

COURSE STRUCTURE
for
B.TECH. DEGREE
in
CIVIL ENGINEERING

(Applicable from the academic session 2024-2025)



Dr. B. C. Roy Engineering College

An Autonomous Institution

Approved by: All India Council for Technical Education (AICTE)

*Affiliated to: Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly Known as -WBUT)*

Jemua Road, Durgapur, West Bengal, India, 713206

The Civil Engineering Course Structure has been reformed on 2nd April, 2025. After that, the subject codes have been modified.

Sanjay Sengupta
H.O.D. I.C.E.
Dr. B. C. Roy Engrg College, Durgapur
Signature of the BoS Chairman

Semester Wise Break Up of Credit (New Autonomous Structure)

Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7	Sem8	Total
20	23	23	22	23	22	20	12	165

S. No.	Category	Breakup of Credits (Actual) As per Proposed Autonomous Structure
1.	Humanities and Social Sciences including Management courses	06
2.	Basic Science Courses	25
3.	Engineering Science courses including workshop, drawing, basics of electrical/ mechanical/ computer etc.	26
4.	Professional core course	55
5.	Professional Elective specialization/branch courses relevant to chosen	25
6.	Indian Knowledge System	02
7.	Multidisciplinary Open Electives Courses	06
8.	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	20
9.	Mandatory Non Credit Courses – Audit Course	15 L
Total Credits		165

B. Tech., 1stYr (1st Semester)

Theory							
Sl No	Paper Name	Paper Code	Marks	L	T	P	Credit
1	Mathematics-I	M-101	100	3	0	0	3
2	Physics	PH-101	100	3	0	0	3
3	Basic Electrical Engineering	EE-101	100	3	0	0	3
4	Engineering Mechanics	ME-101	100	3	0	0	3
5	English Language and Technical Communication	ENG-101	100	3	0	0	3
	Total Theory		500	15	0	0	15
Practical							
1	Physics Lab	PH-191	100	0	0	2	1
2	Basic Electrical Engineering Lab	EE-191	100	0	0	2	1
3	Language Lab	ENG-191	100	0	0	2	1
4	Workshop Practices	ME-192	100	0	0	4	2
	Total Practical		400	0	0	10	5
	Total in 1st Semester		900	15	0	10	20
Extra Curricular Activity							
1	NSS		100				0

B. Tech. 1stYr (2nd Semester)

<i>Theory</i>							
Sl. No.	Paper Name	Paper Code	Marks	L	T	P	Credit
1	Mathematics-II	M-202	100	3	0	0	3
2	Chemistry	CH-201	100	3	0	0	3
3	Basic Electronics Engineering	EC-201	100	3	0	0	3
4	Introduction to Computer Hardware and Software	CS-201	100	3	0	0	3
5	Programming for Problem Solving	CS-202	100	3	0	0	3
	Total Theory		500	15	0	0	15
<i>Practical</i>							
1	Chemistry Lab	CH-291	100	0	0	2	1
2	Basic Electronics Engineering Lab	EC-291	100	0	0	2	1
3	Engineering Graphics	ME 291	100	0	0	4	2
4	Introduction to Computer Hardware and Software Lab	CS 291	100	0	0	4	2
5	Programming for Problem Solving Lab	CS 292	100	0	0	4	2
	Total Practical		500	0	0	16	8
	Total of 2nd Semester		1000	15	0	16	23
<i>Mandatory Courses</i>							
1	Environmental Science	ENV-281		1	0	0	0

Total Credit in 1st Year: 43

Department: Civil Engineering (CE)

Curriculum Structure (Effective from 2024 -25 admission batch)

2 nd Year 3 rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per Week				Credits
					L	T	P	Total	
A. THEORY									
1	BASIC SCIENCE (BS)	MINOR	CE-301	ADVANCED ENGINEERING MATHEMATICS	3	0	0	3	3
2	ENG SCIENCE (ES)	MAJOR	CE-302	SOLID MECHANICS	2	1	0	3	3
3	CORE ENGG (PC)	MAJOR	CE-303	CONCRETE TECHNOLOGY	2	1	0	3	3
4	CORE ENGG (PC)	MINOR	CE-304	SUSTAINABLE AND GREEN CONSTRUCTION	3	0	0	3	3
5	HUMANITIES AND SOCIAL SCIENCES (HSMC)	MINOR	CE-305	UNIVERSAL HUMAN VALUES	2	1	0	3	3
B. PRACTICAL/SESSIONAL									
1	ENG SCIENCE (ES)	MAJOR	CE-381	CIVIL ENGINEERING MATERIALS, TESTING & EVALUATION SESSIONAL	0	1	2	3	2
2	CORE ENGG (PC)	MAJOR	CE-382	BUILDING PLANNING AND COMPUTER-AIDED CIVIL ENGINEERING DRAWING SESSIONAL	0	1	2	3	2
3	MULTIDISCIPLINARY OPEN ELECTIVES COURSE -1 (OE)	MULTIDISCIPLINARY	CE-383	PROBLEM SOLVING USING PYTHON AND MATLAB LABORATORY	0	1	2	3	2
4	MULTIDISCIPLINARY NON-CREDIT COURSE-1 (MNC)	VALUE ADDED	CE-384	DISABILITY, ACCESSIBILITY AND UNIVERSAL DESIGN	3	0	0	3	0
5	ENG SCIENCE (ES)	MAJOR	CE-391	SOLID MECHANICS LABORATORY	0	0	2	2	1
6	CORE ENGG (PC)	MAJOR	CE-392	CONCRETE TECHNOLOGY LABORATORY	0	0	2	2	1
TOTAL THEORY AND PRACTICALS								31	23

2nd Year 4th Semester

2 nd Year 4 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per Week				Credits
					L	T	P	Total	
A. THEORY									
1	CORE ENGG (PC)	MAJOR	CE-401	TRANSPORTATION ENGINEERING	2	1	0	3	3
2	CORE ENGG (PC)	MAJOR	CE-402	SURVEYING AND GEOMATICS	2	1	0	3	3
3	CORE ENGG (PC)	MAJOR	CE-403	GEOTECHNICAL ENGINEERING	2	1	0	3	3
4	CORE ENGG (PC)	MAJOR	CE-404	FLUID MECHANICS AND HYDRAULIC ENGINEERING	2	1	0	3	3
5	CORE ENGG (PC)	MAJOR	CE-405	STRUCTURAL ANALYSIS - I	3	0	0	3	3
B. PRACTICAL/SESSIONAL									
1	MULTIDISCIPLINARY OPEN ELECTIVES COURSE -2 (OE)	MULTIDISCIPLINARY	CE-481	DATA SCIENCE IN CIVIL ENGINEERING LABORATORY	0	1	2	3	2
2	MULTIDISCIPLINARY NON-CREDIT COURSE-2 (MNC)	ABILITY ENHANCEMENT	CE-482	CIVIL ENGINEERING - SOCIETAL & GLOBAL IMPACT	3	0	0	3	0
3	SEMINAR	SKILL ENHANCEMENT	CE-483	SEMINAR	0	0	2	2	1
4	CORE ENGG (PC)	MAJOR	CE-491	TRANSPORTATION ENGINEERING LABORATORY	0	0	2	2	1
5	CORE ENGG (PC)	MAJOR	CE-492	SURVEYING AND GEOMATICS LABORATORY	0	0	2	2	1
6	CORE ENGG (PC)	MAJOR	CE-493	BASIC GEOTECHNICAL ENGINEERING LABORATORY	0	0	2	2	1
7	CORE ENGG (PC)	MAJOR	CE-494	FLUID MECHANICS LABORATORY	0	0	2	2	1
TOTAL THEORY AND PRACTICALS								31	22

3 rd Year 5 th Semester									
Sl. No .	Broad Category	Category	Course Code	Course Title	Hours per Week				Credits
					L	T	P	Total	
A. THEORY									
1	CORE ENGG (PC)	MAJOR	CE-501	DESIGN OF RC STRUCTURES	3	0	0	3	3
2	CORE ENGG (PC)	MAJOR	CE-502	ENVIRONMENTAL ENGINEERING	2	1	0	3	3
3	CORE ENGG (PC)	MAJOR	CE-503	STRUCTURAL ANALYSIS –II	3	0	0	3	3
4	PROGRAM ELECTIVE COURSE- 1 (PE)	MAJOR	CE-504	FOUNDATION ENGINEERING	2	1	0	3	3
			CE-505	STRUCTURAL GEOLOGY					
			CE-506	ROCK MECHANICS					
5	PROGRAM ELECTIVE COURSE- 2 (PE)	MAJOR	CE-514	DESIGN OF HYDRAULIC STRUCTURES AND IRRIGATION ENGINEERING	3	0	0	3	3
			CE-515	RAILWAY AND AIRPORT ENGINEERING					
			CE-516	ENVIRONMENTAL LAWS, POLICIES AND IMPACT ASSESSMENT					
B. PRACTICAL/SESSIONAL									
1	CORE ENGG (PC)	MAJOR	CE-581	RC DESIGN SESSIONAL	0	0	2	2	1
2	CORE ENGG (PC)	MAJOR	CE-582	ENGINEERING ECONOMICS, ESTIMATION & COSTING SESSIONAL	0	1	2	2	2
3	MULTIDISCIPLINARY OPEN ELECTIVES COURSE -3 (OE)	MULTIDISC IPLINARY	CE-583	APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING	0	1	2	3	2
4	MULTIDISCIPLINARY NON-CREDIT COURSE- 3 (MNC)	VALUE ADDED	CE-584	3D PRINTING TECHNOLOGY IN CIVIL ENGINEERING	3	0	0	3	0
5	PROJECT	SKILL ENHANCEMENT	CE-585	MINI PROJECT	0	0	2	2	1
6	CORE ENGG (PC)	MAJOR	CE-591	ENVIRONMENTAL ENGINEERING LABORATORY	0	0	2	2	1
7	PROGRAM ELECTIVE COURSE- 1 (PE)	MAJOR	CE-592	ADVANCED GEOTECHNICAL AND GEOLOGY LABORATORY	0	0	2	2	1
TOTAL THEORY AND PRACTICALS								31	23

3rd Year 6th Semester

3 rd Year 6 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per Week				Credits
					L	T	P	Total	
A. THEORY									
1	CORE ENGG (PC)	MAJOR	CE-601	DESIGN OF STEEL STRUCTURES	2	1	0	3	3
2	CORE ENGG (PC)	MAJOR	CE-602	HYDROLOGY & WATER RESOURCES ENGINEERING	3	0	0	3	3
3	CORE ENGG (PC)	MAJOR	CE-603	CONSTRUCTION ENGINEERING & MANAGEMENT	3	0	0	3	3
4	PROGRAM ELECTIVE COURSE- 3 (PE)	MINOR	CE-604	INTRO TO FINITE ELEMENT ANALYSIS	3	0	0	3	3
			CE-605	EARTHQUAKE ENGINEERING					
			CE-606	SOIL DYNAMICS AND MACHINE FOUNDATION					
5	PROGRAM ELECTIVE COURSE- 4 (PE)	MAJOR	CE-614	INDUSTRIAL WASTE WATER MANAGEMENT	3	0	0	3	3
			CE-615	CONSTRUCTION EQUIPMENTS AND AUTOMATION					
			CE-616	STRUCTURAL HEALTH MONITORING AND REHABILITATION					
B. PRACTICAL/SESSIONAL									
1	BASIC SCIENCE (BS)	MINOR	CE-681	BIOLOGY FOR ENGINEERS LABORATORY	0	1	2	3	2
2	MULTIDISCIPLINARY NON-CREDIT COURSE- 4 (MNC)	SKILL ENHANCEMENT	CE-682	CAREER PLANNING AND SKILL DEVELOPMENT	3	0	0	3	0
3	PROJECT	SKILL ENHANCEMENT	CE-683	MINI PROJECT	0	0	2	2	1
4	CORE ENGG (PC)	MAJOR	CE-691	BUILDING INFORMATION MODELING	0	0	2	2	1
5	CORE ENGG (PC)	MAJOR	CE-692	HYDROLOGY & WATER RESOURCES ENGINEERING LABORATORY	0	0	2	2	1
6	PROGRAM ELECTIVE COURSE- 3 (PE)	MAJOR	CE-693	COMPUTATIONAL TOOLS AND SOFTWARE LABORATORY IN CIVIL ENGINEERING	0	0	2	2	1
7	PROGRAM ELECTIVE COURSE- 4 (PE)	MAJOR	CE-694	ADVANCED TECHNOLOGIES AND MONITORING SYSTEMS LABORATORY	0	0	2	2	1
TOTAL THEORY AND PRACTICALS								31	22

4th Year 7th Semester

4 th Year 7 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per Week				Credits
					L	T	P	Total	
A. THEORY									
1	CORE ENGG (PC)	MINOR	CE-701	INTELLIGENT TRANSPORTATION SYSTEMS	3	0	0	3	3
2	PROGRAM ELECTIVE COURSE- 5 (PE)	MAJOR	CE-702	PAVEMENT MATERIAL	3	0	0	3	3
			CE-703	TOTAL STATION AND GPS SURVEY					
			CE-704	AIR AND NOISE POLLUTION CONTROL					
3	PROGRAM ELECTIVE COURSE- 6 (PE)	MAJOR	CE-712	PRESTRESSED CONCRETE	3	0	0	3	3
			CE-713	TRAFFIC ENGINEERING AND MANAGEMENT					
			CE-714	RAINWATER HARVESTING					
4	PROGRAM ELECTIVE COURSE- 7 (PE)	MAJOR	CE-722	BRIDGE ENGINEERING	3	0	0	3	3
			CE-723	GROUND IMPROVEMENT TECHNIQUE					
			CE-724	CONTRACT MANAGEMENT					
5	INDIAN KNOWLEDGE SYSTEM	ABILITY ENHANCEMENT	CE-732	INDIAN TOWN PLANNING AND ARCHITECTURE	2	0	0	2	2
B. PRACTICAL/SESSIONAL									
1	MULTIDISCIPLINARY NON-CREDIT COURSE- 5 (MNC)	ABILITY ENHANCEMENT	CE-781	DISASTER PREPAREDNESS & PLANNING	3	0	0	3	0
2	INTERNSHIP	SKILL ENHANCEMENT	CE-782	INTERNSHIP	0	0	4	4	2
3	PROJECT	SKILL ENHANCEMENT	CE-783	MINI PROJECT & SEMINAR	0	0	6	6	3
4	PROGRAM ELECTIVE COURSE- 5 (PE)	MAJOR	CE-791	PAVEMENT MATERIAL LABORATORY	0	0	2	2	1
			CE-792	TOTAL STATION AND GPS SURVEY LABORATORY					
			CE-793	AIR AND NOISE POLLUTION CONTROL LABORATORY					
TOTAL THEORY AND PRACTICALS								29	20

4 th Year 8 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per Week				Credits
					L	T	P	Total	
A. PRACTICAL/SESSIONAL									
1	PROJECT	SKILL ENHANCEMENT	CE-881	PROJECT	0	0	24	24	12
TOTAL THEORY AND PRACTICALS								24	12



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BACHELOR OF TECHNOLOGY [B. Tech.]

Common Syllabus of 1st Year [Group-A]

[ECE / EE / ME / CE / CSE(AIML) / CSE(CS)]

(Applicable from the academic session 2024-2025)

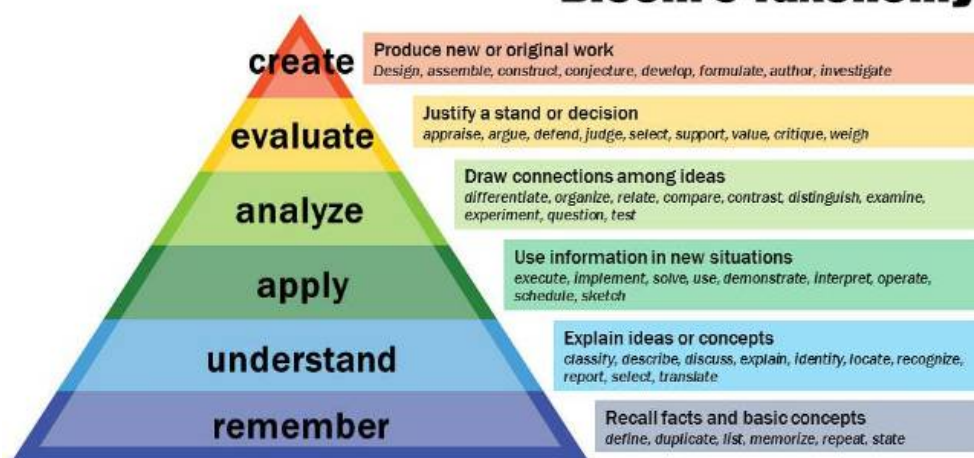


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BLOOM'S TAXONOMY

Bloom's taxonomy is a framework for categorizing educational goals, developed by a committee of educators chaired by Benjamin Bloom in 1956. It was first introduced in the publication *Taxonomy of Educational Objectives: The Classification of Educational Goals*. The taxonomy divides learning objectives into three broad domains: cognitive (knowledge-based), affective (emotion-based), and psychomotor (action-based), each with a hierarchy of skills and abilities. These domains are used by educators to structure curricula, assessments, and teaching methods to foster different types of learning.

Bloom's Taxonomy



Revised Bloom's Taxonomy Action Verbs

Definitions	I.Remembering	II.Understanding	III.Applying	IV.Analyzing	V.Evaluating	VI.Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts and answers	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting giving descriptions and stating main ideas	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way	Examine & break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations	Present & defend opinions by making judgements about information, validity of ideas or quality of work based on a set of criteria	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions
Verb's	- Choose - Define - Find - How - Label - List - Match - Name - Omit - Recall - Relate - Select - Show - Spell - Tell - What - When - Where - Which - Who - Why	- Classify - Compare - Contrast - Demonstrate - Explain - Extend - Illustrate - Infer - Interpret - Outline - Relate - Rephrase - Show - Summarize - Translate	- Apply - Build - Choose - Construct - Develop - Experiment with - Identify - Interview - Make use of - Model - Organize - Plan - Select - Solve - Utilize	- Analyze - Assume - Categorize - Classify - Compare - Conclusion - Contrast - Discover - Dissect - Distinguish - Divide - Examine - Function - Inference - Inspect - List - Motive - Relationships - Simplify - Survey - Take part in - Test for - Theme	- Agree - Appraise - Asses - Award - Choose - Compare - Conclude - Criteria - Criticize - Decide - Deduct - Defend - Determine - Disprove - Estimate - Evaluate - Explain - Importance - Influence - Interpret - Judge - Justify - Mark - Measure - Opinion - Perceive - Prioritize - Prove - Rate - Recommend - Rule on - Select - Support - Value	- Adapt - Build - Change - Choose - Combine - Compile - Compose - Construct - Create - Delete - Design - Develop - Discuss - Elaborate - Estimate - Formulate - Happen - Imagine - Improve - Invent - Make up - Maximize - Minimize - Modify - Original - Originate - Plan - Predict - Propose - Solution - Solve - Suppose - Test - Theory

Program Outcomes (Revised)

1. **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.
2. **PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **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)
4. **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).
5. **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)
6. **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).
7. **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Teamwork:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **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
10. **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.
11. **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)

COURSE STRUCTURE: Group-A

1stYr (1st Semester)

Theory							
Sl No	Paper Name	Paper Code	Marks	L	T	P	Credit
1	Mathematics-I	M-101	100	3	0	0	3
2	Physics	PH-101	100	3	0	0	3
3	Basic Electrical Engineering	EE-101	100	3	0	0	3
4	Engineering Mechanics	ME-101	100	3	0	0	3
5	English Language and Technical Communication	ENG-101	100	3	0	0	3
	Total Theory		500	15	0	0	15
Practical							
1	Physics Lab	PH-191	100	0	0	2	1
2	Basic Electrical Engineering Lab	EE-191	100	0	0	2	1
3	Language Lab	ENG-191	100	0	0	2	1
4	Workshop Practices	ME-192	100	0	0	4	2
	Total Practical		400	0	0	10	5
	Total in 1st Semester		900	15	0	10	20
Extra Curricular Activity							
1	NSS		100				0

B. Tech. 1st Yr (2nd Semester)

Theory							
Sl. No.	Paper Name	Paper Code	Marks	L	T	P	Credit
1	Mathematics-II	M-202	100	3	0	0	3
2	Chemistry	CH-201	100	3	0	0	3
3	Basic Electronics Engineering	EC-201	100	3	0	0	3
4	Introduction to Computer Hardware and Software	CS-201	100	3	0	0	3
5	Programming for Problem Solving	CS-202	100	3	0	0	3
	Total Theory		500	15	0	0	15
Practical							
1	Chemistry Lab	CH-291	100	0	0	2	1
2	Basic Electronics Engineering Lab	EC-291	100	0	0	2	1
3	Engineering Graphics	ME 291	100	0	0	4	2
4	Introduction to Computer Hardware and Software Lab	CS 291	100	0	0	4	2
5	Programming for Problem Solving Lab	CS 292	100	0	0	4	2
	Total Practical		500	0	0	16	8
	Total of 2nd Semester		1000	15	0	16	23
Mandatory Courses							
1	Environmental Science	ENV-201		1	0	0	0

Total Credit in 1st Year: 43

1st SEMESTER SYLLABUS

Group-A

BCREC: Estd.-2000; "Dedicated to Quality Education"

Course Name: Mathematics-I

Course Code: M-101

(Semester I)

Course Broad Category: Basic Science

1. Course Prerequisite:

Concept of Mathematics in 10+2 standard.

