	M	M		M		H		H	H		

8. Justification for CO-PO-PSO Correlation

CO	PO/PSO	JUSTIFICATION
CO1	PO1	Knowledge on science, mathematics and engineering fundamentals will enable students to conduct literature survey.
	PO2	Students will able to identify research problems reaching substantiated conclusions using fundamental principles in science and engineering.
	PO3	Students will be able to review academic documents during literature survey and can identify solutions to various complex engineering problems.
	PO4	Use of research-based knowledge and research methods will enable students to conduct investigation in specified topics.
	PO6	Students can identify research problems by applying contextual knowledge to assess various societal and cultural issues.
	PO7	Students will be able to review literatures by understanding the impact of professional engineering solutions in societal and environmental contexts.
	PO12	Students will be able to develop skills to review various literatures that will provide foundation for lifelong learning .
	PSO1	Knowledge on science, mathematics and engineering fundamentals will enable students to conduct literature survey.
CO2	PO1	Students will be able to apply fundamentals of engineering to analyse various literatures in the field of civil engineering.
	PO2	Knowledge on fundamentals of engineering will be enable students to review research literature and analyse complex engineering problems reaching substantiated conclusions
	PO3	Students will be able to develop practical solutions to various engineering problem that meet the specified needs with appropriate consideration for the public health and safety.
	PO4	Research based knowledge will help students to synthesize and develop valid conclusions to complex civil engineering problems.
	PO6	Students can analyse research problems by applying contextual knowledge to assess various societal and cultural issues.
	PO7	Students will be able to analyse complex research problems in literatures by understanding the impact of professional engineering solutions in societal and environmental contexts.

	PO12	Students will be able to develop skills to analyse various literatures that will inculcate independent and lifelong learning.
	PSO1	Students will be able to apply fundamentals of engineering to analyse various literatures in the field of civil engineering.
CO3	PO1	Students will be able to apply the knowledge on mathematics and engineering fundamentals in the preparation of technical presentation.
	PO2	Students can review and present literatures about complex engineering problems using their knowledge in natural and engineering sciences.
	PO5	Students will be able to create and apply appropriate techniques and modern IT tools in the preparation of technical presentations in the field of civil engineering
	PO8	Students can apply ethical principles and norms of engineering practice while preparing seminar presentations
	PO10	Student will be capable of communicating effectively on complex engineering activities with engineering community and make effective presentations along with report documentations.
	PO12	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change
	PSO1	Students will be able to apply the knowledge on mathematics and engineering fundamentals in the preparation of technical presentation.
CO4	PO1	Knowledge on science, mathematics and engineering will enable students to present a technical document
	PO5	Students will be able to create and apply appropriate techniques and modern IT tools to give technical presentations in civil engineering topics.
	PO8	Students can apply ethical principles and norms of engineering practice in seminar presentations.
	PO10	Student will be capable of communicating effectively on complex engineering activities with engineering community and make effective presentations along with report documentations.
	PO12	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change
	PSO1	Knowledge on science, mathematics and engineering will enable students to present a technical document

CO5	PO1	Students will be able to prepare a technical report by applying knowledge on various engineering fundamentals.
	PO2	Knowledge on fundamentals of engineering will be enable students to review research literature, and analyse complex engineering problems reaching substantiated conclusions in the form of a technical report.
	PO3	Students will be able to develop a technical report with practical solutions to various engineering problem that meet the specified needs with appropriate consideration for the public health and safety.
	PO4	Research based knowledge will help students to develop valid conclusions in the preparation of a technical report
	PO6	Students can prepare a technical report by applying contextual knowledge to assess various societal and cultural issues.
	PO8	Students can apply ethical principles and norms of engineering practice while preparing a technical report
	PO10	Student will be capable to present complex engineering activities with engineering community with proper documentations.
	PO12	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change
	PSO1	Students will be able to prepare a technical report by applying knowledge on various engineering fundamentals.