2. Course Learning Objectives:

The objective of this courses to familiarize the prospective engineers with techniques in calculus multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advance level that will serve them well towards tackling more advance level of mathematics and applications that they would find useful in their disciplines.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

- **End Semester Examination (ESE): Total: 60 Marks**
- **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Mathematics-I

Course Code: M-101

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	45L
1.	Sequence and Series: Sequences: Limit of a Sequence, Boundedness, Convergence, Divergence and Oscillation of a Sequence. Infinite Series: Necessary Condition for Convergence, Tests for Convergence and Divergence, Comparison Test: Only for Series with Positive Terms, Cauchy's Integral Test, D'Alembert's Ratio Test, Cauchy's Root Test, Raabe's Test (Higher Ratio Test), Logarithmic Test, Alternating Series Leibnitz's Theorem, Absolute Convergence and Conditional Convergence, Power Series.	8L
2.	Differential Calculus (Single Variables): Functions of single variable: Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Taylor's Series and Maclaurin's Series Expansions with Different forms of Remainders (Only statements and applications in all cases).	6L
3.	Differential Calculus (Several Variables): Functions of Several Variables: Limit and Continuity, Partial Differentiation, Total Derivative. Partial Differentiation of Composite Functions: Change of Variables, Differentiation of an Implicit Function, Euler's Theorem for Two variables (statement only), Jacobian, Taylor's Theorem for Function of Two Variables (statement only), Maxima and Minima of Functions of Two Variables: With and Without Constraints, Lagrange's Method of Undetermined Multipliers.	10L
4.	Integral Calculus: Improper Integrals: Different types of Improper Integrals and their Convergence, Beta and Gamma function and their properties. Double Integrals and Triple Integrals - Application of Double Integrals and Triple Integrals, Change of Order of Integration.	9L
5.	Linear Algebra: Real Matrices: Symmetric, Skew-Symmetric, and Orthogonal Matrices (examples and uses), Inverse of a Matrix, Rank of a Matrix, Diagonalization of a Matrix. Complex Matrices: Hermitian, Skew-Hermitian, Unitary Matrices (examples and uses). Determinants, Solutions of Linear System of Equations-- Existence, Uniqueness. Cramer's Rule, Gauss-Jordan Elimination., Gauss Elimination Method, LU-decomposition Method from Gaussian Elimination. Basics of Group Theory. Vector Spaces, Basis, Dimension and Nullity. Linear Dependence and Independence. Matrix Eigenvalue Problem - Determining Eigenvalues and Eigenvectors, Cayley-Hamilton Theorem (statement only and uses), Some Applications of Eigenvalue Problems, Linear Transformations.	12L

5. Suggested Learning Resources:

Text Book:

- B. S. Grewal-- Higher Engineering Mathematics; **Publisher.** Khanna Publishers.
- Ramana B. V. --- Higher Engineering Mathematics; **Publisher.** McGraw Hill Education.

Reference Books:

- G. B. Thomas & R.L. Finney--- Calculus and Analytic Geometry; **Publisher.** Penguin Random House Australia.
- E. Kreyszig--- Advanced Engineering Mathematics (9th Edition); **Publisher.** Wiley.
- Veerarajan T.--- Engineering Mathematics for 1st year (TMG); **Publisher.** McGraw Hill Education.
- D. Poole---- Linear Algebra: A Modern Introduction; **Publisher.** Cengage Learning India Private Limited.
- Bali & Goel--- Text Book of Engineering Mathematics; **Publisher.** Laxmi Publications
- H. K. Das---Higher Engineering Mathematics; **Publisher.** Visionias.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
M-101.1	Remember to identify different tools in algebra and calculus which would enable them to devise engineering solutions to encounter in their profession life.	Identify	Remember
M-101.2	Understand the concept to explain applications of functions of single and several variables in applied sciences and engineering problems.	Explain	Understand
M-101.3	Apply to implement the concept of partial derivatives in finding the maxima and minima of a function of several variables in the area of real-life problems.	Implement	Apply
M-101.4	Analyze the ideas of mentioned mathematical tools to organize complex real-life problems.	Organize	Analyze
M-101.5	Evaluating the gradation of described mathematical tools in linear algebra to assess the right approach to solve multidisciplinary engineering problems.	Assess	Evaluate
M-101.6	Construct logical and analytical skills to create a new idea appreciated by academics, research & emerging trends in industry.	Construct	Create

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1
3	2	3	3	2	-	1
4	3	-	-	2	-	1
5	2	-	-	1	3	1

8. Mapping of the Course outcomes to Program Outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
M-101.1	2	2	2	2	1	-	-	-	-	-	1
M-101.2	3	2	1	1	-	-	-	-	-	-	1
M-101.3	3	2	2	1	1	-	-	-	-	-	1
M-101.4	2	3	1	2	2	-	-	-	-	-	2
M-101.5	3	2	1	2	2	-	-	-	-	-	1
M-101.6	2	1	1	1	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

Course Name: PHYSICS

Course Code: PH-101

(Semester – I)

Course Broad Category: Basic Science

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1. Course Prerequisite:

Class-XII level knowledge of Physics and Mathematics.

2. Course Learning Objectives:

- i. Aim of this course is to introduce the students to fundamentals of graduate level physics, which form the basis of all applied science and engineering
- ii. To compile all the knowledge acquired from the course and to apply in industry, academia, and research keeping in the mind about ethical awareness and impact in the field of pollution, social and safety.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

➤ **End Semester Examination (ESE): Total: 60 Marks**

➤ **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: PHYSICS

Course Code: PH-101

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	CO	45L
1.	Vector Algebra and Vector Calculus: Concepts of Vector Algebra, Vector calculus. Gradient, Divergence and Curl. Physical meaning of gradient, divergence and curl. Solenoidal vector (Definition only), Irrotational vector (Definition only), Conservative and non-conservative forces. Vector integration: Line Integral, Surface Integral, Volume Integral. Gauss Divergence Theorem, Stoke's Theorem.	CO1	7L
2	Oscillations: Introduction to S.H.M., Lissajous Figure, Damped Oscillations: Differential Equation and its solution, Different conditions of damping of harmonic oscillations, Logarithmic Decrement, Relaxation Time, Forced oscillations: Differential equation (Qualitative analysis only), Resonance: Amplitude and Velocity Resonance, Quality Factor, Sharpness of Resonance. Formation of Progressive wave and wave equation.	CO2	7L
3	Optics: Basic Concept of interference of light (No derivation), Types of interference, Diffraction of light, Difference between Interference and Diffraction, Difference between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit, Conditions for maxima and minima, Plane Transmission grating, Dispersive and Resolving power of grating. Polarization: Polarization by Reflection and refraction- Brewster's law, Polarization by double refraction, Nicol Prism, Polaroids and its uses. Retardation Plate, Circular and elliptical polarization.	CO3	5L 5 L
4	Dielectric and Magnetic Properties of Materials: Dielectric material, Polar and Non-polar Dielectric, Dielectric constant,	CO4	2L

Module	Topics	CO	45L
	Polarization ($\vec{P}$), Electrical Susceptibility. Relation between Dielectric Constant and Electrical Susceptibility. Polarizability, Applications of Dielectric. Magnetic Induction Vector or Magnetic Flux Density ($\vec{B}$), Magnetic Field Intensity($\vec{H}$), Magnetization ($\vec{M}$), Magnetic Permeability(μ), Magnetic Susceptibility (χ), Relation between Magnetic Flux Density($\vec{B}$), Magnetic Field Intensity($\vec{H}$) and Magnetization($\vec{M}$), Classification of Magnetic Materials, Hysteresis Loop.		5L
5	Electromagnetic Induction and Maxwell's Equation: Faraday's law of electromagnetic induction, Biot-Savart Law, Ampere's Circuital Law and displacement current, Maxwell's equations - Differential and Integral forms. Electromagnetic wave equations in terms of Electric and Magnetic field, Poynting Vector, Transverse nature of electromagnetic wave. Velocity of electromagnetic wave.	CO5	7L
6	Quantum Physics: Inadequacy of classical mechanics, Blackbody radiation, Planck's Law of Radiation Demonstration of Wien's Radiation Law, Wien's Displacement Law, Rayleigh-Jean's Law and Stefan Boltzmann Law as limit. Photoelectric effect. de-Broglie's hypothesis, Phase Velocity, Group Velocity, Heisenberg's uncertainty principle.	CO6	5L 2L

5. Suggested Learning Resources

Text Books

- Engineering Physics, Sujay Kumar Bhattacharya, McGraw Hill Education (India) Pvt. Ltd.
- Principles of Engineering Physics- 1, S P Kuila, New Central Agency (P) Ltd.
- Principles of Engineering Physics- 2, S P Kuila, New Central Agency (P) Ltd.
- Engineering Physics, Malik & Singh, Tata McGraw Hill Education Pvt. Ltd.
- Engineering Physics, Satya Prakash

References Books:

- Vector Analysis: Murray Spiegel (Author), Seymour Lipschutz, Dennis Spellman
- Waves and Oscillations, N. K. Bajaj, Tata McGraw-Hill
- Optics, A. K. Ghatak, McGraw Hill Education India Private Limited
- A textbook on light, Ghosh, Mazumdar
- Electrodynamics, Gupta, Kumar & Singh
- Electricity and Magnetism: D. Chattopadhyay & P. C. Rakshit
- Quantum Physics, R. Eisberg and R. Resnick, John Wiley and Sons

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
PH-101.1	Know basic concepts of vector algebra and vector calculus.	Explain	Understand
PH-101.2	Understand the concepts of oscillation	Identify, Select	Understand
PH-101.3	Elaborate the concept of optics and introduction to polarization.	Implement	Apply
PH-101.4	Impart basic knowledge of the dielectric and magnetic properties of materials.	Design	Create
PH-101.5	Rationalize the electromagnetic induction and Maxwell's equation.	Identify, Implement	Apply
PH-101.6	Familiarize with the basic of Quantum Physics	Recognize	Understand

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PH-101.1	3	2	-	-	-	-	-	1	-	-	2
PH-101.2	3	2	-	-	-	-	-	1	-	-	2
PH-101.3	3	2	-	-	-	-	-	1	-	-	2
PH-101.4	3	2	-	-	-	-	-	1	-	-	2
PH-101.5	3	2	-	-	-	-	-	1	-	-	2
PH-101.6	3	2	-	-	-	-	-	1	-	-	2

9. Mapping to Program Specific Outcomes (PSO)

	PSO1	PSO2	PSO3
CO1			-
CO2			-
CO3			-
CO4			-
CO5			-
CO6			-

Course Name: BASIC ELECTRICAL ENGINEERING

Course Code: EE-101

(Semester I)

Course Broad Category: Engineering Science

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1. Course Prerequisite:

Class-X+2 level knowledge of Physics and Mathematics.

2. Course Learning Objectives:

- i. Foundational understanding of electrical circuits, machines, and systems.
- ii. DC and AC circuit analysis: Kirchhoff's laws, circuit theorems, and transient responses of RL, RC, RLC circuits.
- iii. Single-phase and three-phase systems: Power calculations, resonance, star-delta connections, and power measurement.
- iv. Understanding of following Electrical machines:
 - DC generators, motors, and transformers (construction, operation, and performance).
 - Three-phase induction motors (torque-speed characteristics and control methods).
- v. Practical application: Real-world problem-solving using electrical engineering principles.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

- **End Semester Examination (ESE): Total: 60 Marks**
- **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Basic Electrical Engineering

Course Code: EE-101

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	40L
1.	Electrical circuit elements (R, L and C), Dependent voltage and current sources, independent voltage and current sources, Star-Delta conversion. Kirchhoff current and voltage laws, Analysis of simple circuits with dc excitation. Superposition theorem, Nodal analysis, Mesh analysis, Thevenin theorem, Norton theorem and Maximum power transfer theorem, Time-domain analysis of first-order and second order RL, RC and RLC circuits.	10L
2.	Representation of sinusoidal wave forms, peak and rms values, phasor representation and analysis, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-Combinations (series and parallel), resonance. Poly phase system: Phase sequence, three phase balanced circuits, voltage and current relations in star and delta connections, 3 Phase power measurement using two wattmeter method.	10L
3.	Construction, Basic concepts of winding (Lap and wave), DC generator: Principle of operation, EMF equation, characteristics (open circuit, load), DC motors: Principle of operation, Speed-torque Characteristics (shunt and series machine), 3-point starter, speed control (armature voltage and field control).	6L
4.	Magnetic materials, BH characteristics, ideal and practical transformer, Core and shell type construction, EMF equation, no-load and on load operation, phasor diagram and equivalent circuit, losses of a transformer, open and short circuit tests, regulation and efficiency calculation. Auto-transformer and three-phase transformer connections.	6L
5.	Types, Construction, Production of rotating magnetic field, Principle of operation, Equivalent circuit and phasor diagram, rating, Torque-speed characteristics (qualitative only). Starter for induction motor. Brief introduction of speed control of 3-phase induction motor (voltage control, frequency control, rotor resistance control)	8L

5. Suggested Learning Resources :

Text Book:

1. A. Chakrabarti, S. Nath, C.K. Chanda, "Basic Electrical Engineering", McGraw Hill Education, 2023.
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. Ritu Sahdev, "Basic Electrical Engineering", Khanna Book Publishing Co. (P) Ltd., Delhi.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

Reference Books:

1. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EE-101.1	Illustrate & analyse the characteristics of the electric and magnetic circuits	Analyse, Identify	Understand
EE-101.2	To study the working principles and construction of DC machines, concepts of different windings used in DC machines and their characteristics and testing	Identify, Select	Understand, Apply
EE-101.3	To study the working principles of different AC machines (Transformer, 3-phase induction motor) and their characteristics and testing	Identify, Select	Understand, Apply
EE-101.4	To study different speed control techniques and applications of different electrical motors used in different industrial applications (DC motor, 3 phase induction motor)	Identify, Select	Understand, Apply
EE-101.5	Solve numerical problems of basic electrical circuits (both dc and ac) and different electrical machines.	Identify, Implement	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5
1	3	2	-	-	3
2	3	2	-	-	3
3	2	3	-	2	3
4	3	-	3	-	3
5	3	-	3	2	3

8. Mapping of the Course outcomes to Program Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
EE-101.1	1	2	-	-	-	-	-	-	-	-	-
EE-101.2	1	2	3	-	2	-	-	-	-	-	1
EE-101.3	1	2	3	2	2						1
EE-101.4	1	2	3	3	2						2
EE-101.5	1	2	2	2	-	-	-	-	-	-	-

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO 2	PSO 3	PSO 4
CO1				
CO2				
CO3				
CO4				
CO5				

Course Name: ENGINEERING MECHANICS

Course Code: ME-101

(Semester I)

Course Broad Category: Engineering Science

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1. Course Prerequisite:

Class XI and XII level knowledge of Mechanics, Mathematics (Vector Algebra and Coordinate Geometry, Differential and Integral Calculus)

2. Course Learning Objectives:

- iii. This course introduces Statics and Dynamics of Engineering Mechanics with elaborate concepts on equilibrium of forces and motion under forces.
- iv. Students will also get introduced to the subject of Mechanics of Deformable Bodies.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and real world problem discussion.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

- **End Semester Examination (ESE): Total: 60 Marks**
- **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Engineering Mechanics

Course Code: ME-101

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	42L	CO
1.	Introduction to Statics: Importance of Mechanics in engineering; Fundamental idealization: Particle and Rigid body concept; Types of forces (collinear, concurrent, parallel, concentrated and distributed); Vector and scalar quantities; Transmissibility of a force (sliding vector); Lami's Theorem. Introduction to Vector Algebra: Parallelogram law; Addition and subtraction of vectors; Free vector, Bound Vector; Representation of Forces and Moments in terms of i, j, k; Cross product and Dot product and their applications. Two and Three Dimensional Force Systems: Moment and Couple; Varignon's theorem; Resolution of a coplanar force by its equivalent Force-couple system. Concept of Equilibrium in Two and Three dimensions; Free body concept; Equations of Equilibrium.	12L	CO1 and CO2
2.	Concept of Friction: Laws of Coulomb friction; Angle of Repose; Coefficient of friction; Types of friction. Distributed Force: Centroid and Centre of Gravity; Centroids of a triangle, circular arc, quadrilaterals, circular sector, triangular lamina, composite areas. Moment of Inertia: M.I of plane figure with respect to an axis in its plane; M.I of plane figure with respect to an axis perpendicular to the plane of the figure, Parallel axis theorem; Mass moment of inertia of symmetrical bodies, e.g. circular plate, ring, cylinder, sphere, rod.	12L	CO3 and CO4
3.	Introduction to Dynamics: Kinematics and Kinetics; Newton's laws of motion; Law of gravitation & acceleration due to gravity; Rectilinear motion of particles; determination of position, velocity and acceleration under uniform and nonuniformly accelerated rectilinear motion; construction of $x-t$, $v-t$ and $a-t$ graphs. Plane Curvilinear Motion of Particles: Rectangular components (Projectile motion); Normal and Tangential components (Circular motion). Kinetics of Particles and Rigid bodies: Newton's second law; Equation of motion; D. Alembert's principle and free body diagram; Principle of work and energy; Principle of conservation of energy; Principle of Linear Impulse and Momentum; Power and efficiency with simple examples.	16L	CO5
4.	Concept of Simple Stresses and Strains: Normal stress, Shear	5L	CO6

Module	Topics	42L	CO
	stress, Bearing stress, Normal strain, Shear strain; Hooke's law; Poisson's ratio; Stress-strain diagram of ductile and brittle materials; Proportional limit; Elastic limit; Yielding; Ultimate stress; Modulus of elasticity; Working stress; Factor of safety; Definition of malleability, ductility, toughness and resilience; Basic concept of thermal stress and strain.		

5. Suggested Learning Resources:

Text Book:

1. Engineering Mechanics by S. S. Bhavikatti, New Age International Publishers, 9th Edition, 2023.
2. Engineering Mechanics by S. Rajasekaran & G. Sankarasubramanian, Vikas Publishing House Pvt Ltd., Noida.

Reference Books:

1. Engineering Mechanics: Statics & Dynamics by I. H. Shames, 4th ed. – PHI.
2. Engineering Mechanics: Statics & Dynamics by Hibbeler & Gupta, 11th ed. – Pearson.
3. Engineering Mechanics by R.S. Khurmi, S. Chand Publications, Delhi.
4. A Text Book of Engineering Mechanics by Bansal R. K.(2010), Laxmi Publications.
5. Elements of Strength of Materials by Timoshenko & Young, 5th ed. – E.W.P.
6. Engineering Mechanics by M.P. Poonia & D.S. Bedi, Khanna Publishing House, 2019.
7. Mechanics for Engineering by Beer, F.P. and Johnston.
8. Fundamental Concepts In Engineering Mechanics by Suman Chakraborty, Everest PublishingHouse
9. Engineering Mechanics by Timoshenko, Young and Rao, Revised 4th ed. – TMH.
10. Engineering Mechanics by Basudeb Bhattacharyya– Oxford University Press.
11. Fundamentals of Engineering Mechanics by Debabrata Nag & Abhijit Chanda – ChhayaPrakashani
12. Engineering Mechanics [Vol-I & II] by Meriam & Kraige, 5th ed. – Wiley India

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME-101.1	Explain the fundamental principles of mechanics, including the importance of mechanics in engineering and the concepts of particles and rigid bodies.	Explain	Understand
ME-101.2	Determine analytically the forces and moments acting on statically determinate structure.	Identify, Select	Understand
ME-101.3	Understand the presence and effects of friction in statics and dynamics.	Implement	Understand
ME-101.4	Compute the centroid of lamina and centre of gravity of solids, area moment of inertia, mass moment inertia of solids.	Compute	Evaluate
ME-101.5	Apply the fundamental concept of kinematics and kinetics to determine displacement, velocity and	Apply	Apply

	acceleration of particle and rigid body during linear/ angular/ general plane motions and the extension of Newton's law of motion to work energy principle and Impulse momentum principle.		
ME-101.6	Understand the deformation and mechanical behaviour of bodies under various load conditions.	Recognize	Understand

7. Mapping of course outcomes to module / course content (hrs)

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	6	6				
2			6	6		
3					16	
4						5

8. Mapping of the Course outcomes to Program Outcomes (PO)

Course Outcomes	CO-PO Correlation Level											BT
	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	
	1	2	3	4	5	6	7	8	9	10	11	
ME-101.1	2	2	1	2	1	1	1	-	2	1	1	U(L2)
ME-101.2	2	2	2	2	2	2	1	-	1	1	1	U(L2)
ME-101.3	2	2	1	2	2	-	1	-	2	2	1	P(L3)
ME-101.4	2	2	1	1	1	1	1	-	1	1	1	P(L3)
ME-101.5	2	2	1	1	1	1	1	-	1	1	1	A(L4)
ME-101.6	2	2	2	2	2	1	2	-	2	2	1	U(L2)
AVERAGE	2	1.6	2	1.6	1.6	1.2	1.2	-	1.3	1.1	1	

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		
CO6		

BCREC: Estd.-2000; "Dedicated to Quality Education"

Course Name: English Language and Technical Communication

Course Code: ENG-101

(Semester I)

Course Broad Category: Humanities

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1. Course Prerequisite:

Class- XII level knowledge of English grammar and reading, listening, writing skills.

2. Course Learning Objectives:

- i. This course introduces the concepts of sustainability in civil engineering and explores the role of construction materials in developing green infrastructure.
- ii. Students will also learn to design energy-efficient buildings, implement sustainable site planning, navigate green building certifications, and evaluate the economics and ethics of sustainable construction practices.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

- **End Semester Examination (ESE): Total: 60 Marks**
- **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: English Language and Technical Communication

Course Code: ENG-101

Hours per Week: 3L: 0T: 0P

Credits: 3

	Module	Topics	36L	COs
1.	Introduction to LSRW	Definition of Listening, Speaking, Reading, Writing, Types, Criteria for Effectiveness, Practice Purposes, Barriers, Effectiveness Criteria, Note Taking, Note Making, Jargon, Technical Content Reading, Visual Information Reading, Comprehension	8L	CO1
2.	Introduction to Business Communication	Introduction to Business Communication: types, features, process, flow, channels and criteria for effectiveness. Purposes, Barriers. Verbal, non-verbal communication, formal, informal, body language, paralanguage.	4L	CO3, CO4
3.	Introduction to Corporate communication	Corporate Communication, Definition, Types, Features of types, Handling Media, Barriers, Effectiveness Criteria, Office-dynamics, debate, Group discussion, Email etiquette, Telephone etiquette.	6L	CO5
4.	Grammar	Basic syntactical grammar for professional communication: error detection, articles, tense, preposition, subject-verb agreement, synonyms, antonyms, homonyms, homophones.	5L	CO2
5.	Written Correspondence	Comprehension, Business Correspondence, Technical Writing, Proposals, Technical Reports, Memo, Notice-agenda-Minutes, Email, Posters, Essay/ Precis	8L	CO5
6.	Introduction to Soft Skills	Critical thinking ability, Time management, Team-building skills, Time management, Conflict management.	5L	CO6

5. Suggested Learning Resources:

Text Book:

- Effective Technical Communication. Dr. Bharti Kukreja, Dr. Anupam Jain. Katson Books. First Edition 2019, Reprint 2023.
- Effective Technical Communication. (Late) M. Ashraf Rizvi, Priyadarshi Patnaik. McGraw Hill.
- Communication Skills. Sanjay Kumar, Pushp Lata. Rainbow Book Distributors.

Reference Books:

- Practical English Usage Fully Revised International Edition. Michael Swan. Oxford.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ENG-101.1	Develop basic idea of LSRW in English professionally.	Develop	L1
ENG-101.2	Improve concept of grammar and vocabulary for professional communication.	Improve/Understand	L2
ENG-101.3	Apply English language skills in professional situations.	Apply	L3
ENG-101.4	Analyze different listening, reading and speaking contents.	Analyze	L4
ENG-101.5	Evaluate the instructions and reciprocate properly.	Evaluate	L5
ENG-101.6	Create an ambience to effectively communicate in general and professional settings.	Create	L6

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	2	2	2	2
2	2	3	3	3	3	2
3	3	2	3	2	2	3
4	2	2	2	3	2	3
5	3	3	3	2	3	2
6	3	3	3	2	2	2

8. Mapping of the Course outcomes to Program Outcomes (PO)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ENG-101.1	3	1	1	1	1	1	1	1	1	3	1
ENG-101.2	3	2	2	1	1	1	1	1	3	3	2
ENG-101.3	1	2	2	1	1	1	1	3	3	3	1
ENG-101.4	3	3	3	3	1	2	1	2	3	3	3
ENG-101.5	2	3	3	2	2	2	2	2	3	3	3
ENG-101.6	3	3	3	2	1	1	1	1	2	3	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

BCREC: Estd.-2000; "Dedicated to Quality Education"

Course Name: PHYSICS LABORATORY
Course Code: PH-191
(Semester – I)
Course Broad Category: BASIC SCIENCE

1. Course Prerequisite:

Class-XII level knowledge of Physics Practical.

2. Course Learning Objectives:

- i..Expose students to various experimental skills and tools
- ii. To gain practical knowledge by applying experimental methods to correlate with the theory. Apply the analytical techniques and graphical analysis to the experimental data.

3. Teaching methodology and evaluation system for the course:

Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

- A. **Internal Assessment (PCIA): (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
 - B. **End-Semester Examination: (40 Marks)-** Summative Assessment.
- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: PHYSICS LABORATORY
Course Code: PH-191
Hours per Week: 0L: 0T: 2P
Credits: 1

Module	Topics	10P
1.	Experiments in General Properties of matter: 1. Determination of Young's modulus of material of a bar by Flexure Method. 2. Determination of modulus of rigidity of the material of a rod by static method. 3. Determination of rigidity modulus of the material of a wire by dynamic method. 4. Determination of coefficient of viscosity of water by Poiseuille's capillary flow method	3P

Module	Topics	10P
2.	Experiments in Optics: 1. Determination of dispersive power of the material of a prism. 2. Determination of the wavelength of a given laser / mercury lamp source by diffraction method. 3. Specific rotation of Sugar Solution using polarimeter.	1P
3.	Electricity & Magnetism experiments: 1. Determination of dielectric constant of a given dielectric material. 2. Determination of the thermo-electric power at a certain temperature of the given thermocouple. 3. Study of series resonance of LCR circuit. 4. Determination of specific charge (e/m) of electron by J J Thompson's Method. 5. Determination of unknown resistance using Carey Foster's bridge.	2P
4.	Quantum Physics Experiments: 1. Determination of Planck's constant using photoelectric cell. 2. Determination of Stefan's radiation constant. 3. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment. 4. Determination of Hall co-efficient of semiconductors. 5. Determination of band gap of semiconductors by four probe method. 6. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.	4P

Minimum of eight experiments to be performed taking at least one from each module mentioned above.

5. Suggested Learning Resources:

Text books

- Advanced Practical Physics (vol.1 and vol.2) B. Ghosh and K. G. Mazumdar.
- Advanced course in practical physics D. Chattopadhyay and P. C. Rakshit.

Reference Books

- Optics –Eugene Hecht Pearson Education India Private Limited.
- Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited.
- Waves and Oscillations by N.K. Bajaj.
- Optics, Ghatak, McGraw Hill Education India Private Limited.
- Refresher Course in B.Sc. Physics –Vol1 and Vol 2 –C.L.Arora.

6. Course Outcomes (CO):

After going through this course the Students will be able:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
PH 191.1	To Understand the general property of matters like Viscosity, Young's Modulus and Modulus of Rigidity	Explain	Understand
PH 191.2	To Know the concepts of optics	Identify, Select	Understand
PH 191.3	To Measure the electrical parameters.	Implement	Apply
PH 191.4	To Understand Quantum Physics with the help of experiments like Energy band gap of semiconductor, Planck constant and Characteristics of Solar Photovoltaic cell.	Design	Create
PH 191.5	To Analyze Electricity and Magnetism with the help of experiments like Hall Effect of Semiconductors.	Identify, Implement	Apply
PH 191.6	To Measure the Specific charge of electron	Recognize	Understand

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PH 191.1	3	1	-	-	-	-	-	2	-	-	2
PH 191.2	3	1	-	-	-	-	-	2	-	-	2
PH 191.3	3	1	-	-	-	-	-	2	-	-	2
PH 191.4	3	1	-	-	-	-	-	2	-	-	2
PH 191.5	3	1	-	-	-	-	-	2	-	-	2
PH 191.6	3	1	-	-	-	-	-	2	-	-	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			-
CO2			-
CO3			-
CO4			-
CO5			-
CO6			-

Course Name: Basic Electrical Engineering Laboratory

Course Code: EE-191

(Semester I)

Course Broad Category: Engineering Science

1. Course Prerequisite:

Class-X+2 level knowledge of Physics and Mathematics.

2. Course Learning Objectives:

- i. Understand the basic demonstration and application of electrical instruments and machines.
- ii. Calibrate electrical instruments and verify network theorems.
- iii. Analyse steady state response and evaluate resonance conditions of R-L-C circuit.
- iv. Measure power in three phase unbalanced circuit by two wattmeter method.
- v. Determine efficiency, regulation and parameters of single-phase transformer.
- vi. Analyse the operational behaviour of DC machine and three phase induction motor.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Practical

Evaluation System

A. Internal Assessment (PCIA): (60 Marks)- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. End-Semester Examination: (40 Marks)- Summative Assessment.

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: Basic Electrical Engineering Laboratory

Course Code: ESC-EE 191

Hours per Week: 0L: 0T: 2P

Credits: 1

Exp. No	Title
1.	Introduction to Basic Electrical Lab (Do's and Don'ts), Familiarization of measuring Instruments (Voltmeter, Ammeter, Multimeter, Wattmeter), circuit parameters (real life resistors with colour code, capacitors, inductors and autotransformer).
2.	i) Verification of Superposition Theorem.

Exp. No	Title
	ii) Verification of Norton's Theorem.
3.	I) Verification of Thevenin's Theorem. II) Verification of Maximum power Transfer Theorem.
4.	Calibration of Ammeter and Wattmeter.
5.	Determination of steady state response of R-L, R-C and R-L-C circuit and calculation of impedance and power factor.
6.	Determination of resonance frequency and quality factor of series and parallel R-L-C circuit.
7.	Measurement of power in a three-phase unbalanced circuit by two wattmeter method.
8.	Open circuit and short circuit test of a single-phase transformer.
9.	Load test of a single-phase transformer and determination of efficiency and regulation.
10.	No load characteristics of DC Separately Excited Generator.
11.	Determination of Torque-Speed characteristics of separately excited DC motor.
12.	Determination of Torque-speed characteristics and observation of direction reversal by change of phase sequence of connection of Induction motor.

5. Suggested Learning Resources:

Text Book:

1. A. Chakrabarti, S. Nath, C.K. Chanda, "Basic Electrical Engineering", McGraw Hill Education, 2023.
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. Ritu Sahdev, "Basic Electrical Engineering", Khanna Book Publishing Co. (P) Ltd., Delhi.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

Reference Books:

1. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EE 191.1	To understand the basic demonstration and application of electrical instruments.	Identify	Understand
EE 191.2	To calibrate electrical instruments and verify network theorems.	Calibrate, verify	Apply
EE 191.3	To analyse steady state response of R-L, R-C and R-L-C circuit and calculate circuit parameters, and evaluate resonance conditions in series and parallel R-L-C configurations.	Analyse, Evaluate	Analyse
EE 191.4	To measure power in three phase unbalanced circuit by two wattmeter method.	Identify, Measure	Understand
EE 191.5	To determine efficiency, regulation and parameters of single-phase transformer	Identify, Select	Analyse
EE 191.6	To analyse the operational behaviour of DC machine and three phase induction motor.	Analyse, Implement	Analyse

7. Mapping of course outcomes to experiments

EXP. No.	CO1	CO2	CO3	CO4	CO5	CO6
EXP1	3	-	-	-	-	-
EXP2	2	3	-	-	-	-
EXP3	2	3	-	-	-	-
EXP4	2	3	-	-	-	-
EXP5	2	-	3	-	-	-
EXP6	2	-	3	-	-	-
EXP7	2	-	-	3	-	-
EXP 8	3	-	-	-	3	-
EXP 9	3	-	-	-	3	-
EXP 10	2	-	-	-	-	3
EXP 11	2	-	-	-	-	3
EXP 12	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
EE 191.1	3	-	-	-	-	-	-	2	-	-	2
EE 191.2	3	2	2	-	-	-	-	2	-	-	2
EE 191.3	3	2	2	1	-	-	-	2	-	-	2
EE 191.4	3	2	-	-	-	-	-	2	-	-	2
EE 191.5	3	2	3	2	-	-	-	2	-	-	2
EE 191.6	3	2	3	2	-	-	-	2	-	-	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-
CO6	3	-	-

Course Name: Language Laboratory
Course Code: ENG-191
(Semester I)
Course Broad Category: HUMANITIES

.....

1. Course Prerequisite:

Class- XII level knowledge of English grammar and reading, listening, writing skills.

2. Course Learning Objectives:

- i. This course introduces the concepts of sustainability in civil engineering and explores the role of construction materials in developing green infrastructure.
- ii. Students will also learn to design energy-efficient buildings, implement sustainable site planning, navigate green building certifications, and evaluate the economics and ethics of sustainable construction practices.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Activities

Evaluation System –

A. Internal Assessment (60 Marks)- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. End-Semester Exam (40 Marks)- Summative Assessment.

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: Language Laboratory
Course Code: ENG-191
Hours per Week: 0L: 0T: 2P
Credits: 1

Module	Topics	30 L
1.	Listening (Telephonic Communication, Motivational Speeches)	4
2.	Speaking (Self Introduction, Role Playing, JAM, Extempore, News reading)	6
3.	Presentation (Poster + Audio Visual + short skits)	12

Module	Topics	30 L
4.	Body Language (Debate, Group Discussion, Public speaking)	6
5.	Professional Etiquette (Conducting a programme, Presentation)	2

5. Suggested Learning Resources:

Text Book:

- Effective Technical Communication. Dr. Bharti Kukreja, Dr. Anupam Jain. Katson Books. First Edition 2019, Reprint 2023.
- Effective Technical Communication. (Late) M. Ashraf Rizvi, Priyadarshi Patnaik. McGraw Hill.
- Communication Skills. Sanjay Kumar, Pushp Lata. Rainbow Book Distributors.

Reference Books:

- Practical English Usage Fully Revised International Edition. Michael Swan. Oxford.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ENG 191.1	Acquire basic proficiency in English, including reading, listening comprehension, writing, and speaking skills, and demonstrate a basic understanding of English.	Application	Understand
ENG 191.2	Communicate confidently in English, using appropriate grammar, vocabulary, and syntax, and demonstrate effective speaking and presentation skills in different contexts.	Application	Apply, create
ENG 191.3	Communicate appropriately in professional and social situations, using appropriate language.	Application	Apply
ENG 191.4	Improve teamwork, leadership skills, and problem-solving skills through group activities.	Understand	Apply
ENG 191.5	Organize and write business correspondence properly and correctly, using appropriate knowledge of language.	Understand,	Apply
ENG 191.6	Develop active listening skills, including effective listening strategies and note-taking.	Understand	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	2	2	2	2
2	2	3	3	3	3	2
3	3	2	3	2	2	3
4	2	2	2	3	2	3
5	3	3	3	2	3	2

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ENG 191.1	3	1	1	1	1	1	1	1	1	3	1
ENG 191.2	3	2	2	1	1	1	1	1	3	3	2
ENG 191.3	1	2	2	1	1	1	1	3	3	3	1
ENG 191.4	3	3	3	3	1	2	1	2	3	3	3
ENG 191.5	2	3	3	2	2	2	2	2	3	3	3
ENG 191.6	3	3	3	2	1	1	1	1	2	3	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			

Course Name: WORKSHOP PRACTICES

Course Code: ME-192

(Semester I)

Course Broad Category: Engineering Science

.....

1. Course Prerequisite:

Class-XII level knowledge of Physics and Mathematics.

2. Course Learning Objectives:

a. Understand and Apply Fundamental Workshop Practices:

To comprehend the principles of basic manufacturing processes (moulding, casting, forming, joining, machining), workshop safety rules, and the use of tools and machines across various workshops, while fostering ethical and safety-conscious behavior on the shop floor.

b. Develop Practical Skills in Fabrication and Machining:

To acquire hands-on experience in machining, welding, fitting, forging, carpentry, pattern-making, and sheet metal fabrication, enabling students to manufacture components and assemblies as per specified dimensions and quality standards.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Theoretical Instruction, Demonstration, Hands-on Practice, Guided Group Activities, Assessment & Feedback, Interactive Learning Methods, Documentation & Reporting.

Evaluation System –

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks

Includes practical performance, reports, and viva voce after each experiment. Throughout the Semester

Section 2: Practical End Semester Examination (PESE) - 40 Marks

Final comprehensive practical examination covering the entire syllabus. At the end of the semester

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: Workshop Practices

Course Code: ME-192

Hours per Week: 0L: 0T: 4P

Credits: 2

Module	Topics	44hrs
1.	General: Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge. Study of mechanical tools, components and their applications Machine Shop a. Study of Lathe, Shaper and Milling machine and their operations b. To make a threaded pin from a mild steel rod in a lathe c. To make V- slot in a shaping and a rectangular slot in milling machine in a block of cast iron or mild steel	8
2.	Fitting Bench Working Shop a. Study of tools and operations b. Making a Gauge (V-Fit) from MS plate involving drilling/tapping/dieing	8
3.	Black Smithy Shop a. Study of tools and operations b. A simple job of making a square rod from a round bar	4
4.	Welding Shop a. Study of Arc welding & Gas welding b. To join two thick (approx 6mm) MS plates by manual metal arc c. To join two thin mild steel plates or sheets by gas welding	8
5.	Sheet Metal Shop a. Study of tools and Operations b. Fabrication of tool box/ tray with soldering	4
6.	Carpentry Shop a. Study of tools and Operations and carpentry joints. b. To prepare T- lap joint/Cross Lap Joint.	8
7.	Foundry a. Study of tools and operations b. Making a mould using single piece pattern.	4

5. Suggested Learning Resources:

Text Book:

- Hajra Choudhury S. K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

Reference Books:

- "Workshop Technology, Vol. I" by W A J Chapman
- Kalpakjian S. and Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, “Manufacturing Technology – I” Pearson Education, 2008.
- Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
- Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME 192.1	Discuss workshop safety rules and manufacturing methods namely, moulding, casting, forming, joining, machining.	Discuss	Understand
ME 192.2	Acquire skill set of machining on Lathe, milling and shaping as per given dimensions.	Acquire	Apply
ME 192.3	Build wooden pattern and sand mould using pattern and moulding tools.	Build	Apply
ME 192.4	Fabricate components of given dimensions using Arc and Gas welding	Fabricate	Apply
ME 192.5	Make jobs as per given dimensions in fitting and forging shops.	Make	Apply
ME 192.6	Demonstrate sheet metal work.	Demonstrate	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3		-	-	-	-
2	-	3	-	-	-	-
3	-	3	-	-	3	-
4	-	-	-	-	3	-

5	-	-	-	3	-	-
6	-	-	-	-	-	3
7	-	-	3	-	-	-
8	-	-	3	-	-	-

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
ME 192.1	3	2	1	-	-	-	1	1	1	-	1
ME 192.2	2	3	2	-	-	-	1	1	1	-	1
ME 192.3	2	3	2	-	-	-	1	1	1	-	1
ME 192.4	2	3	2	-	-	-	1	1	1	-	1
ME 192.5	2	3	2	-	-	-	1	1	1	-	1
ME 192.6	2	3	1	-	-	-	1	1	1	-	1

9. Mapping to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1
CO6	3	1

Course Name: National Service Scheme (NSS)

(Semester- I)

Course Category: Extra Curricular Activity

1. Course Prerequisite: NA

2. Course Learning Objectives:

- i. The course helps students to understand the community in which they work and identify the needs and problem of the community and their solutions.
- ii. Develop capacity to meet emergencies and natural disasters
- iii. Practice national integration and social harmony

3. Teaching methodology and evaluation system for the course:

Teaching methodology –

Practical learning through different activities in community immersion programmes throughout the semester. One orientation seminar conducted by a guest lecturer.