9. Internal Assessment mark allocation (as per university curriculum)

(Provide details as mentioned in syllabus)

Continuous Internal evaluation - 100 marks

Total -100 marks

10. Evaluation criteria (as per syllabus)

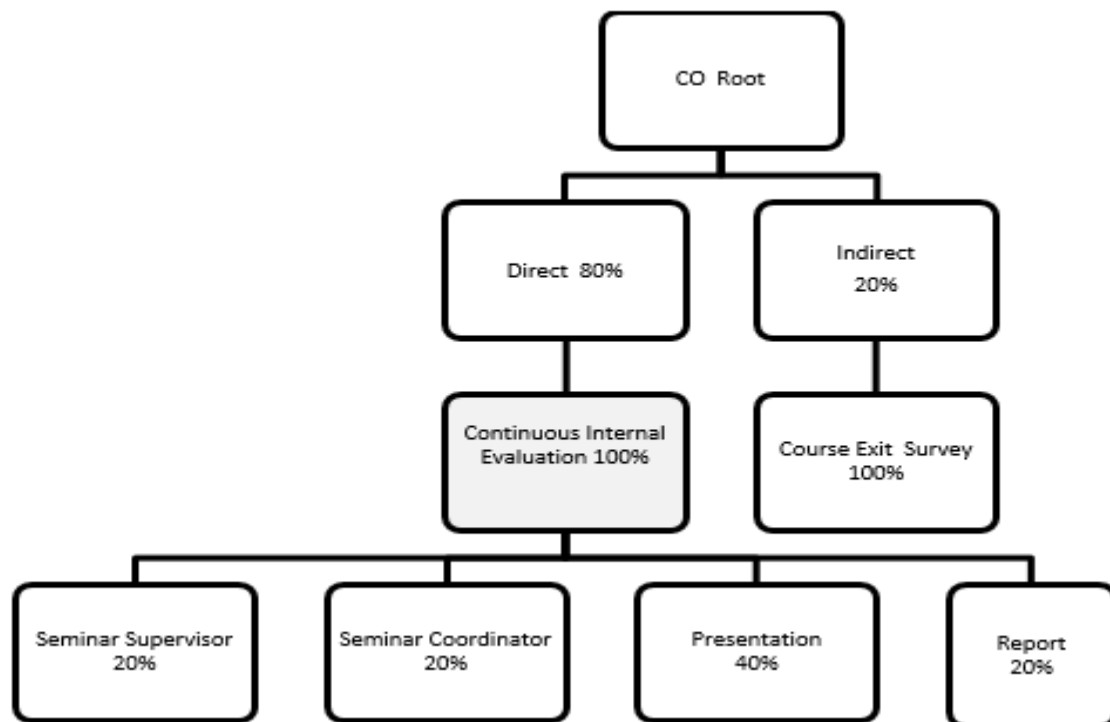
Sl. No.	Nature of Evaluation**	Evaluation Pattern**	Topics of Evaluation**	Duration* *	Weightage of marks**
1	Continuous Internal evaluation (100 marks)				
a	Seminar supervisor	Background Knowledge – 10 marks Relevance of the paper/topic selected – 10 marks			20%

b	Seminar Coordinator	Seminar Diary – 10 marks Attendance – 10 marks			20%
c	Presentation	IEC-40 marks	Clarity of presentation-10 marks Interactions – 10 Overall participation – 10 marks		40%
d	Report	IEC-20 marks			20%

11. **Assessment – CO Mapping** (Put 'x' if mapping is present)

	Tools**	Weightage [#]	CO 1	CO2	CO 3	CO 4	CO5
a.	Seminar supervisor	20%	x	x	x	x	x
b.	Seminar Coordinator	20%	x	x	x	x	x
c.	Presentation	40%	x	x	x	x	x
d.	Report	20%					x
Indirect Assessment Tool	Course Exit Survey	100%	x	x	x	x	x

12. **Assessment Configuration**



Prepared By : Prof. Anagha S / Dr. Bindumol T V / Dr. Benny Mathews Abraham
Checked By : Dr. Ramadas. T, Project Cell Coordinator
Approved By : HOD

1. Prescribed Syllabus

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

2. Text Books (T)

3. Reference Books (R)

R1. Minimum 5 SCI Indexed journals

Web Source References:

W1 <http://www.sciencedirect.com>

W2 <https://www.springer.com/in>

W3 <https://www.asce.org/>

W4 <https://www.indianconcreteinstitute.org/>

W5 <http://www.irc.nic.in>.

4. Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems

5. Course Pre / Co-requisite

Basic Knowledge of undergraduate Civil Engineering Subjects

6. Course Outcomes

After completion of the course, student will be able to

CO1: Model and solve real world problems by applying knowledge across domains.