Evaluation System –

- i. Participation and organizing in community immersion programmes (2 for each student); Each programme contains maximum 25 marks)
- ii. Project report submission on activities done (50 marks)

4. Course Content:

Course Name: National Service Scheme (NSS)

Course Code:

Hours per Week: 0

Credits: 0

Module	Topics	No.
1.	Orientation Seminar	1
2.	Activities generating environmental awareness	2
3.	Activities focusing on health and hygiene improvement of community	2
4.	Activities generating literacy awareness	2
5.	Activities enabling youth and gender empowerment	2

5. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO-1	Understand the meaning NSS and its importance in society.	Explain	Understand
CO-2	Identify and implement solutions to environmental hazards	Identify, Implement	Create
CO-3	Implementation of basic activities, method and adaptation done by NSS	Implement	Apply
CO-4	Uphold the concept of volunteerism & leadership among youth and women	Design	Apply
CO-5	Be able to identify organizational structure and responsibilities	Identify, Select	Analysis

6. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5
1	3	-	-	-	-
2	-	3	2	-	-
3	-	-	2	-	-
4	-	-	2	-	2
5	-	-	2	3	2

7. Mapping of the Course outcomes to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		1				2		2	1		2
CO2		1				2	3	2	1		2
CO3		1				2		2	1		2
CO4		1				2		2	1		2
CO5		1				2		2	1		2

9. Mapping to Program Specific Outcomes (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			

***** End of 1st Semester Syllabus*****

2nd SEMESTER SYLLABUS

BCREC: Estd.-2000; "Dedicated to Quality Education"

Course Name: Mathematics-II

Course Code: M-202

(Semester II)

Course Broad Category: Basic Science

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1. Course Prerequisite:

Concept of Mathematics in 10+2 standard and First Semester.

2. Course Learning Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations and complex variables. It also aims to familiarize the prospective engineers to get the knowledge to apply the concept of transform calculus in various engineering field. It aims to equip the students to deal with advanced level applied mathematics and applications that would be essential for their disciplines.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

➤ **End Semester Examination (ESE): Total: 60 Marks**

➤ **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Mathematics-II

Course Code: M-202

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	45L
10.	Ordinary differential equations (ODE)- First order: Exact equations, Necessary and sufficient condition of exactness of a first order and first-degree ODE (statement only), Rules for finding Integrating factors, Linear equation, Bernoulli's equation, Euler's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x. General solution of ODE of first order and higher degree (different forms with special reference to Clairaut's equation).	10L
11.	Ordinary differential equations (ODE)- Higher order: General linear ODE of order two with constant coefficients, Method of variation of parameters, Cauchy-Euler equations, Solution of simultaneous linear differential equations. Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	10L
12.	Transform calculus: Laplace Transform, General Properties of Laplace Transform, Inverse Laplace Transform, Convolution, Application of Laplace Transform to Differential Equations with Constant Coefficients. Fourier Integral Theorem, Fourier Transform, Convolution, Fourier Sine and Cosine Transforms, Parseval's Identity for Fourier Transforms.	9L
13.	Complex Analysis-I: Functions of Complex variable, Limit and Continuity, Differentiation of complex functions, Cauchy-Riemann equations, Analytic functions, Harmonic functions, determination of harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithmic) and their properties; Conformal mappings, Mobius transformations and their properties.	8L
14.	Complex Analysis-II: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy's integral formula (without proof), Cauchy's integral formula for Derivative, Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, Zeros of analytic functions, Singularities, Laurent's series; Residues, Cauchy residue theorem (without proof), Evaluation of definite integral involving sine and cosine. Evaluation of certain improper integrals.	8L

5. Suggested Learning Resources:

Text Book:

- B.S. Grewal-- Higher Engineering Mathematics; Khanna **Publishers**.
- Ramana B. V. --- Higher Engineering Mathematics, McGraw Hill Education.

Reference Books:

- Brown J.W and Churchill R.V: Complex Variables and Applications, McGraw-Hill.
- Brown J.W and Churchill R.V: Complex Variables and Applications, McGraw-Hill.
- Kreyzig E.: Advanced Engineering Mathematics, John Wiley and Sons.
- Potter M.C, Goldberg J.L and Aboufadel E.F.: Advanced Engineering Mathematics, OUP.
- James G.: Advanced Modern Engineering Mathematics, Pearson Education.
- Spiegel M. R., Lipschutz S., John J.S., and Spellman D.: Complex Variables, TMH.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
M 202.1	Remember to recognize various methods of ordinary differential equations which would enable to solve different engineering problems to encounter in their profession life.	Recognize	Remember
M 202.2	Understand to explain the uses and applications of complex variables in applied sciences and engineering problems.	Explain	Understand
M 202.3	Apply the concept of conformal mapping, its relation to analytic functions, their properties, and the Cauchy-Riemann equations to illustrate problems in applied mathematics.	Illustrate	Apply
M 202.4	Analyze the basic properties of complex integration and having the ability to organize such integrals.	Organize	Analyze
M 202.5	Evaluate the Laplace transforms and inverse Laplace transforms to determine the solutions of differential and integral equations in engineering fields like network analysis and control systems.	Determine	Evaluate
M 202.6	Construct logical and analytical skills to create a new idea appreciated by academics, research & emerging trends in industry.	Construct	Create

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	1
2	3	-	-	-	-	1
3	-	-	-	-	3	1
4	-	3	2	-	-	1
5	-	-	-	3	-	1
6	-	-	-	-	-	-

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
M 202.1	3	2	2	1	1	-	-	-	-	-	1
M 202.2	2	1	1	1		-	-	-	-	-	1
M 202.3	2	1	1	1		-	-	-	-	-	1
M 202.4	2	1	2	1	1	-	-	-	-	-	1
M 202.5	3	2	2	2	3	-	-	-	-	-	1
M 202.6	2	2	3	1	2	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

Course Name: CHEMISTRY

Course Code: CH-201

(Semester II)

Course Broad Category: BASIC SCIENCE

.....
1. Course Prerequisite:

Class-XII level knowledge of Chemistry, Mathematics, and Environmental Science.

2. Course Learning Objectives:

- i. This course impart basic knowledge of chemistry, general awareness of environmental pollution aspects, their impact and the basic ideas about material science (structure property relationships) among the engineering students for the better foundation of technical education.
- ii. To provide basic fundamentals among the upcoming young engineers and to carry out advanced research work in chemistry and allied domains.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies and Guest Lectures.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

➤ **End Semester Examination (ESE): Total: 60 Marks**

➤ **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Chemistry

Course Code: CH-201

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	42L
1.	<u>Chemical Bonding:</u> Molecular orbitals of homonuclear and heteronuclear diatomic molecules. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Organometallic compounds and their Industrial Applications. Band structure of solid sand the role of doping on band structure.	8L
	<u>Thermodynamics & Electrochemistry:</u> Introduction, thermodynamic functions: enthalpy, entropy and free energy. Estimations of entropy and free energies. Gibbs Helmholtz equation. Electrochemistry- conductance, Sp. Conductance, equivalent conductance, Ostwald dilution law, conductometric titration. Free energy and EMF. Cellpotentials, The Nernst equation and applications. Latium Ion Battery, H ₂ /O ₂ fuel Cells. Water chemistry. Corrosion.	7L
2.	<u>Organic Reactions & Mechanism:</u> Introduction to reactions involving substitution,, addition, elimination, oxidation, reduction, Condensation.	6L
	<u>Polymer: Properties & Applications:</u> Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg. viscosity avg.: Theory and mathematical expression only), Poly dispersity index (PDI). Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of T _m) and amorphicity (Concept of T _g) of polymer. Preparation, structure and use of some common polymers: plastic (PE:HDPE, LDPE, PVC, Bakelite, PP), rubber (natural rubber, SBR, NBR)and Vulcanization. Fibre (nylon 6.6, Nylon 6, Polyester). Conducting and semi-conducting polymers.	5L
3.	<u>Industrial Chemistry:</u> Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Coalanalysis: Proximate and ultimate analysis. Liquid fuel: Petroleum, classification of petroleum, Refining, Petroleum distillation, Thermal cracking, Octane number, Cetane number, Gaseousfuels: Naturalgas, watergas, coalgas, biogas. Cement and its classification, Chemical composition, Physical properties, Setting and hardening, Properties. <i>Iron and steel manufacturing, Hardening and annealing, Alloy Steel</i>	6L
	<u>Spectroscopic Techniques & Applications:</u> Basic concepts of UV, IR, NMR spectroscopy and their applications. MRI and its structural elucidation.	3L
4.	<u>Nanochemistry & Composite Materials:</u> Nanotechnology: Introduction, Synthesis, Properties, Nanomaterials, Nanostructure, Nanochemistry and environmental application like water purification.	3L

Module	Topics	42L
	Composite materials: Introduction, Constituents, Fibre reinforced composites, Particle reinforced composites, Failure.	
	<u>Green Chemistry:</u> Introduction, Principles of green chemistry, Use of alternative feed stock, Use of Alternative Solvents, Design of safer chemicals, Bio-fuel for sustainable development using green chemistry. Atom economy.	3L

5. Suggested Learning Resources:

Text Book:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai & Co Pvt Ltd
2. A Text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co Pvt Ltd
3. Engineering Chemistry, Gourkrishna Das Mohapatra, Vikas Publishing House
4. Engineering Chemistry, K. L. Chugh, Kalyani Publishers.
5. Engineering Chemistry, Wiley

Reference Books:

1. General & Inorganic Chemistry, R. P. Sarkar, New Central Book Agency P Ltd
2. I.L. Finar, Organic Chemistry, Addison Wesley Longman, Inc
3. Organic Chemistry, Morrison & Boyd, Prentice Hall of India
4. Physical Chemistry, K.L. Kapoor, McMillan
5. P. C. Rakshit, Physical Chemistry, Sarat Book House (7th Edition)
6. Green Chemistry Theory and Practice By Paul T. Anastas, John Charles Warner Oxford University Press

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CH 201.1	Correlate Structure and Properties of Solids and Coordination Compounds.	Identify, Select	Analyse
CH 201.2	Rationalise bulk properties and processes using thermodynamic and electrochemical concept	Explain	Understand
CH 201.3	Interaction of radiation with matter and structural elucidation.	Recognize	Understand
CH 201.4	Analysis of polymeric property and application of industrial materials.	Identify, Implement	Apply
CH 201.5	Importance of green chemistry and nanomaterial towards structural application and sustainable development.	Design	Apply
CH 201.6	Organic reaction mechanism and structural determination.	Implement	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	3	-	-	-	-
2	-	-	-	3	-	3
3	-	-	3	2	-	-
4	-	-	-	-	3	-

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CH 201.1	2	1	1	-	-	-	-	-	-	-	2
CH 201.2	1	2	1	-	-	-	-	-	-	-	2
CH 201.3	1	1	1	-	-	-	-	-	-	-	2
CH 201.4	1	2	1	-	-	-	-	-	-	-	2
CH 201.5	1	2	1	-	-	-	-	-	-	-	2
CH 201.6	1	1	2	-	-	-	-	-	-	-	2

9. Mapping to Program Specific Outcomes (PSO)

	PSO1	PSO2	PSO3
CO1			-
CO2			-
CO3			-
CO4			-
CO5			-
CO6			-

Course Name: BASIC ELECTRONICS ENGINEERING

Course Code: EC-201

(Semester – II)

Course Broad Category: ENGINEERING SCIENCE

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1. Course Prerequisite:

Class-XII level knowledge of Physics and Mathematics

2. Course Learning Objectives:

- v. This course introduces the concepts about solid-state electronic components and their applications.
- vi. Students will also learn to design and analyze basic analog electronic and digital logic circuits.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

➤ **End Semester Examination (ESE): Total: 60 Marks**

➤ **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: BASIC ELECTRONICS ENGINEERING

Course Code: EC-201

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	36L
1.	Semiconductor Diodes: Semiconductor materials- intrinsic and extrinsic types • Ideal Diode, practical diode: open circuit, forward and reverse bias condition, V-I characteristics, knee voltage, junction breakdown: Avalanche and Zener • Peak Inverse Voltage (PIV), small signal model, Zener diode and its application • Half-wave, Full-wave (centre tapped) and bridge Rectifier: efficiency, ripple factor, PIV etc, Clipper: positive, negative and biased, Clamper: positive and negative, biased	11L
2.	Bipolar Junction Transistors (BJTs): Physical structure and operation • Operating region of BJT • D.C. analysis • Biasing the BJT: fixed bias, emitter feedback bias, collector feedback bias and voltage divider bias • load line, Bias stability, Basic BJT amplifier configuration: common emitter, common base and common collector • relation between α , β and γ , Transistor as a switch: cut-off and saturation modes.	10L
3.	MOS Field Effect Transistor (MOSFET): Enhancement-type MOSFET: structure and physical operation, • Depletion, accumulation and inversion region, • threshold potential, Pass-characteristics • Drain and Transfer characteristics, • Cut-off, linear and saturation region, punch-through breakdown • drain resistance, trans-conductance, • channel length modulation, • Depletion-type MOSFET • CMOS Inverter, transient response, delay definition.	5L
4.	Operation Amplifier (Op-amps): Ideal Op-amp Characteristics: Common Mode Rejection Ratio (CMRR), input/output offset voltage and current, slew rate, PSRR etc • Op-amp circuits: comparator, unity gain buffer, inverting amplifier, non-inverting amplifier, adder, subtractor, integrator, differentiator etc.	5L
5.	Digital Electronics: Binary, octal and hexadecimal number	5L

Module	Topics	36L
	systems, number conversion. Binary arithmetic: Addition, subtraction, multiplication and division, basic and universal Logic gates, Truth tables. Function Representation in SOP, POS form; Min-term, Max-term, Canonical Form, Boolean algebra, demorgan's theorem, k-map optimization, logic design.	

5. Suggested Learning Resources:

Text Book:

- Electronic Principles, by Sanjay Sharma, S.K.Kataria & Sons
- Integrated Electronics by Millman & Halkias

Reference Books:

- Electronics Devices & Circuits by Salivahanan
- Electronics Circuits by Schilling & Belove

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC 201.1	Understand and Explain the characteristics of P-N junction diode	Explain	Understand
EC 201.2	Identify and analyze the characteristics of Bipolar Junction Transistor	Identify	Analyze
EC 201.3	Identify the characteristics of MOSFET and apply for digital circuit design	Identify, Design	Apply
EC 201.4	Apply diode, BJT and MOSFET to design various electronic circuits	Design	Apply
EC 201.5	Understand and Implement op-amp circuit for different mathematical operations	Implement	Understand
EC 201.6	Design and analyze digital logic circuits	Design	Analyze

7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	-
2	-	3	-	2	-	-
3	-	-	3	2	-	-
4	-	-	-	2	3	-
5	-	-	-	2	-	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
EC 201.1	3	1	1	1	-	-	-	-	-	2	-	1
EC 201.2	3	1	1	1	-	-	-	-	-	2	-	1
EC 201.3	3	1	1	1	-	-	-	-	-	2	-	1
EC 201.4	3	1	1	1	-	-	-	-	-	2	-	1
EC 201.5	3	1	1	1	-	-	-	-	-	2	-	1
EC 201.6	2	1	1	1	-	-	-	-	-	2	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO 2	PSO 3	PSO 4
CO1				
CO2				
CO3				
CO4				
CO5				

Course Name: Introduction to Computer Hardware and Software

Course Code: CS-201

(Semester – II)

Course Broad Category: Engineering Science

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1. Course Prerequisite:

Basic knowledge of computers and general mathematical operations.

2. Course Learning Objectives:

- i. To introduce students to the fundamental concepts of computer hardware and software.
- ii. To equip students with knowledge and practical skills essential for understanding modern computing systems and networks.
- iii. To provide an overview of emerging computing technologies and their applications in various domains.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

➤ **End Semester Examination (ESE): Total: 60 Marks**

➤ **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Introduction to Computer Hardware and Software Course

Course Code: CS-201

Hours per Week: 3L: 0T: 0P

Credits: 3

Module	Topics	Lectures
Unit 1: Computer Basics	Definition and Characteristics of Computers, Evolution of Computers, Generations of Computers, Classification of Computers, Applications of Computers, Computer System, its Components, and their Functions.	4L
Unit 2: Number Systems and Data Representation	Basic Concepts of Number Systems, Binary, Octal, Decimal, and Hexadecimal Number Systems, Conversion Between Different Number Systems (Base 2 to Base 10), Shortcut Methods for Conversion among Binary, Octal, and Hexadecimal, Arithmetic Operations in Different Number Systems, Signed and Unsigned Number Systems, Data Representation: Bits, Bytes, and Words, ASCII and Unicode Character Sets, Boolean Algebra and Logic Gates	10L
Unit 3: Memory	Introduction to Computer Memory, Understanding Data Representation in Computer Memory, Speed, Capacity, and Memory Hierarchy, Primary Memory and its Types, Secondary Memory and Classification of Secondary Memory, Various Secondary Storage Devices and Their Utilities.	4L
Unit 4: Computer Software and its Types	Classification of Computer Software, System Software and Application Software, Utility Software, Operating System (OS): Role and Types (CLI-based OS, GUI-based OS), Mobile OS and Network OS.	4L
Unit 5: Data Communication, Computer Network, and Internet Basics	Fundamental Concepts of Data Communication, Transmission Media, Multiplexing and Switching, Computer Networks (LAN, WAN, MAN, PAN), Network Topologies (Bus, Star, Ring, Mesh, and Hybrid), Network Devices: Router, Switch, Hub, Bridge, Gateway, Basics of the Internet and Protocols (TCP/IP, HTTP, FTP, etc.), Email and Client-Server Architecture.	6L
Unit 6: Basics of Programming	Problem-Solving: From Algorithms (Pseudo code and Flowcharts) to Program, Concept of Variables and Constants, Operators, Naming Rules for Variables. Decision Making and Iteration, Concept of Compilers and Interpreters.	6L
Unit 7: Emerging Processing and Computing Technologies	Multi-core processor, Graphics Processing Unit (GPU), Tensor Processing Unit (TPU), Neural Processing Unit (NPU), Quantum Processor, Artificial Intelligence and Machine Learning (AI/ML), Cloud Computing, Cybersecurity, Internet of Things (IoT), Augmented Reality (AR) and Virtual Reality (VR), Big Data and Data Analytics.	4L

5. Suggested Learning Resources:

Text & References Books:

- Introduction to Computer Science; Pearson publication
- Fundamentals Of Computers by V. Rajaraman, PHI Learning
- Fundamentals of Computers by E Balagurusamy, McGraw Hill Education (India)

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS 201.1	Define, describe, and classify computers, their evolution, and their components. Explain the role of computer systems and their applications in real-world scenarios.	Define, describe, classify & Explain	Remember, Understand
CS 201.2	Apply arithmetic operations and conversion techniques between binary, octal, decimal, and hexadecimal number systems. Analyze Boolean algebra expressions and evaluate logic gate operations to solve problems in data representation.	Apply, Analyze, Evaluate & Solve	Apply, Analyze
CS 201.3	Analyze different memory types (primary and secondary) and their characteristics such as speed, capacity, and usage. Compare and evaluate the performance impact of memory hierarchy on computer systems.	Analyze, Compare & Evaluate	Analyze, Evaluate
CS 201.4	Classify various types of software (system software, application software, utility software) and describe their roles in the functioning of computer systems. Examine operating systems, mobile OS, and network OS and assess their impact on the environment and user experience.	Classify, Describe, Examine & Assess	Understand, Classify, Examine
CS 201.5	Apply principles of data communication and network design, including the use of routers, switches, and other networking devices. Analyze network topologies, internet protocols (TCP/IP, HTTP, FTP), and demonstrate the use of networking tools to establish basic computer networks.	Apply, Analyze, & Demonstrate	Apply, Analyze, Demonstrate
CS 201.6	Explore emerging technologies such as multi-core processors, GPUs, and quantum processors. Evaluate the applications of Artificial Intelligence, Cloud Computing, IoT, AR/VR, and Big Data in modern computing. Students will demonstrate the ability to adapt to new technologies and collaborate in interdisciplinary teams.	Explore, Evaluate, Demonstrate, Adapt & Collaborate	Evaluate, Explore, Collaborate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3
7	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS 201.1	3	2	1		2	1				2	
CS 201.2	3	3	2	2	2					1	
CS 201.3	3	2	2	1	2					1	
CS 201.4	2	2	2	1	3					1	
CS 201.5	2	3	2	1	2	1	1			2	
CS 201.6	3	2	3	2	3			1		2	

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-
CO6	-	-	-

Course Name: Programming for Problem Solving

Course Code: CS-202

(Semester –II)

Course Broad Category: Engineering Science

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1. Course Prerequisite:

Basic knowledge of computers and general mathematical operations.

2. Course Learning Objectives:

- i. Students will gain an understanding of core programming concepts, including the basic components of a computer system, algorithms, and program execution.
- ii. They will develop problem-solving skills by translating algorithms into code using control structures such as conditionals, loops, and functions.
- iii. Students will also learn to implement and optimize basic data structures like arrays and strings, as well as algorithms for searching and sorting.
- iv. Additionally, they will work with advanced programming features like recursion, structures, pointers, and file handling to solve more complex problems.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

CIA-1 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

CIA-2 (Total: 40 Marks)

- **Class Test (Objective + Subjective): 25 Marks (Duration: 1 hour)**
- **Assignment: 10 Marks**
- **Attendance: 5 Marks**

➤ **End Semester Examination (ESE): Total: 60 Marks**

➤ **The minimum passing marks to be secured is 40 (40%) out of allotted total 100 marks (CIA: 40 marks and ESE: 60 marks).**

4. Course Content:

Course Name: Programming for Problem Solving

Course Code: CS-202

Hours per Week: 3L: 0T: 0P

Credits: 3

Mod ule	Topics	Lectures
1	Introduction to Programming (4 lectures) Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - (1 lecture). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. (1 lecture) From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code - (2 lectures)	8
2	Arithmetic expressions and precedence (2 lectures)	2
3	Conditional Branching and Loops (6 lectures) Writing and evaluation of conditionals and consequent branching (3 lectures) Iteration and loops (3 lectures)	6
4	Arrays (6 lectures) Arrays (1-D, 2-D), Character arrays and Strings	6
5	Basic Algorithms (6 lectures) Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)	6
6	Function (5 lectures) Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference	5
7	Recursion (4 - 5 lectures) Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	5
8	Structure (4 lectures) Structures, Defining structures and Array of Structures	4
9	Pointers (2 lectures) Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)	2
10	File handling (only if time is available, otherwise should be done as part of the lab)	

5. Suggested Learning Resources:

Text & References Books:

- R. S. Salaria, Computer Concepts and Programming in C, Khanna Publishers
- Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
- Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India (India)

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details	Action Verb	Knowledge Level
CS 202.1	Analyze the problem and formulate algorithms for them.	Analyze	K4
CS 202.2	Translate the algorithms to programs (in language).	Understand	K2
CS 202.3	Understand the correct syntax of logical expression, branch instruction, iteration,	Understand	K2
CS 202.4	Apply array and pointer to solve problem.	Apply	K3
CS 202.5	Understand the use of function, recursion.	Understand	K2
CS 202.6	Build analytical skill.	Create	K6

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 202.1	3	3	3	3	2	1	1	1	1	1	2	2
CS 202.2	3	3	3	3	-	1	1	1	1	1	2	2
CS 202.3	3	3	3	3	-	-	-	-	1	1	-	2
CS 202.4	3	3	3	3	-	-	-	-	1	1	-	2
CS 202.5	3	3	3	3	-	-	-	-	1	1	-	2
CS 202.6	3	3	3	3	-	-	-	-	1	1	-	2
AVG.	3	3	3	3	2	1	1	1	1	1	2	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				
CO6				

Course Name: Environmental Science
Course Code: ENV-281
(Semester- II)
Course Broad Category: Mandatory Course

1. Course Prerequisite:

Class-XII level knowledge of Environmental Science, Chemistry and Mathematics.

2. Course Learning Objectives:

- This course impart basic knowledge of environment, general awareness of environmental pollution aspects, their impact and the basic ideas about material science (structure property relationships) among the engineering students for the better foundation of technical education.
- To provide basic fundamentals among the upcoming young engineers and to carry out advanced research work in environmental science and allied domains.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies and Guest Lectures.

Evaluation System–

A. Report Writing: 50 Marks

B. Student Seminar at End Semester: 50 Marks

4. Course Content:

Course Name: Environmental Science

Course Code: ENV-281

Hours per Week: 1L:0T:0P

Credits: 0

Module	Topics	42L
1.	Basic Concepts of Environment: Basic ideas of environment and its component, Renewable and nonrenewable resources and reserves. <u>Air pollution and control:</u> Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere and their temperature variations. Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Green House Effects: Definition, impact of greenhouse gases Green house effects: Definition, impact of green house gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth's heat budget, carbon capture, carbon footprint	8L

Module	Topics	42L
	Definition of pollutants and contaminants, Primary and secondary pollutants, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Photochemical Smog. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification	
2.	Water Pollution and Control Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides. River/Lake/groundwater pollution: River: DO, 5day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD. Lake: Eutrophication [Definition, source and effect]. Groundwater: Aquifers, hydraulic gradient, ground water flow (Definition only)	4L
15.	Noise Pollution Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighborhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), effective perceived noise level. Noise pollution control.	2L
4.	Land Pollution Solid Waste: Municipal, industrial, commercial, agricultural, domestic pathological and hazardous solid wastes, electronic waste Recovery and disposal method- Open dumping, Land filling, incineration, composting. Recycling, Reduce, Reuse, Refuse.	2L

5. Suggested Learning Resources:

Text Book:

1. Gour Krishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

Reference Books:

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ENV 201.1	To understand the natural environment and its relationships with human activities.	Identify, Select	Understand
ENV 201.2	To apply the fundamental knowledge of science and engineering to assess environmental and health risk.	Apply, Explain	Evaluate

ENV 201.3	To develop guidelines and procedures for health and safety issues obeying the environmental energy aspects.	Recognize	Create
ENV 201.4	To acquire skills for scientific problem-solving related to air, water, land and noise pollution.	Identify, Implement	Analyze
ENV 201.5	To acquire knowledge about various Waste Management aspects.	Design	Analyze

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5
1	3	3	2	3	2
2	-	1	2	3	1
3	-	1	-	3	1
4	-	1	-	3	1

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ENV 201.1	1	1	1	-	-	2	-	-	-	-	2
ENV 201.2	1	1	1	-	-	2	-	-	-	-	2
ENV 201.3	1	1	1	-	-	2	-	-	-	-	2
ENV 201.4	1	1	1	-	-	2	-	-	-	-	2
ENV 201.5	1	1	1	-	-	2	-	-	-	-	2

10. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			

Course Name: CHEMISTRY LABORATORY

Course Code: CH-291

(Semester – II)

Course Broad Category: BASIC SCIENCE

1. Course Prerequisite:

Class-XII level knowledge of Chemistry Practical.

2. Course Learning Objectives:

- i. Expose students to various experimental skills and tools
- ii. To gain practical knowledge by applying experimental methods to correlate with the theory. Apply the analytical techniques and graphical analysis to the experimental data.

3. Teaching methodology and evaluation system for the course:

Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System–

A. Internal Assessment (60 Marks)– Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. End-Semester Exam (40 Marks)– Summative Assessment.

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: CHEMISTRY LABORATORY

Course Code: CH-291

Hours per Week: 0L: 0T: 2P

Credits: 1

Module	Topics	10P
1.	Instrumental Analysis: 1. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution. 2. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution	2P

Module	Topics	10P
2.	Estimation through Titrimetric Methods: - To determine chloride ion in a given water sample by Argentometric method. - Removal and estimation of hardness of water by Complex ometric titration.	2P
3.	Determination of Specific Property of a Solution: - Determination of viscosity of Sugar Solution. - Determination of surface tension of a sugar solution by drop count method. - Determination of partition coefficient of a substance between two immiscible liquids.	3P
4.	Verification of Law & Equations: - Verification of Lambert Beer's Law using visible colorimeter Determination of Stefan's radiation constant. - Study the adsorption of oxalic acid from solution on activated charcoal and examine the validity of Freundlich isotherm. - Determination of dissolved oxygen present in a water sample	3P

Minimum of eight experiments to be performed taking at least one from each module mentioned above.

5. Suggested Learning Resources

Textbooks

- Experiments in Applied Chemistry By Dr. Sunita Ratan.
- Quantitative Chemical Analysis By Arthur Vogel.

Reference Books

- Practical Chemistry by Dr. R. C. Bhattacharya.
- Practical Chemistry By S. Chand .

5. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CH 291.1	Implement Instrumental analytical procedure for the enrichment of modern technical skill.	Evaluate	Analyze
CH 291.2	Rationalize inter molecular phenomena using thermodynamic considerations.	Identify, Select	Evaluate
CH 291.3	Understand titrimetric methods of water analysis required for environmental context	Implement	Apply
CH 291.4	Concept of radiation matter interaction and its application.	Design	Create
CH 291.5	Evaluate different surface phenomena by adsorption technique.	Identify, Implement	Apply
CH 291.6	Estimate essential parameter like oxygen in water by titrimetric method.	Recognize	Understand

6. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	-	3	-	-	-
3	-	2	-	-	1	-
4	-	-	-	1	1	1

7. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CH 291.1	2	1	-	-	-	1	-	-	-	-	2
CH 291.2	2	1	-	-	-	1	-	-	-	-	2
CH 291.3	2	1	-	-	-	1	-	-	-	-	2
CH 291.4	2	1	-	-	-	1	-	-	-	-	2
CH 291.5	2	1	-	-	-	1	-	-	-	-	2
CH 291.6	2	1	-	-	-	1	-	-	-	-	2

8. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
C01			-
C02			-
C03			-
C04			-
C05			-
C06			-

BCREC: Estd.-2000; "Dedicated to Quality Education"

Course Name: BASIC ELECTRONICS ENGINEERING LABORATORY

Course Code: EC-291

Course Broad Category: ENGINEERING SCIENCE

1. Course Prerequisite:

Class-XII level knowledge of Physics Practical.

2. Course Learning Objectives:

- i. Expose students to experimental skills on electronic circuit design and analysis
- ii. To gain practical knowledge by applying experimental methods to correlate with the basic electronic theory.
- iii. To apply the analytical techniques and graphical analysis to the experimental data.

3. Teaching methodology and evaluation system for the course:

Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

A. Internal Assessment (60 Marks)- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. End-Semester Exam (40 Marks)- Summative Assessment.

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: BASIC ELECTRONICS ENGINEERING LABORATORY

Course Code: EC-291

Hours per Week: 0L: 0T: 2P

Credits: 1

Module	Topics	13P
1.	Familiarization with electronic component and measuring instruments: 1. Familiarization with Electronic components such as Resistors, Capacitors, Diodes, Transistors etc. 2. Familiarization with measuring equipment like Multimeter, Trainer-kit, CRO, Signal Generator etc.	2P
2.	Experiment on Diode and Diode Circuits:	5P

Module	Topics	13P
	1. Study on V-I characteristics of Junction Diode. 2. Realization of positive and negative Clippers circuit using Diode. 3. Realization of Clamper circuit using Diode 4. Realization of Bridge Rectifier using Diode 5. Realization of Voltage regulator using Zener Diode.	
3.	Experiment on BJT and MOSFET: 1. Study of V-I Characteristics of Bipolar Junction Transistors (BJT). 2. Study on V-I Characteristics of MOS-Field Effect Transistors (MOSFET).	2P
4.	Experiments on OP-AMP circuit: 1. Realization of Inverting and non-inverting Op-amp amplifier 2. Realization of Op-amp Adder	2P
5.	Experiment on Digital Logic: 1. Truth table verification of basic and universal logic gates 2. Logic verification and design of XOR using NAND-Gate	2P

5. Suggested Learning Resources:

Textbooks

- Electronic Principles, by Sanjay Sharma, S.K.Kataria & Sons
- Integrated Electronics by Millman & Halkias

Reference Books

- Electronics Devices & Circuits by Salivahanan
- Electronics Circuits by Schilling & Belove

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC 291.1	Understand different electronic components and measuring equipments	Explain	Understand
EC 291.2	Select and Examine the characteristics of P-N Junction Diode, BJT and MOSFET	Identify, Select	Examine
EC 291.3	Apply and execute diode clipper, clamper and rectifier circuit	execute	Apply
EC 291.4	Apply and implement Zener-diode Circuit	Implement	Apply
EC 291.5	Implement and examine op-amp circuit	Implement	examine
EC 291.6	Implement and analyze digital circuit using logic gate	Implement	Analyze

7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	2	3	2	-	-
3	-	3	-	-	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
EC 291.1	2	2	1	2	2	-	-	-	-	-	-	2
EC 291.2	3	3	1	2	2	-	-	-	-	-	-	2
EC 291.3	3	3	1	2	2	-	-	-	-	-	-	2
EC 291.4	3	3	1	2	2	-	-	-	-	-	-	2
EC 291.5	3	3	1	2	2	-	-	-	-	-	-	2
EC 291.6	3	3	1	2	2	-	-	-	-	-	-	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
C01			
C02			
C03			
C04			
C05			

BCREC: Estd.-2000; "Dedicated to Quality Education"

Course Name: ENGINEERING GRAPHICS

Course Code: ME-291

(Semester: II)

Course Broad Category: Engineering Science

1. Course Prerequisite: Understanding of basic geometric concepts, such as points, lines, angles, and planes.

2. Course Learning Objectives:

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modeling

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Theoretical Instruction, Hands-on Practice, Assessment & Feedback, Interactive Learning Methods, Documentation & Reporting.

Evaluation System –

Section 1: Practical Continuous Internal Assessment (PCIA) - **60 Marks**

Includes practical performance, reports, and viva voce after each experiment. Throughout the Semester

Section 2: Practical End Semester Examination (PESE) - **40 Marks**

Final comprehensive practical examination covering the entire syllabus, at the end of the semester

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: Engineering Graphics

Course Code: ME-291

Hours per Week: 0L: 0T: 4P

Credits: 2

Module	Topics	Practical (P)
1	INTRODUCTION TO ENGINEERING DRAWING Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of line and their use, Dimensioning.	4

2	SCALES Plain scale, Diagonal scale and Vernier Scales.	4
3	GEOMETRICAL CONSTRUCTION AND CURVES Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	4
4	PROJECTION OF POINTS, LINES, SURFACES Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes -Auxiliary Planes.	8
5	PROJECTION OF REGULAR SOLIDS Projection of simple regular solids, viz. prisms, cubes, cylinders, pyramids, cones, tetrahedrons, spheres, hemi-spheres etc.	4
6	SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS Section of solids; section by perpendicular planes; sectional views; true shapes of sections.	4
7	DEVELOPMENT OF SURFACES Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.	4
8	ISOMETRIC PROJECTIONS Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.	4
9	OVERVIEW OF COMPUTER GRAPHICS Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];	4

5. Suggested Learning Resources:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
6. Corresponding set of CAD Software Theory and User Manuals
7. Pal & Bhattacharya (2006), Engineering Drawing, 6/e, Viva Books Private Limited,

6. Course Outcomes (CO):

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

COs	Description	Action Verb	Knowledge level
ME 291.1	UNDERSTAND the basic concept of lines and dimension for engineering drawing.	UNDERSTAND	Understand
ME 291.2	INTERPRET and construct scales (plain, vernier & diagonal) and curves (ellipse, parabola, hyperbola, cycloids, involute, spiral).	INTERPRET	Understand
ME 291.3	CONSTRUCT orthographic projections of points, lines, planes, solids.	CONSTRUCT	Apply
ME 291.4	ILLUSTRATE surface development and section of solids.	ILLUSTRATE	Apply
ME 291.5	APPLY the concept of isometric projection.	APPLY	Apply
ME 291.6	UNDERSTAND the basic concept of Auto CAD in engineering drawing.	UNDERSTAND	Understand

7. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ME 291.1	3	1	1	-	-	-	-	-	-	-	-
ME 291.2	3	1	1	-	1	1	-	1	1	1	-
ME 291.3	3	1	1	-	1	1	-	1	1	1	-
ME 291.4	3	1	1	-	-	-	-	-	-	-	-
ME 291.5	3	1	1	-	1	1	-	1	1	1	-
ME 291.6	3	1	-	-	1	1	-	-	-	-	-
Avg	3	1	1	-	1	1	-	1	1	1	-

8. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-
CO5	1	-

Following is the list of drawing instruments that required for Engineering Drawing:

1. Drawing Board
2. Mini drafter/Set-squares(45°–45°&60°–90°),T-square
3. Protractor(180°,360°)
4. Scales(Plain, Diagonal)
5. Compass(Small and Large)
6. Divider(Small and Large)

Course Name: Introduction to Computer Hardware and Software Laboratory

Course Code: CS-291

(Semester –II)

Course Broad Category: Engineering Science

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1. Course Prerequisite:

Basic knowledge of computers and general mathematical operations.

2. Course Learning Objectives:

- i. To introduce students to the fundamental concepts of computer hardware and software.
- ii. To equip students with knowledge and practical skills essential for understanding modern computing systems and networks.
- iii. To provide an overview of emerging computing technologies and their applications in various domains.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

A. Internal Assessment (60 Marks)- Formative Continuous Assessment

B. End-Semester Exam (40 Marks)- Summative Assessment.

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: Introduction to Computer Hardware and Software Laboratory

Course Code: CS-291

Hours per Week: 0L: 0T: 4P

Credits: 2

Unit	Content
Unit 1: Experiments on Dismantling PCs (1P)	- Dismantling the System Unit: Recognize all major components inside a PC, describe the function of each component, and define the relationship of internal components. - Networking Hardware: Familiarize with the basic hardware required for networking.
Unit 2: Basics of CLI and GUI (3P)	- **a) Command Line Interface (CLI)**: - Learn the main set of commands, shortcut keys, switches, path, current directory, and parent directory. - Understand the power and flexibility of CLIs, especially for

	network and system administrators. - Perform tasks such as: 1. Making a list of all files in a photo folder and saving it in a text document. 2. Copying all files changed in the last week to a flash drive. 3. Deleting all files ending in ".doc". 4. Renaming every file ending in ".txt" to ".doc". 5. Other similar tasks. - **b) Graphical User Interface (GUI) and Google Drive**: - Perform similar tasks using a GUI and compare them with CLI operations. - Execute tasks using Google Drive.
Unit 3: Report Formatting using MS Word and Google Docs (2P)	- **a) Basic Document Creation**: - Learn all shortcut keys. - Design and create a Bio-Data or a technical report, including mathematical functions. - **b) Project Report Formatting**: - Given a project report in PDF format, transfer it to word processor software (MS Word or Google Docs). - Format the document to include: - Title page - Specified paragraph and page formatting (page size, orientation, line spacing, font type, font size, indent, bullets, paragraph formatting) - Acknowledgement page - Table of contents page - List of figures page - List of tables page - Bibliography and references - Distinct headers for each chapter - Page numbering in Roman numerals for initial pages and standard numbering from the first chapter - Check for spelling errors and make corrections.
Unit 4: Content Presentation using Presentation Software (MS PowerPoint and Google Slides) (2P)	- **a) Creating Presentations**: - Prepare presentations on topics such as "Impact of Social Media on Youth" and "Emerging Trends in Mobile Technology". - Include slide animations, slide transitions, sound recordings, slide timings, and customer feedback videos. - Export the presentation as a video or save it as a slideshow. - Prepare handouts for the audience. - **b) Wild-Life Presentation**:

	- Make a presentation on "Wild-Life" and apply the following: - Add audio and video effects. - Apply various color schemes. - Apply various animation schemes. - Apply slide show settings. - **c) Using Google Slides**: - Perform similar tasks using Google Slides.
Unit 5: MS Excel and Google Sheets (3P)	- **a) Basic Operations in MS Excel and Google Sheets**: - Create a worksheet containing roll numbers and marks in 2 subjects for 50 students. - Calculate results and grades: - A student is declared as PASS if they score 40 or more in both subjects, otherwise FAIL. - All FAILED students are given Grade IV. - For PASSED students, the grade is assigned as follows: - Average $\geq 60 \rightarrow$ Grade I - <60 but $\geq 50 \rightarrow$ Grade II - <50 but $\geq 40 \rightarrow$ Grade III - **b) Similar Tasks Using Google Sheets**: - Perform the same tasks using Google Sheets.
Unit 6: Data Capture using Google Forms (1P)	- **a) Creating a Quiz**: - Design and create a quiz using Google Forms. - **b) Data Forms**: - Create data forms for: - Event registration - Event feedback - Customer feedback/satisfaction on a product or service - Order requests
Unit 7: Fundamentals of C Programming (4P) (Optional for Group A)	- **a) Understanding C Programs**: - Learn the structure of a C program, the necessity of preprocessor directives, and how to compile and execute simple C programs. - **b) Debugging C Programs**: - Debug one or two C programs line by line. - Understand and explain the effect of the execution of individual lines at the memory level.