CO2: Develop products, processes or technologies for sustainable and socially relevant Applications.

CO3: Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks.

CO4: Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms.

CO5: Identify technology/research gaps and propose innovative/creative solutions.

CO6: Organize and communicate technical and scientific findings effectively in written and oral forms.

7. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO ₁	M	M	M	L	M	M	M	L	L	L	L	M	H		
CO ₂	M	M	M		L	H	H	L	L		L	L	H		
CO ₃									H	M	M	L		M	
CO ₄					M			H	M	M	H	M	H		
CO ₅	M	H	H	L	M							L			H
CO ₆					M			M	M	H	L	L		M	

8. Justification for CO-PO-PSO Correlation

CO	PO	Justification
CO1	PO1	Students will be able to apply knowledge of mathematics, science and fundamental of engineering for the solution of real-world problem across the domains.
	PO2	Knowledge on natural sciences, mathematics and engineering will enable students to identify and analyse complex problems in civil engineering.
	PO3	Students will develop design solutions for civil engineering problems that meet IS specifications with appropriate consideration for public health and safety.
	PO4	Knowledge on different methods will enable students to conduct research and provide valid conclusions in the field of engineering.
	PO5	Students will be able to apply appropriate techniques, resources and modern tools to solve complex real-world problems with an understanding of the limitations.

	PO6	Students could apply reasoning informed by contextual knowledge to assess health, safety, legal and cultural issues in the civil engineering
	PO7	Students will be able to model and solve complex civil engineering problems with an understanding of its impact in society and environment
	PO8	Students will develop solutions for civil engineering problems by applying ethical principles and norms of engineering practice.
	PO9	Student will be able to function effectively as an individual and a member in diverse teams and in multi-disciplinary projects.
	PO10	Student will be capable of communicating effectively on complex engineering activities with engineering community and make effective presentations along with report documentations.
	PO11	Students will be able to demonstrate knowledge and understanding of 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 multi -disciplinary environments
	PO12	Students will be able to recognize the need for and have the preparation and ability to engage in independent and lifelong learning broadest context of technological change
	PSO1	Knowledge on fundamental principles of engineering will enable students to model and analyse real life civil engineering problems
CO2	PO1	Students will gain an ability to develop products and technologies for sustainable civil engineering projects by applying the fundamentals of engineering and mathematics.
	PO2	Understanding natural science and fundamentals of civil engineering will enable students to formulate technologies to solve complex civil engineering problems
	PO3	Student will be able to design sustainable products or processes for complex civil engineering problems with appropriate consideration for public health and safety.
	PO5	Students will able to develop solutions or processes for complex civil engineering problems.by applying appropriate techniques, resources and IT tools.
	PO6	Students will be able to apply reasoning informed by contextual knowledge to assess societal, safety, health, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
	PO7	Students will be able to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development
	PO8	Students will be able to apply ethical principles and responsibilities and norms of the engineering practice
	PO9	Students will be able to function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary setting
	PO11	Students will be able to demonstrate knowledge and understanding of 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 areas
	PO12	Students will be able to recognize the need for and have the preparation and ability to engage in independent and lifelong learning broadest context of technological knowledge
	PSO1	Knowledge on fundamental principles of engineering will enable students to develop sustainable products/technology with socially relevant applications.