5. Suggested Learning Resources:

Text & References Books:

- Introduction to Computer Science; Pearson publication
- Fundamentals Of Computers by V. Rajaraman, PHI Learning
- Fundamentals of Computers by E Balagurusamy, McGraw Hill Education (India)

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details	Action Verb	Knowledge Level
CS 291.1	Identify and describe the major components of a computer system and understand their interrelationships..	Identify, Describe	Knowledge, Comprehension
CS 291.2	Demonstrate proficiency in using both CLI and GUI to perform various tasks.	Demonstrate, Perform	Application, Analysis
CS 291.3	Design, format, and create professional documents and presentations, including project and technical reports, using MS Word, Google Docs, MS PowerPoint, and Google Slides.	Design, Format, Create, Integrate	Application, Synthesis, Evaluation
CS 291.4	Perform basic operations in MS Excel and Google Sheets for data analysis and grade calculation.	Perform, Calculate	Application, Analysis
CS 291.5	Perform basic operations in MS Excel and Google Sheets for data analysis and grade calculation.	Perform, Calculate	Application, Analysis
CS 291.6	Understand and debug simple C programs, demonstrating the knowledge of program structure, preprocessor directives, and memory-level execution.	Understand, Debug	Knowledge, Application, Comprehension

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	3	-	-	-
5	-	-	-	3	-	-
6	-	-	-	-	3	-
7	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes (PO)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CS 291.1	3	3	2	2	3					1	
CS 291.2	2	2	2	1	3	1				1	
CS 291.3	3	3	3	2	3				1	2	
CS 291.4	3	3	3	2	3				1	2	
CS 291.5	2	2	2	2	3	1	1			2	1
CS 291.6	1	2	2	1	2			1	3	3	2

9. Mapping to Program Specific Outcomes (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			

Course Name: Programming for Problem Solving Laboratory

Course Code: CS-292

(Semester –II)

Course Broad Category: Engineering Science

1. Course Prerequisite:

- Basic knowledge of computers and general mathematical operations.
- And/ Or ESC-CS 191

2. Course Learning Objectives:

- Students will gain an understanding of core programming concepts, including the basic components of a computer system, algorithms, and program execution.
- They will develop problem-solving skills by translating algorithms into code using control structures such as conditionals, loops, and functions.
- Students will also learn to implement and optimize basic data structures like arrays and strings, as well as algorithms for searching and sorting.
- Additionally, they will work with advanced programming features like recursion, structures, pointers, and file handling to solve more complex problems.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

- Internal Assessment (60 Marks)- Formative Continuous Assessment
- End-Semester Exam (40 Marks)- Summative Assessment.

- **The minimum passing marks to be secured is 50 (50%) out of allotted total 100 marks (PCIA: 60 marks and ESE: 40 marks).**

4. Course Content:

Course Name: Programming for Problem Solving Lab

Course Code: CS-292

Hours per Week: 0L: 0T: 4P

Credits: 2

Unit	Content
1	Problem solving using computers: Familiarization with programming environment
2	Variable types and type conversions: Simple computational problems using arithmetic expressions
3	Branching and logical expressions: Problems involving if- then -else structures
4	Loops, while and for loops: Iterative problems e.g., sum of series
5	1D Arrays: searching, sorting: 1D Array manipulation
6	2D Arrays and Strings: Matrix problems, String operations
7	Functions, call by value: Simple functions

8	Numerical methods (Root finding, numerical differentiation, numerical integration): Programming for solving Numerical methods problems
9	Recursion, structure of recursive calls: Recursive functions
10	Pointers, structures and dynamic memory allocation: Pointers and structures
11	File handling: File operations

5. Suggested Learning Resources:

Text & References Books:

- R. S. Salaria, Computer Concepts and Programming in C, Khanna Publishers
- Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
- Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India (India)

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details	Action Verb	Knowledge Level
CS 292.1	Familiarize with the programming environment and use computers for problem-solving.	Familiarize, Solve	Knowledge, Application
CS 292.2	Solve simple computational problems using arithmetic expressions, understanding variable types and type conversions.	Solve, Understand	Comprehension, Application
CS 292.3	Implement branching and logical expressions for problems involving if-then-else structures.	Implement, Solve	Application, Analysis
CS 292.4	Solve iterative problems using loops, such as calculating the sum of series.	Solve, Calculate	Application, Analysis
CS 292.5	Manipulate 1D and 2D arrays, perform searching, sorting, matrix problems, and string operations.	Manipulate, Perform	Application, Synthesis
CS 292.6	Understand and implement numerical methods (root finding, numerical differentiation, and numerical integration) to solve problems using programming.	Understand, Implement	Application, Analysis
CS 292.7	Apply pointers, structures, and dynamic memory allocation concepts for efficient data management and implement file operations for real-world applications.	Apply, Implement	Application, Synthesis

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6	CO7
1	3	-	-	-	-	-	
2	-	3	-	-	-	-	
3	-	-	3	-	-	-	
4	-	-	-	3	-	-	
5,6	-	-	-	-	3	-	
7,8	-	-	-	-	-	3	
9,10,11							3

8. Mapping of the Course outcomes to Program Outcomes (PO)

	P O1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 292.1	2	2	2	2	-	-	-	-	-	-	-	2
CS 292.2	2	2	2	2	-	-	-	-	-	-	-	2
CS 292.3	2	2	2	2	-	-	-	-	-	-	-	2
CS 292.4	2	2	2	2	-	-	-	-	-	-	-	2
CS 292.5	2	2	2	2	-	-	-	-	-	-	-	2
CS 292.6	2	2	2	2	-	-	-	-	-	-	-	2
AVG.	2	2	2	2	0	0	0	0	0	0	0	2

9. Mapping to Program Specific Outcomes (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			

***** End of 1st Year Syllabus*****



Department of Civil Engineering
(Detailed Autonomous Syllabus)

Course Name: Advanced Engineering Mathematics

Course Code: BSC-M 301 (CE)

(Semester III)

Course Broad Category: B. Tech CE

1. Course Prerequisite:

Knowledge in functions of several variables and ODE, Set Theory.

2. Course Learning Objectives:

The objective of these courses to familiarize the prospective engineers with techniques in apply the concept of partial differential equations like heat and wave equations. It aims to equip the students with the concepts and tools of probability and statistics. It will also aim to enhance the knowledge and techniques to solve problems numerically.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

- A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
- B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
- C. End-Semester Exam (60 Marks)- Summative Assessment.

4. Course Content:

Course Name: Advanced Engineering Mathematics

Course Code: BSC-M 301 (CE)

Hours per Week: 3L:1T:0P

Credits: 3

Module	Topics	36L
1.	Partial Differential Equations: Formation and Solution of Partial Differential equations, solutions of First order Linear PDEs, Second order linear equations and their classification, Solution to Homogeneous and Non-Homogeneous Linear PDEs of second order by complimentary function and particular integral method.	8L
2.	Application Of Partial Differential Equations: D'Alembert's solution of the wave equation, Duhamel's principle for one dimensional wave equation, Heat diffusion and vibration problems, Separation of variable method.	8L

3.	Basic concept in Probability and Statistics: Probability: Definition of various probability axioms, Independent events, Conditional event, Baye's Theorem, Random variable and Expectation, Moment Generating Function, Probability mass function (Binomial Distribution, Poisson's Distribution) and Probability density function (Normal Distribution), Poisson approximation to Binomial (application). Statistics: Measure of central tendency, Correlation- Regression, confidence interval and testing of hypothesis.	12L
4.	Numerical methods: Interpolation by polynomial: forward, backward, Lagrange, divided difference. Concept of simple Difference equations. Solution of nonlinear equations: fixed point iteration, Newton and secant methods. Convergence condition. Numerical Integration – trapezoidal and Simpson's one third Rule, solution of ODE – Euler's and RK method, Systems of ODE.	8L

5. References:

Text Book:

- B. S. Grewal-- Higher Engineering Mathematics; Publisher. Khanna **Publishers**.
- Ramana B. V. --- Higher Engineering Mathematics; **Publisher**. McGraw Hill Education.

Reference Books:

- E. Kreyszig--- Advanced Engineering Mathematics (9th Edition)
- Bali & Goel--- Text Book of Engineering Mathematics.
- H. K. Das---Higher Engineering Mathematics
- Zafar Ahsan --- Differential Equations and Their Applications
- R. K. Jain and I. C. Gupta ---Partial Differential Equations
- M. G. Nadkarni ----Partial Differential Equations: A Unified Approach
- Stanley J. Farlow ----Partial Differential Equations for Scientists and Engineers
- Sheldon Ross---A First Course on probability
- R N Hazra & Moly Sarakar ---Fundamental of Probability and Statistics
- Veerarajan T.--- Probability and Statistics
- Dr. S. A. Mollah ----Introduction to Numerical Analysis
- Rajaraman, V ---Numerical Methods.
- S. S. Sastry---Introductory Methods of Numerical Analysis
- Jain & Jain---Numerical Analysis for Scientists and Engineers

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
BSC-M 301.1	Learn to apply different tools in Partial Differential Equations and Probability which would enable them to devise solutions to encounter engineering problems in their profession life.	Identify	Learn
BSC-M 301.2	Understand the concept of uses and applications of Probability and Statistics in applied sciences and engineering problems.	Explain	Understand
BSC-M 301.3	Apply the concept of Interpolation, Numerical Integration and Solution of nonlinear equations to find solutions in real life problems.	Implement	Apply
BSC-M 301.4	Analyze the ideas of mentioned mathematical tools to solve complex real-life problems.	Organize	Analyze
BSC-M 301.5	Evaluating the gradation of described Statistical and Numerical tools and determines the right approach to solve multidisciplinary engineering problems.	Assess	Evaluate
BSC-M 301.6	Build up logical and analytical skills to create a new idea appreciated by academics, research & emerging trends in industry.	Construct	Create

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1
3	2	3	3	2	-	1
4	3	-	-	2	-	1
5	2	-	-	1	3	1

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	2	-	-	-	-	-	1
CO2	1	2	3	1	-	-	-	-	-	-	1

CO3	1	2	2	1	1	-	-	-	-	-	1
CO4	1	2	1	1	2	-	-	-	-	-	2
CO5	2	2	2	2	2	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	2	1
CO3	3	2	1
CO4	3	3	1
CO5	3	3	1
CO6	1	1	1

Course Name: SOLID MECHANICS

Course Code: CE-302

(Semester III)

Category: Major

Course Broad Category: ENG SCIENCE (ES)

5. Course Prerequisite:

Engineering Mechanics, Basic Calculus.

6. Course Learning Objectives:

- Students will learn to analyze stress, strain, and mechanical behavior of materials, including beams, trusses, and columns under various forces.
- They will apply solid mechanics principles to solve practical engineering problems related to torsion, bending, and buckling.

7. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

8. Course Content:

Course Name: Solid Mechanics

Course Code: CE-302

Hours per Week:2L:1T:0P

Credits: 3

Module	Topics	42L	Syllabus Coverage (%)
5.	Simple Stress and Strain: Definition of stress and strain; Types of stress and strain; Hooke's law; Stress-Strain diagram of ductile and brittle materials; Elastic limit; Ultimate stress; Yielding; Modulus of elasticity; Lateral strain, Poisson's ratio, Volumetric strain, Elastic modulus and its variation; Factor of safety.	3L+2T	12
6.	Shear Force Diagram and Bending Moment for Determinate Beams: Support reactions; Concepts of redundancy; Axial force; Shear force and bending moment diagrams for simply supported beams, cantilever and overhanging beams with concentrated, uniformly distributed, linearly varying load, concentrated moments; Point of contraflexure.	4L+2T	14
7.	Beam Bending: Theory of simple bending; Basic kinematic assumption; moment of inertia; elastic flexure formulae and its application; Bending and shear stress for regular sections; Bending of unsymmetrical sections; Section modulus; shear centre.	4L+1T	12
8.	Deflection of Statically Determinate Beams: Slope, deflection and radius of curvature; Differential equation for the elastic line of a beam; Double integration and Macaulay's methods; Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L, Uniformly varying load and couple; Mohr's theorems; Moment area method; Conjugate beam method; Application to simple cases.	4L+2T	14
9.	Analysis of Determinate Plane Trusses: Concepts of redundancy; Analysis by method of joints, Method of sections.	2L+1T	7
10.	Two Dimensional Stress Problems: Principal stresses; Maximum shear stresses; Mohr's stress circle.	2L+1T	7
11.	Introduction to Cylindrical & Spherical Shells: Thin cylinders; Thick cylinders and sphere; Hoop stress and meridional-stress; Volumetric strain.	2L+1T	7
12.	Torsion of Circular and Non-Circular Sections: Pure torsion; Derivation of torsion equation and its assumptions; Torsion of circular solid shaft and hollow shafts; Torsional rigidity; Torsion of non-circular sections.	3L+1T	10
13.	Spring: Types of springs; Helical springs under axial load and under axial twist.	2L+1T	7
14.	Columns: Fundamentals; Criteria for stability in equilibrium; Column buckling theory; Euler's load for columns with different end conditions; Limitations of Euler's theory – problems; Eccentric load and secant formulae.	3L+1T	10

15. References:

Text Book:

- Strength of Materials, S. S.Bhavikatti,Vikas Publishing House Ltd.
- Strength of Materials, S. Ramamrutham, Dhanpat Rai & Sons.
- Strength of Materials, R. Subramanian, OXFORD University Press.

Reference Books:

- Elements of Strength of Material, S. P. Timoshenko and D. H. Young, EWP Pvt. Ltd.
- Fundamentals of Strength of Material, Nag & Chandra, WIE.

16. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the concepts of stress, strain, and Hooke's law, and use stress-strain diagrams to interpret the mechanical behavior of ductile and brittle materials, including factors such as elastic limit, ultimate stress, and Poisson's ratio.	Explain, Use	Apply
CO2	Design shear force and bending moment diagrams for various beam configurations, and use the theory of bending and deflection to solve problems involving beam bending stresses, deflection and moments, including the application of elastic flexure formulae and point of contraflexure.	Design, Use	Create
CO3	Implement the concept of Mohr's circle to find principal stresses and maximum shear stresses in two-dimensional stress systems.	Implement	Apply
CO4	Examine internal forces in determinate plane trusses with the help of method of joints and method of sections, considering concepts of redundancy.	Examine	Analyse
CO5	Investigate the stress distributions in thin and thick cylindrical and spherical shells under internal pressure, and solve torsion equations to analyze circular and non-circular shafts, as well as helical springs under axial load and twist.	Investigate, Solve	Create
CO6	Examine column buckling theory and Euler's load equations for stability problems in columns with various end conditions, considering the limitations of Euler's theory and eccentric loading scenarios.	Examine	Analyse

17. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	3	-	-	-	-
4	-	2	-	-	-	-
5	-	-	-	3	-	-
6	-	-	3	-	-	-
7	-	-	-	-	3	-
8	-	-	-	-	2	-
9	-	-	-	-	2	-
10	-	-	-	-	-	3

18. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	-	1	-	-	-	-	-
CO2	3	3	3	1	-	-	-	-	-	-	-
CO3	3	3	-	2	2	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	-	-	-	-
CO5	3	3	2	3	-	2	-	-	-	-	-
CO6	3	3	-	2	-	1	-	-	-	-	-

19. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-
CO6	3	-	-

Course Name: CONCRETE TECHNOLOGY

Course Code: CE-303

(Semester III)

Category: MAJOR

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Basic civil engineering material knowledge.

2. Course Learning Objectives:

- The course focuses on concrete making materials including supplementary cementitious materials. Concrete production process also forms a part of the discussion.
- Going through the course students would develop first-hand knowledge on concrete production process and properties and uses of concrete as a modern material of construction. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, and Field Visits.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

- CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
- CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
- Final exam: 60 marks ESE (Written Examination) Final comprehensive exam of 3hrs, covering the entire syllabus. The paper includes 5 compulsory questions (20 marks each). Each question must contain sub-parts derived from different Course Outcomes (COs).

4. Course Content:

Course Name: CONCRETE TECHNOLOGY

Course Code: CE-303

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Cement: Manufacturing of cement, oxides composition of cement and the calculation of compounds, types of cement, and different grades of cement. chemical composition, hydration and structure of hydrate cement, setting of cement, test on cement, special cements, cement plant.	5L
2.	Aggregates: Classification of aggregate, types of aggregates, deleterious substances in aggregates, particle shape & texture, strength, alkali aggregate reaction & other mechanical properties of aggregate. Test on aggregates, sieve analysis, fineness modulus, grading curves, grading of fine & coarse aggregates, specific gravity, bulk density, porosity, adsorption & moisture content of aggregate, bulking of sand, soundness of aggregate, thermal properties, flakiness & elongation index.	5L
3.	Admixtures: Types, uses, water reducers, air entrainers, set controllers, specialty admixtures, structure properties, and effects on concrete properties. Case study. Introduction to supplementary cementing materials and pozzolans (fly ash, blast furnace slag, silica fume, and metakaolin – their production, properties, and effects on concrete properties). Reactive and inert mineral additives in concrete.	4L
4.	Fresh Concrete: Workability, Factors affecting workability, measurement of workability by different tests: slump test, compacting factor test, vee-bee test, flow table test., setting times of concrete, effect of time and temperature on workability, segregation & bleeding, mixing and vibration of concrete, steps in manufacture of concrete, quality of mixing water, sea water for mixing concrete. Curing of concrete.	5L
5.	Hardened Concrete : Water / cement ratio, Abram's Law, gel space ratio, Nature of strength of concrete, maturity concept, strength in tension & compression, factors affecting strength, relation between compressive & tensile strength. flexural strength, stress-strain characteristics, modulus of elasticity, poisson's ratio, Creep, Shrinkage, permeability of concrete, micro cracking of concrete.	5L
6.	Testing of Hardened Concrete: Compression tests, tension tests, flexure tests, splitting tests, pull-out test, non-destructive testing methods, codal provisions for NDT. Elasticity, Creep & Shrinkage – Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete.	5L
7.	Mix Design: Objectives of Mix Design, Factors in the choice of mix proportions, Methods of Mix Design, Mix design by I.S. 10262-2019. (With & without admixture).	4L
8.	Durability and quality control of concrete, Chemical attack of concrete corrosion of steel rebar, other durability issues Sampling and testing, acceptance criteria.	4L
9.	Special Concrete: Introduction to lightweight concrete, cellular concrete, no-fines concrete, high density concrete, fibre reinforced concrete, polymer concrete, high performance concrete, self-compacting concrete, ready mix concrete, batching plant, ferrocement, mass concrete.	5L

6. References:

Text Book:

- Concrete Technology by M. S. Shetty. – S. Chand & Co. 2004
- Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
- Properties of Concrete by A. M. Neville Pearson 5th edition Education Ltd 2016.
- Concrete: Microstructure, Properties and Materials – P. K. Mehta and J. M.

Monteiro, McGraw Hill Publishers.

- AR Santa kumar, Concrete Technology, Oxford University Press

Reference Books:

- Concrete Technology by Job Thomas -Cengage learning India Pvt Ltd 2015.
- IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards (BIS), New Delhi, India.
- IS 10262 (2019), Concrete Mix Proportioning – Guidelines, Bureau of Indian Standards (BIS), New Delhi, India.

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the composition, manufacturing process, chemical compounds and types of cement, along with influence of aggregate and water in concrete making.	Explain	Understand
CO2	Identify appropriate aggregate types and conduct tests to evaluate their suitability for concrete construction.	Identify	Understand
CO3	Recognize the role of admixtures in concrete and understand the effectiveness of material additives in concrete.	Recognize	Understand
CO4	Relate the factors affecting fresh and hardened concrete properties and perform tests to measure workability and strength.	Relate	Analyze
CO5	Design concrete mixes using the IS 10262-2019 method.	Design	Create
CO6	Evaluate the durability parameters of concrete and relate the applicability of special concrete in the industry.	Evaluate	Understand

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	3	-	-
6	-	-	-	-	-	-
7	-	-	-	-	3	-
8	-	-	-	-	-	3
9	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	-	-	1	-	-	-	-	-
CO2	2	2	1	-	-	1	-	-	-	-	-
CO3	2	1	3	1	2	1	-	-	-	-	1
CO4	2	2	3	3	2	-	-	-	-	-	-

CO5	3	3	3	2	2	1	-	-	-	-	1
CO6	2	1	1	1	-	1	-	-	-	-	1

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	1
CO3	3	2	2
CO4	3	2	1
CO5	3	2	2
CO6	3	1	2

Course Name: SUSTAINABLE AND GREEN CONSTRUCTION

Course Code: CE-304

(Semester III)

Category: Minor

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics, and Environmental Science; Undergraduate level introductory knowledge of Civil Engineering.