CO3	PO9	Students will be able to function effectively as an individual and as a member or leader in diverse teams and in multi -disciplinary setting
	PO10	Students will be able to communicate effectively on complex engineering activities and clearly communicate and propose a work plan
	PO11	Understanding engineering and management principles will enable students to manage a project work as individual / a member or leader in a team effectively.
	PO12	Being in a team students will be able to engage in independent and life-long learning broadest context of technological change
	PSO2	Students will be able to interact effectively with engineers from other disciplines regarding sustainable solutions for the benefit of society.
CO4	PO5	Students will be able to use modern tools for planning and executing tasks within timelines ,following ethical and professional norms
	PO8	Students will be able to apply ethical principles while planning and executing tasks
	PO9	During planning and execution of a task students will be able to function effectively as an individual and as a member or leader in diverse teams
	PO10	Students will be able to communicate effectively during planning phase of a task which will in turn result in flawless execution
	PO11	Understanding the financial aspect and management principles will enable the student to efficiently plan a task utilizing the given resources
	PO12	A good and well executed plan will remain with the student and also with result in lifelong learning
	PSO1	Knowledge of engineering fundamentals helps the students to plan and execute task within the time using professional norms.
CO5	PO1	Students will be able to apply knowledge of engineering to identify research gaps and suggest ground breaking solutions
	PO2	Identifying knowledge gaps in research with improve analysis skills of students and will help in solving complex problems in civil engineering.
	PO3	Students will develop design solutions for civil engineering problems that arise as research gaps and it will help in proposing creative solutions.
	PO4	Students will learn to conduct investigations of technology gaps and will help to come up with creative solutions
	PO5	Students will be able to apply appropriate resources and modern tools to identify research gaps and propose creative solutions
	PO12	Solving the technology and research gaps in civil engineering will help the students in lifelong learning
	PSO3	By applying modern engineering tools enable the students to create innovative solutions for complex problems.
CO6	PO5	Students will learn to apply modern tools to organize the scientific findings in written and oral forms
	PO8	Students will be able to apply ethical principles while organizing and communicating technical findings
	PO9	Students will be able to function effectively as an individual and as a team member when organizing scientific findings and communicating it in different forms
	PO10	Students will be able to improve their communication skills when they are in the process of organizing their research findings from the field of civil engineering

	PO11	The management and financial side of a project will be understood by the student when they start organize and communicate technical findings effectively in written forms
	PO12	The way a student starts organize and communicate technical findings will play a major role in life long learning in the field of civil engineering
	PSO2	Enable the students to interact with engineers from other disciplines to organise technical findings effectively.

9. Curricular gaps (if any)

NA

10. Course Enrichment Activities*

NA

11. Internal Assessment mark allocation (as per university curriculum)

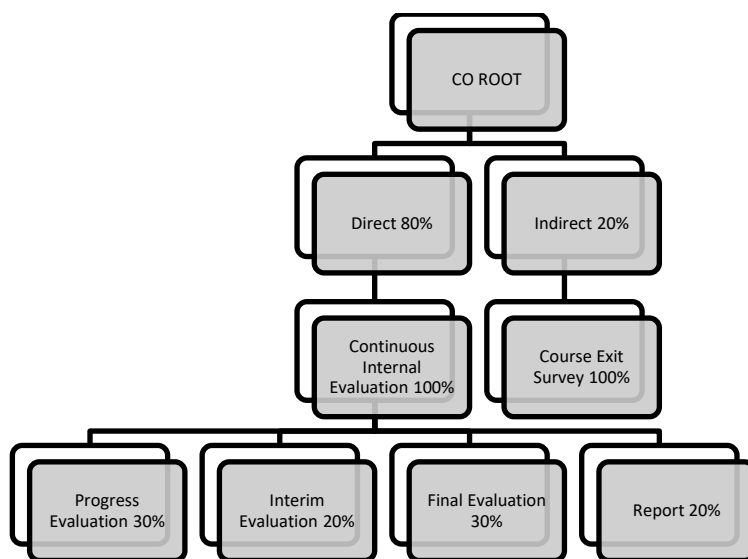
(Provide details as mentioned in syllabus)

Project progress evaluation by guide	: 30 Marks.
Interim evaluation by the Evaluation Committee	: 20 Marks.
Final Evaluation by the Evaluation Committee	: 30 Marks.
Report (By Evaluation Committee)	: 20Marks.
Total Marks	: 100Marks

12. Assessment – CO Mapping (Put ‘ x’ if mapping is present)

Sl.No.	Tools**	Weightage [#]	CO1	CO2	CO3	CO4	CO5	CO6
Direct Assessment Tool	Progress Evaluation	30%	x	x	x	x	x	x
	Interim Evaluation	20%	x	x	x	x	x	x
	Final Evaluation	30%	x	x	x	x	x	x
	Report	20%						x
Indirect Assessment Tool	Course Exit Survey	100%	x	x	x	x	x	x

13. Assessment Configuration



14. Course Plan

Hour	Topic	Module	Reference(s)	Teaching Pedagogy
1	Proposal Form submission			
2	Zeroth presentation			
3	Abstract			
4	Interim presentation			
5	Final Evaluation			

15. Question Bank

NA

Prepared By : Ms. Ayana V S, Course Faculty
Checked By : Dr. Ramadas. T, Project Cell Coordinator
Approved By : HOD