2. Course Learning Objectives:

- This course introduces the concepts of sustainability in civil engineering and explores the role of construction materials in developing green infrastructure.
- Students will also learn to design energy-efficient buildings, implement sustainable site planning, navigate green building certifications, and evaluate the economics and ethics of sustainable construction practices.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Sustainable and Green Construction

Course Code: CE-304

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	100 %
1.	Introduction to Sustainable Development and Environmental Science: Definition and concepts of sustainable development. Historical background and development of sustainability. Global and local sustainability challenges, Landscape and bio-diversity, Climate Change and Its Consequences, Environmental Pollution.	5L	12
2.	Sustainable Construction Materials and Technologies: Green building materials and technologies, life cycle assessment of materials, resource utilization and waste reduction in construction.	5L	12
3.	Energy Efficiency in Buildings and Water Management: Principles of Energy-Efficient Design, Integration of Renewable Energy in Building	10L	24

Module	Topics	42L	100 %
	Design, Energy-Efficient HVAC Systems, Overview of SCADA and Remote Sensing, Smart Green Buildings, Intelligent Inter-active and Economical Lighting Systems, Intelligent Addressable Fire Detection and Alarm System, Energy Saving Devices and Harnessing Solar Energy, Sustainable Water utilization in Construction Processes, Rainwater Harvesting and Greywater Recycling, Automatic Controls in Water Supply and Transportation Management.		
4.	Sustainable Building Design and Site Planning: Principles of green building design, Application of sustainable technologies in design, Site selection and evaluation for sustainable construction, green space planning, and landscaping.	6L	14
5.	Construction and Demolition Waste Management: Overview of Waste Reduction Practices, Recycling in Construction, Responsible Demolition Techniques, Recycling of Road Materials in Highway Development, Introduction to Circular Economy in Construction, Sustainable Project Planning and Implementation, Stakeholder Engagement and Communication, Monitoring and Assessment of Sustainability Performance.	8L	19
6.	Building Certifications, Environmental Regulations, and Ethics in Construction:LEED, GRIHA, BREEAM, and Other Certifications, Building Codes and Regulations for Sustainable Construction, Government Policies Promoting Green Construction, Cost-Benefit Analysis for Green Building Projects, Ethical Considerations and Social Impacts of Green Construction Projects.	8L	19

7. References:

Text Book:

- Introduction to Green Buildings & Built Environment, Indian Green Building Council, BS Publications, 2022.
- Automation Systems in Smart & Green Buildings, Er. A. K. Jain, Khanna Publishers, 2009.
- The Idea of Green Building, Er. A. K. Jain, Khanna Publishers, 2014.

Reference Books:

- Sustainable Construction Practices, Er. Chirag K Baxil, Dr. Snehal Abhyankar, Nexus Stories Publication, 2023.
- Sustainable Construction Management and Building Design Technologies, Mahmood Md. Tahir, Ali Keyvanfar, Arezou Shafaghat, LAP Lambert Academic Publishing, 2015.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain key concepts of sustainable development, including historical context and global/local challenges.	Explain	Understand
CO2	Identify and select sustainable construction materials and technologies based on life cycle assessment principles.	Identify, Select	Understand
CO3	Implement energy-efficient design principles and integrate renewable energy systems in building projects.	Implement	Apply
CO4	Design sustainable buildings by incorporating energy conservation, green technologies, and	Design	Create

	effective site planning.		
CO5	Identify and implement construction and demolition waste management strategies, focusing on recycling and circular economy principles.	Identify, Implement	Apply
CO6	Recognize environmental regulations and building certifications, and demonstrate the ethical implications of sustainable construction practices.	Recognize	Understand

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	-	-	2	-	-	-	-
CO2	1	2	3		2	-	2	-	-	-	1
CO3	1	2	3	2	2	-	2	-	-	-	1
CO4	1	2	3	3	2	-	2	-	-	-	2
CO5	1	2	2	2	-	-	2	-	-	-	-
CO6	1	-	-	-	-	-	2	3	-	-	-

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	2	2
CO4	3	2	3
CO5	2	2	2
CO6	3	1	2

Course Name: UNIVERSAL HUMAN VALUES

Course Code: CE-305

(Semester III)

Category: Minor

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite: None

2. Course Learning Objectives:

- iii. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
- iv. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- v. Highlight the ethical implications of a holistic understanding, fostering trustful and mutually fulfilling human behavior and a mutually enriching interaction with nature.
- vi. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Group work.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks ESE (Written Examination) Final comprehensive exam of 3hrs, covering the entire syllabus. The paper includes 5 compulsory questions (20 marks each). Each question must contain sub-parts derived from different Course Outcomes (COs).

4. Course Content:

Course Name: UNIVERSAL HUMAN VALUES

Course Code: CE(HSMC)301

Hours per Week: 2L: 1T:0P

Credits: 3

Module	Topics	28L+14T
10.	Introduction to Value Education: Understanding Value Education, self-exploration, and holistic development's role in education. Continuous Happiness and Prosperity: Basic Human Aspirations and current scenario.Methods to fulfill these basic aspirations.	6L+3T
11.	Harmony in the Human Being: Understanding the human being as the coexistence of the Self and the Body. Distinguishing the needs of the Self and the Body. Viewing the Body as an instrument of the Self.	4L+2T
12.	Self-Regulation and Health: Ensuring self-regulation and health through harmony between the Self and the Body	2L+1T
13.	Harmony in the Family and Society: Harmony in the family, the basic unit of human interaction. 'Trust' as the foundational value in relationships and 'Respect' as right evaluation. Justice in human-to-human relationships and vision for Universal Human Order.	6L+3T

Module	Topics	28L+14T
14.	Harmony in Nature/Existence: Understanding the interconnectedness and self-regulation among the four orders of nature. Realizing existence as coexistence at all levels. Holistic perception of harmony in existence.	4L+2T
20.	Implications of Holistic Understanding – Professional Ethics: Natural acceptance of human values and definitiveness of ethical human conduct. Basis for humanistic education and universal human order. Competence in professional ethics, holistic technologies, and value-based living strategies.	6L+3T

References:

Text Book:

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034- 47-1.
- The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, ExcelBooks, New Delhi, 2019. ISBN 978-93-87034-53
- Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi, 2022.

Reference Books:

- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Course Outcomes:

After completion of this course, the learners will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE-305.1	Explain lack of understanding of human values is the root cause of most of the present-day problems.	Explain	Understand
CE-305.2	Distinguish their respective needs and view the body as an instrument of the Self.	Distinguish	Analyse
CE-305.3	Recognize self-regulation and health by fostering harmony between the Self and the Body.	Recognize	Understand
CE-305.4	Use harmony comes from competence and right evaluation, resolving societal issues through shared potential and aspirations.	Use	Apply
CE-305.5	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them.	Differentiate	Analyse
CE-305.6	Demonstrate sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.	Demonstrate	Apply

21. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	2	3		-	-
4	-	-	1	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

22. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	-	-	2	-	1	1	-	1
CO2	1	1	3	-	-	2	-	1	1	-	1
CO3	1	1	3	2	-	2	-	2	2	-	1
CO4	1	1	3	3	-	2	-	-	2	-	2
CO5	1	1	2	2	-	2	-	-	2	-	1
CO6	1	-	-	-	-	2	-	1	-	-	1

23. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	2	2
CO4	3	2	2
CO5	2	2	2
CO6	3	1	2

Course Name: SOLID MECHANICS LABORATORY

Course Code: CE-391

(Semester III)

Category: Major

Course Broad Category: ENG SCIENCE (ES)

1. Course Prerequisite:

Solid Mechanics, Strength of Materials.

2. Course Learning Objectives:

- This course will provide students with hands-on experience in conducting mechanical tests on structural materials, including tension, compression, bending, torsion, hardness, impact, and fatigue tests, to evaluate their mechanical properties.
- Students will learn to apply standard testing procedures and interpret experimental data, enabling them to analyze material behavior under various loading conditions and make informed engineering decisions.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands on Laboratory session, Pre-lab Theoretical Lectures and Discussions, Problem solving sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks (written exam)

4. Course Content:

Course Name: Solid Mechanics Laboratory

Course Code: CE-391

Hours per Week: 0L:0T:2P

Credits: 1

Experiment	Topics	14P
1.	Tension Test on Structural Materials: Mild Steel and Tor steel (HYSD bars)	2P
2.	Compression Test on Structural Materials: Bricks	2P
3.	Bending Test on Mild Steel	2P
4.	Torsion Test on Mild Steel Circular Bar	1P
5.	Hardness Tests: Brinell and Rockwell Tests	2P
6.	Test on Closely Coiled Helical Spring for Tension and Compression	2P
7.	Impact Test: Izod and Charpy	2P
8.	Demonstration of Fatigue Test	1P

9. References:

Text Book:

- A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999.
- B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003.
- N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.

10. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Operate experimental techniques to conduct tension, compression, and bending tests on various structural materials (mild steel, HYSD bars and bricks) and examine the obtained test data to determine key mechanical properties (e.g., yield strength, ultimate tensile strength, modulus of elasticity).	Operate and Examine	Analyse
CO2	Execute the principles of torsion testing on mild steel circular bar and organise the key mechanical properties (shear modulus) using the test data.	Execute and Organise	Analyse
CO3	Implement the principles and procedures of Brinell and Rockwell hardness tests to find the hardness of various materials.	Implement	Apply

CO4	Demonstrate experimental techniques to conduct tests on closely coiled helical springs and examine the obtained data to determine key spring and spring material characteristics (spring stiffness, modulus of rigidity).	Demonstrate and Examine	Analyse
CO5	Interpretation principles and procedures of Izod and Charpy impact tests to get the impact strength of various materials.	Use	Apply
CO6	Explain the concepts of fatigue test.	Explain	Understand

11. Mapping of course outcomes to module / course content

Experiment	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	3	-	-	-	-	-
4	-	3	-	-	-	-
5	-	-	3	-	-	-
6	-	-	-	3	-	-
7	-	-	-	-	3	-
8	-	-	-	-	-	3

12. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	1	-	-	2	1	-	1
CO2	3	3	1	2	1	-	-	2	1	-	1
CO3	3	3	1	2	1	-	-	2	1	-	1
CO4	3	3	1	2	1	-	-	2	1	-	1
CO5	3	3	1	2	1	-	-	2	1	-	1
CO6	3	1	-	1	1	-	-	1	1	-	1

13. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	1
CO3	3	-	-
CO4	3	1	1
CO5	3	1	-
CO6	3	1	2

Course Name: Concrete Technology Laboratory
Course Code: CE-392
(Semester III)
Category: Minor
Course Broad Category: CORE ENGG (Professional Core Courses)

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1. Course Prerequisite:

CE-392 Concrete Technology.

2. Course Learning Objectives:

The objective of this lab is to teach the student basic properties ingredients of concrete, fresh and hardened concrete properties and prepare mix design as per codal provisions.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Emphasizes experiential learning through hands-on experiments, allowing students to explore material behavior and mix design directly.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Includes practical performance, reports, and viva voce after each experiment.)

Section 2: Practical End Semester Examination (PESE) - 40 Marks (Final comprehensive practical examination covering the entire syllabus.)

4. Course Content:

Course Name: CONCRETE TECHNOLOGY

LABORATORY

Course Code: CE-392

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics
1	Test on Fine aggregates: Bulking, specific gravity, bulk density, percentage voids, fineness modulus. grading curve.
2	Test on Coarse aggregates: Specific gravity, bulk density, percentage voids, fineness modulus. grading curve.
3	Test on Cement: Normal consistency, fineness, Initial setting and final setting time of cement. Specific gravity, soundness and compressive strength of cement.
4	Test on Fresh Concrete: Concrete mix design, various workability tests – slump, compacting factor, vee-bee test.
5	Test on Hardened Concrete: Compressive strength on mortar and cube, split-tensile strength test, flexure test, NDT Tests (Rebound hammer and Ultra-sonic pulse velocity).

6. References:

- Concrete Technology by M. S. Shetty. – S. Chand & Co. 2004
- Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
- Properties of Concrete by A. M. Neville Pearson 5th edition Education Ltd 2016.
- IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards (BIS), New Delhi, India.
- IS 10262 (2019), Concrete Mix Proportioning – Guidelines, Bureau of Indian Standards (BIS), New Delhi, India.

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Demonstrate the method and findings of tension and compression tests on concrete.	DEMONSTRATE	APPLY
CO2	Describe the concepts of different test on hardened concrete and different properties of cement.	DESCRIBE	UNDERSTAND
CO3	Calculate the specific gravity of concrete ingredients.	EXAMINE	ANALYSE
CO4	Calculate the mix proportion of high grade of concrete.	TEST	ANALYSE
CO5	Measure the workability of concrete mix.	DESIGN	CREATE
CO6	Investigate the quality of concrete.	INVESTIGATE	CREATE

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	-	2	2	-	-	-
2	-	-	3	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	3	-
5	2	2	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	0	1	1	1	0	1	1	0	1
CO2	2	1	0	1	1	1	0	1	1	0	1
CO3	2	3	1	1	2	1	0	2	1	0	1
CO4	2	3	2	1	2	1	0	2	1	0	1
CO5	3	3	1	1	2	2	1	2	2	0	1
CO6	3	3	2	3	3	3	1	3	2	1	1

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	2
CO5	3	3	1
CO6	3	3	3

Course Name: Civil Engineering Materials, Testing & Evaluation Sessional
Course Code: CE-381
(Semester III)
Category: Major
Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

- Knowledge of basic engineering materials and construction techniques.
- Understanding of fundamental mechanics and material properties

2. Course Learning Objectives:

By the end of the course, students will:

1. Conduct standardized tests on various civil engineering materials to evaluate their mechanical properties.
2. Interpret test results to assess material suitability for different construction applications.
3. Develop practical skills in handling material testing equipment and reporting results.
4. Apply testing methodologies to ensure the quality and performance of civil engineering materials.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –: Lab-based experiments demonstrations, discussions on testing procedures, hands-on practice with testing equipment, and real-life case studies.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks

Section 2: Practical End Semester Examination (PESE) - 40 Marks

4. Course Content:

Course Name: Civil Engineering Materials, Testing & Evaluation Sessional

Course Code: CE-381

Hours per Week: 0L:1T:2P

Credits: 2

Module	Topics	42L
1.	Introduction to Civil Engineering Material: Overview on materials, material selection & testing.	2L
2.	Tests on Bricks: Dimensions and shape evaluation, Water absorption test, Efflorescence test, Compressive strength test.	5L
3.	Tests on Aggregates (Coarse Aggregate and Sand): Sieve analysis, Aggregate impact value, Aggregate crushing value, Specific gravity, Flakiness and elongation index and water absorption test.	6L
4.	Tests on Concrete (Fresh and Hardened): Slump test for workability, Compaction factor test, Compressive strength of hardened concrete (cube test), Split tensile strength test and Flexural strength test.	6L
5.	Tests on Bitumen & Bituminous Mixes: Penetration test, Ductility test, Softening point test, Marshall stability test.	6L
6.	Quality Assessment & Testing of Timber: Surface soundness Test, Tensile test, 3-point flexure test.	5L

Module	Topics	42L
7.	Tests on Steel & Metals: Tensile strength test, Hardness test (Brinell and Rockwell), Impact test (Charpy and Izod)	6L
8.	Tests on Tiles, Glass, Paints, Other Special Materials, and Composites: Strength test of tiles, Paint & Coating test, strength test of composite materials and Glass quality assessment.	6L

9. References:

Text Books:

- M.L. Gambhir, "Concrete Technology: Theory and Practice," Tata McGraw-Hill
- S. K. Duggal, "Building Materials," New Age International
- S. S. Bhavikatti, "Testing of Materials," Vikas Publishing House

Reference Books:

- A.M. Neville, "Properties of Concrete," Pearson Education
- P.K. Mehta and P.J.M. Monteiro, "Concrete: Microstructure, Properties, and Materials," McGraw-Hill

10. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Examine the performance on a wide variety of Civil Engineering materials and conduct their tests.	Examine	Analyse
CO2	Define the mechanical properties of bricks, aggregates, concrete, bitumen, and polymers.	Define	Remember
CO3	Discuss the behavior of materials under loading conditions and environmental factors.	Discuss	Understand
CO4	Appraise the suitability of different materials for construction projects based on testing results.	Appraise	Evaluate
CO5	Execute quality control tests on construction materials to meet industry standards.	Execute	Apply
CO6	Develop hands-on experience with testing methods used in the evaluation of civil engineering materials.	Develop	Create

11. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	1	-	-	-	-	3
2	2	3	-	-	-	1
3	2	3	-	3	1	1
4	1	-	-	3	1	2
5	3	2	-	-	3	-
6	-	-	3	-	-	-
7	-	1	-	-	-	-
8	-	1	-	1	2	-

12. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1	-	-	-	-	-	1
CO2	3	3	2	2	1	-	-	-	-	-	1

CO3	3	3	3	2	2	1	-	-	-	-	1
CO4	3	3	2	3	2	1	-	-	-	-	1
CO5	3	3	2	3	3	1	-	-	-	-	1
CO6	3	3	2	3	3	3	-	-	-	-	1

13. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	2	3	2
CO5	2	3	1
CO6	3	3	2

Course Name: BUILDING PLANNING AND COMPUTER-AIDED CIVIL ENGINEERING DRAWING SESSIONAL

Course Code: CE-382

(Semester III)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Class-XII level knowledge of Mathematics and Geometry; Undergraduate level introductory knowledge of Civil Engineering.

2. Course Learning Objectives:

- This course introduces the implementation of basic principles of planning of buildings.
- Students will also be able to design and draw various constructional components of the buildings and plan various building services.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Hands-on in AUTOCAD, Interactive Discussions and Case Studies and Guest Lectures.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks

Section 2: Practical End Semester Examination (PESE) - 40 Marks

4. Course Content:

Course Name: Building Planning and Computer-Aided Civil Engineering Drawing Sessional

Course Code: CE-382

Hours per Week: 0L:1T:2P

Credits: 2

Module	Topics	14T+28P
1.	INTRODUCTION TO BUILDING DRAWING: Introduction to concept of drawings, Interpretation of typical drawings, planning drawings to show information concisely and comprehensively, optimal layout of drawings and Scales.	3T+4P

2.	BASICS OF AUTOCAD: Commands: Initial settings, drawing aids, drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan.	3T+6P
3.	BRICK BONDS IN MASONRY CONSTRUCTION: Types of sizes of various types of bricks, details of bricks used in construction, types of brick bonds used in construction and their specific advantages and disadvantages. Layout of various brick bonds in AUTOCAD.	2T+4P
4.	ISOMETRIC PROJECTION: Principles of isometrics, relation between true length and isometric length, steps for isometric projection in AUTOCAD.	2T+4P
5.	PERSPECTIVE VIEW: Purpose of Perspective View, Vanishing Point, Various components of Perspective view.	1T+2P
6.	INTRODUCTION TO REVIT: Overview of Revit, the procedures for carrying out a simple project in Revit.	3T+8P

5. References:

Text Book:

- M.G.Shah, Kale, Patki, Building Drawing with an Integrated Approach to Built Environment, Tata McGraw-Hill Education India, 5th edition, 2011, (ISBN: 9780071077873, 0071077871).
- Building Services Environmental And Electro Mechanical Services, Second Revised, 2014, (ISBN: 9788175259805).
- Scott Onstott, AutoCAD 2018 and AutoCAD LT 2018 Essentials, Wiley (2017), (ISBN:9788126569298)

Reference Books:

- Croome, J. D. & Roberts, B. M., "AIR-CONDITIONING AND VENTILATION OF BUILDINGS VOL-1". Pergamon Press, (ISBN: 0080247792)
- Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989, (SP-41: ISBN: 8170610117)

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Discuss the basic concepts of drawing.	Discuss	Understand
CO2	Differentiate the various signs and symbols used in AUTOCAD.	Differentiate	Analyze
CO3	Compare the various types of masonry bonds.	Compare	Analyze
CO4	Describe isometric projection of a building.	Describe	Understand
CO5	Demonstrate perspective view and the concept of vanishing points.	Demonstrate	Apply
CO6	Defend the fundamentals of Building Information Modelling through REVIT.	Defend	Evaluate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-

4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	0	0	0	0	0	0	0	2
CO2	3	2	0	0	3	0	0	0	0	0	2
CO3	3	3	3	1	1	0	0	2	1	0	2
CO4	3	3	1	2	1	0	0	2	1	0	2
CO5	3	2	1	0	0	0	0	0	0	0	2
CO6	3	3	3	3	1	0	0	2	1	0	2

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1
CO6	3	1	1

Course Name: PROBLEM SOLVING USING PYTHON AND MATLAB LABORATORY

Course Code: CE-383 (Semester III)

Category: Minor

Course Broad Category: MULTIDISCIPLINARY OPEN ELECTIVES

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1. Course Prerequisite:

Theoretical knowledge of Problem solving using Python and Matlab_CE(OE)301 and basic knowledge in computer application.

2. Course Learning Objectives:

- i. Understanding Fundamental Concepts: Students should grasp core programming concepts such as variables, data types, control structures (if statements, loops), functions, and error handling.
- ii. Algorithmic Thinking: Encourage students to develop the ability to think algorithmically. They should learn to break down problems into smaller, manageable components and devise step-by-step solutions.
- iii. Practical Application: Students should apply Python programming skills to solve real-world problems. This could involve coding exercises, projects, or challenges that require the application of concepts learned.
- iv. Debugging and Testing: Emphasize the importance of debugging and testing code. Students should learn techniques for identifying and fixing errors, as well as how to writing test cases.
- v. Collaboration and Communication: Foster teamwork by having students work in pairs or groups. They should practice explaining their thought processes and solutions to peers, enhancing their communication skills.
- vi. Continuous Learning: Instill a mindset of continuous improvement. Encourage students to seek out new libraries, tools, and techniques in Python and stay updated on best practices.

3. Teaching methodology and evaluation system for the course: Teaching methodology – Hands-on practical in lab.
Evaluation System –
Total Marks : 100 [60(PCIA) + 40(Final)]
PCIA: 60 Marks (Continuous Assessment, attendance, and viva voce)
FINAL: 40 Marks (Written Exam)
4. Course Content:
Course Name: Problem Solving Using Python and Matlab Laboratory
Course Code: CE-383
Hours per Week: 0L:1T:2P
Credits: 2

Modules	Topics	14P + 14T
Module 1	Introduction: Overview on Problem-Solving using Python and Matlab. Python and Matlab basics (download and installation of Python and Matlab).	1P
Module 2	Theoretical concepts and hands-on practice through problem-solving on identifiers, keywords, statements, variables, operators, data types, indentation, comments, reading inputs, printing outputs, type conversions, the type () function and its usage, and the concepts of dynamic and strongly typed language.	3P + 4T
Module 3	Theoretical concepts and hands-on practice through problem-solving on identifiers, keywords, statements, variables, operators, data types, indentation, comments, reading inputs, printing outputs, type conversions, the type() function and its usage, and the concepts of dynamic and strongly typed language.	2P + 4T
Module 4	Theoretical concepts and hands-on practice on files, regular expression operations, and solving basic problems in object-oriented programming.	2P + 2T
Module 5	Introduction to MATLAB, variables and data types, arrays and matrices, solving and understanding linear equations and matrix operations using MATLAB, basic plotting (2D & 3D), use of MATLAB toolboxes including Signal Processing Toolbox, and Simulink. Hands-on practice and problem-solving are integrated throughout the module using MATLAB.	4P + 2T
Module 6	Theoretical concepts and Hands-on practice and solving problemson Numerical Methods, Ordinary Differential Equations (ODEs)and Partial Differential Equations (PDEs), Trapezoidal rule and Simpson's rule, Eigenvalue problems, Euler's method, Runge-Kutta methods, Newton-Raphson method by using Python and Matlab. Hands-on practice on real life problems, application of Python and Matlab in engineering, e.g. analyzing survey or geotechnical data or modeling structural behavior etc.	2P + 2T

5. References:

- Text Book: “Let us Python” by Kanetkar
- Reference Books: Online sources, e.g. NPTEL, SWAYAM etc.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE-383.1	Analyze and explain the problem and formulate algorithms for them.	Explain	Understand
CE-383.2	Select the algorithms to programs.	Identify, Select	Understand
CE-383.3	Understand and implement the correct syntax of logical expression, branch instruction, iteration.	Implement	Apply

CE-383.4	Design and apply array and pointer to solve problem.	Design	Create
CE-383.5	Identify the use of function, recursion.	Identify, Implement	Apply
CE-383.6	Build analytical skill and solve real time problems and can execute projects.	Create	Understand

7. Mapping of course outcomes to module / course content

Module	CO 1	CO 2	CO 3	CO 4	CO 5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	3	2	1	0	0	0	1
CO2	3	3	3	2	3	2	1	0	0	0	1
CO3	3	3	2	3	1	2	0	0	0	0	1
CO4	3	3	3	3	3	2	0	0	0	0	1
CO5	3	3	2	2	2	2	1	0	0	0	1
CO6	3	3	3	3	3	2	0	0	0	0	1

9. Mapping to PSO

	PSO1	PSO 2	PSO 3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Course Name: DISABILITY, ACCESSIBILITY AND UNIVERSAL DESIGN

Course Code: CE-384

(Semester III)

Category: Value Added Courses

Course Broad Category: Multi-Disciplinary Non-credit Course

5. Course Prerequisite:

Basic Sciences.

6. Course Learning Objectives:

- This course introduces the study of the basic concepts of disability, diversity, and accessibility in built environments.
- Students will also learn the key policy frameworks for legislative and technical perspectives of access.
- Also, this course helps students to develop an insight into the understanding of universal design as an approach.

7. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, and Guest Lectures.

Evaluation System –

Attendance: 20

Internal Assessment (20 Marks)- Formative Continuous Assessment [Assignment]

End-Semester Exam (60 Marks)- Summative Assessment.

8. Course Content:

Course Name: Disability, Accessibility, and Universal Design.

Course Code: CE-384

Hours per Week: 3L:0T:0P

Credits: 0

Module	Topics	42L
15.	Foundations of Disability and Accessibility: Introduction to Disability Studies: Social model vs. medical model.Types of disabilities and their impact on interaction with the built environment.Legal frameworks and accessibility standards (e.g., ADA, local building codes).The importance of inclusivity in civil engineering.	7L
16.	Principles of Universal Design: The seven principles of Universal Design and their application to civil engineering.Ergonomics and human factors in design.Inclusive design strategies for diverse user groups.	7L

Module	Topics	42L
17.	Accessible Infrastructure Design: Accessible pedestrian pathways and sidewalks: Ramps, curb cuts, tactile paving.Accessible transportation: Design of accessible public transportation systems, bus stops, and railway stations.Accessible buildings: Entrance design, accessible restrooms, elevators, and emergency egress.Accessible public spaces: Parks, recreational areas, and outdoor environments.Accessible road design.	7L
18.	Accessible Transportation Infrastructure: Design of accessible public transportation systems (bus stops, railway stations, etc.).Accessible road design, including parking and traffic control.Integration of accessibility into transportation planning and design.Emergency evacuation planning for people with disabilities.	7L
19.	Accessibility in Construction and Maintenance: Construction practices for ensuring accessibility.Inspection and evaluation of accessibility in existing infrastructure.Maintenance and retrofitting of infrastructure for improved accessibility.	7L
20.	Technology and Innovation: Assistive technologies and their role in accessibility.Emerging technologies for accessible infrastructure.Smart city applications for inclusive environments	7L

5. Course Outcomes:

After completion of this course, students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Demonstrate a comprehensive understanding of relevant disability legislation and accessibility standards.	Demonstrate	Understand
CO2	Implement the principles of Universal Design and human factors engineering to create inclusive and accessible civil engineering designs.	Implement	Apply
CO3	Design accessible pedestrian pathways, sidewalks, public spaces, and outdoor environments, incorporating appropriate features such as ramps, tactile paving, and wayfinding systems.	Design	Analyse
CO4	Design accessible transportation infrastructure, including public transportation systems, roads, and related facilities, ensuring compliance with accessibility standards.	Design	Analyse
CO5	Integrate accessibility considerations into the design of buildings, including entrances, restrooms, elevators, and emergency egress systems.	Integrate	Apply
CO6	Utilize emerging technologies to enhance accessibility in existing infrastructure or in new civil engineering projects.	utilize	Apply

6. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3		-	-
4	-	-		3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

7. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-
CO5	3	3	3	3	1	-	-	-	-	-	1
CO6	3	3	3	3	1	-	-	-	-	-	2

8. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	2	2	2
CO6	3	2	3



Department of Civil Engineering
(Detailed Autonomous Syllabus)

Course Name: Transportation Engineering

Course Code: CE-401

(Semester IV)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

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1. Course Prerequisite(s):

Students are expected to know the fundamentals of Physics, Mathematics, Engineering Mechanics.

2. Course Learning Objectives:

The objectives of the course are to enable the student

- To understand key transportation systems and road development history of India.
- To apply geometric design principles for highway alignment and cross-section elements.
- To design inclusive and accessible infrastructure for public places and transportation.
- To analyze traffic flow and develop effective traffic management solutions.
- To evaluate and design pavement systems using appropriate materials standards.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Transportation Engineering

Course Code: CE-401

Hours per Week: 2L:1T:0P

Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Highway Development and Planning: Introduction to Different Modes of Transportation, History of Road Transportation in India, Jayakar Committee Report, Classification of Roads, Road Development in India, Smart Road Technologies, Public-Private Partnership (PPP) in Highway Projects.	4L	10

2.	Highway Geometric Design and Alignment: Highway Alignment and Route Planning, Highway Cross Section Elements, Sight Distance, Design Principles of Highway Alignment, Design Principles of Vertical Alignment, Problems.	6L+2T	19
3.	Accessible Infrastructure Design: Design of Access Routes and Walkways (Elements of walkways, Tactile Navigation Systems, BRT Systems and Inclusive Public Transportation, Pedestrian streets), Overview of Pedestrian and Cyclist Facilities, Accessible Streets and Mobility Environments (Street Elements for Accessibility, tactile ground surface indicators (TGSIs), ramps, hand rails), Inclusive Design of Public Spaces.	5L + 1T	14
4.	Traffic Engineering and Management: Traffic Characteristics, Traffic Engineering Studies, Traffic Flow and Capacity, Traffic Regulation and Control, Design of Road Intersections and Parking Facilities, Traffic Signs, Highway Lighting, Introduction to Intelligent Transportation Systems (ITS), Problems.	6L + 2T	19
5.	Pavement Materials and Testing: Materials used in Highway Construction - Soils, Aggregates, Bituminous Binders, Bituminous Paving Mixes; Portland cement and Cement Concrete, Testing of Pavement Materials, Recycled and Emerging Materials, Problems.	4L + 2T	14
6.	Design and Maintenance of Pavements: Design of Pavements - Introduction; Flexible Pavements - Factors affecting Design and Performance, Design of Flexible Pavements as per IRC codes, and Stress Analysis; Rigid Pavements - Components of Rigid Pavements, Factors affecting their Design and Performance, and Design of Concrete Pavements as per IRC standards; IIT PAVE Software for Pavement Design, Pavement Failures, Remedial Measures for Pavement Distresses, Problems.	8L + 2T	24

5. References:

Text Books:

1. Highway Engineering, Khanna, S.K., Justo, C.E. and Veeraragavan, A.; Revised 10th Edition, Nem Chand & Bros, 2017.
2. Textbook of Highway Engineering, Srinivasa Kumar, R, Universities Press, 2011.
3. Traffic Engineering and Transport Planning, Kadiyalai, L.R., Khanna Publishers.

Reference Books:

1. Hydraulics and Fluid Mechanics Including Hydraulics Machines by P. N. Modi and S. M. Seth, 23rd Edition, Standard Book House, 2022.
2. Fluid Mechanics and Hydraulic Machines-Problems and Solution by K. Subramanya, 2nd Edition, McGraw Hill Education, 2018.
3. Hydraulics, Fluid Mechanics and Hydraulic Machines by R. S. Khurmi and N. Khurmi, 15th Edition, S Chand & Company Ltd., 1987.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe the importance of highway infrastructure, including modes, historical development, classifica	Describe	Understand

	tion, and trends.		
CO2	Implement design principles of sight distance, cross-section elements, and highway geometric alignment to optimize a safe and efficient road network.	Implement	Apply
CO3	Design inclusive infrastructure to ensure compliance with accessibility standards for all users, including individuals with disabilities.	Design	Create
CO4	Design effective traffic management systems, and implement appropriate traffic control measures based on traffic characteristics.	Design, Implement	Create
CO5	Identify highway construction materials and relate the suitability of recycled and emerging materials for sustainable pavement design.	Identify, Relate	Analyze
CO6	Design pavement structures according to IRC codes, and recommend maintenance strategies based on observed pavement distresses.	Design	Create

7. Mapping of Course Outcomes (CO) to Module:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	-	-	-	-
2	1	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	1	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	1	-	-	1	-	2
CO2	3	3	2	1	2	2	-	-	1	1	1
CO3	2	2	3	1	1	3	2	2	1	1	1
CO4	3	3	2	2	2	2	1	-	2	2	1
CO5	3	2	2	1	2	3	2	-	1	-	2
CO6	3	3	3	2	2	2	1	-	1	2	1

Average	2.83	2.50	2.17	1.40	1.80	2.17	1.50	2.00	1.17	1.50	1.33
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9. Mapping of the Course Outcomes (CO) to Program Specific Outcomes (PSO):

CO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	3
CO5	3	3	2
CO6	3	2	3

Course Name: SURVEYING AND GEOMATICS

Course Code: CE-402

(Semester IV)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics, Numerical Methods and Geography; Undergraduate level introductory knowledge of Civil Engineering.

2. Course Learning Objectives:

- This course introduces the concepts of sustainability in civil engineering and explores the role of construction materials in developing green infrastructure.
- Students will also learn to design energy-efficient buildings, implement sustainable site planning, navigate green building certifications, and evaluate the economics and ethics of sustainable construction practices.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

Attendance

Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]

Mid-Term Exam (30 Marks)- Summative Assessment

End-Semester Exam (50 Marks)- Summative Assessment.

4. Course Content:

Course Name: Surveying and Geomatics

Course Code: CE-402

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
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1.	Principles of Surveying Introduction, Principles and classification of surveying; Concept of scales; Survey stations and lines – ranging and bearing; Chain surveying – Concept, Instruments, numerical problems on errors due to incorrect chain; Compass Surveying – Applications of different types of compass, traversing, correction due to errors; Plane table surveying – Advantages, disadvantages, parts, methods; Elements of simple and compound curves, concept of transition curve.	10L
2.	Levelling: Levelling – Principles, different methods and instruments used in levelling, Precautions and Difficulties; Differential levelling, Concepts and numerical problems; Contouring.	5L
3.	Triangulation and Trilateration: Theodolite survey – Instruments, measurements of horizontal and vertical angles; Triangulation – Network, signals, numerical examples; Baseline measurement – site selection, measuring equipment, numerical problems o baseline corrections; Trigonometric levelling – Axis signal correction.	7L
4.	Photogrammetric Surveying: Concept; Classification of photogrammetric surveying – terrestrial, aerial and satellite; scale of a vertical photograph; relief displacement and object height determination; Stereoscopic vision – depth perception, parallaxic angle, stereoscopes; Object height determination using parallax; Parallax bar; Flight planning – Concept and numerical problems; Photo mosaic; Orthophotography; Stereoscopic plotting instruments.	7L
5.	Remote Sensing: Energy sources and radiation principles; Concept of Electromagnetic Spectrum; Energy interactions in the atmosphere and earth surface features; Data acquisition and interpretation; Platforms and sensors – Geostationary and sun-synchronous orbits, push broom and whiskbroom scanning system, characteristics of IRS, Landsat and Sentinel sensors; Visual image Interpretation, Digital Image Processing: Concept; Image rectification and restoration; Image enhancement; Image classification; Accuracy assessment and post-classification smoothing.	7L
6.	Advanced Surveying: Principle of Electronic Distance Measurement (EDM); Types of EDM instruments; Distomats; Total Station – Parts, advantages, applications, field procedure and errors; Global Positioning System (GPS) – Concept, applications, segments, location determination, errors; Principle of Differential GPS; Terrestrial laser scanner, Applications of Geomatics in Civil Engineering: 3D mapping; Earthquake and landslides; Runoff modeling; Groundwater targeting; Flood risk assessment; Urban planning; Highway and transportation.	6L

5. References:

Text Book:

- "Surveying Vol. 1, 2, & 3" by B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, Laxmi Publications
- "Higher Surveying" by A.M. Chandra, New Age International Publishers
- "Fundamentals of Surveying" by S.K. Roy, PHI Learning Pvt. Ltd. Publishers

Reference Books:

- "Remote Sensing and GIS" by Basudeb Bhatta, Oxford University Press Publishers
- "Textbook of Surveying" by C. Venkatramaiah, University Press Publishers

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
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CO1	To explain and state the scope of surveying and geomatics in civil engineering	Explain	Understand
CO2	To demonstrate the basic principles of surveying and geomatics engineering	Demonstrate	Apply
CO3	To solve the problems using different methods of surveying and geomatics to measure the features of interest	Solve	Apply
CO4	To examine the traditional and advanced methods of surveying	Examine	Analyze
CO5	To relate the different techniques of surveying and geomatics in solving real world problems.	Relate	Analyze
CO6	To develop and construct solutions for real-world problems related to surveying and geomatics.	Develop	Create

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	0	0	1	0	0	1	0	2
CO2	3	2	1	1	1	1	0	0	1	0	1
CO3	3	3	2	2	2	1	0	0	1	1	1
CO4	2	3	2	2	2	2	1	0	1	1	1
CO5	3	3	3	2	2	2	1	0	2	2	1
CO6	3	3	3	2	2	2	1	0	2	2	1
Total	2.83	2.67	2	1.50	1.50	1.50	0.50	0	1.33	1	1.17

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	2
CO4	2	3	2
CO5	3	2	3
CO6	3	2	3

Course Code: CE-403
(Semester IV)
Category: Major
Course Broad Category: CORE ENGG (Professional Core Courses)

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1. Course Prerequisite:
Engineering Mechanics, Engineering Mathematics.
 2. Course Learning Objectives:
 - i. This course introduces the study of the behaviour of soils under the influence of internal and external loading conditions and soil-water interactions.
 - ii. Students will also learn to predict different soil parameters by using different numerical and graphical methodologies.
 3. Teaching methodology and evaluation system for the course:
 Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
 Evaluation System –
 Internal Assessment (40 Marks)- Formative Continuous Assessment [Continuous Assessment 1(CIA1- 25 Marks written class test, 15 Marks Attendance/Assignment); [Continuous Assessment 2(CIA2- 25 Marks written class test, 15 Marks Attendance/Assignment).
 End-Semester Exam (60 Marks)- Summative Assessment.
 4. Course Content:
 Course Name: Geotechnical Engineering
 Course Code: CE-403
 Hours per Week: 3L:0T:0P
 Credits: 3

Module	Topics	42L
1.	Soil formation and soil classification: Origin of soil, Formation and types of soil, Formative classification, Some special types of soils, Structure and composition, Clay mineralogy; Classification of soil by structure, Particle size classification, Textural classification, Unified Classification, AASHTO classification, IS code classification, Plasticity chart.	4L
2.	Physical properties and Index properties: Phase system of soil, Basic definitions, Mass-Volume relationships, Physical properties: Density, Moisture content, specific gravity, Relative density, functional relationships; Index properties: particle size distribution, Mechanical analysis, Sedimentation analysis, Consistency, Atterberg limits, and indices.	8L
3.	Soil Hydraulics and Flow through Soil: Pore-water pressure: Pore water, Total pressure, Effective pressure under different conditions. Permeability: Darcy's Law, Coefficient of Permeability, Discharge Velocity, Seepage Velocity, Factors Affecting Permeability, Determination of coefficient of Permeability. Seepage: Seepage pressure, Flow nets, Flow through earthen dam, Estimation of seepage quantity, Construction of flow nets, Piping effect,	6L

Module	Topics	42L
	Uplift due to seepage, Critical hydraulic gradient, Quick sand condition.	
4.	Stress Distribution in Soil: Geostatic stress, Boussinesq's Equation, Determination of stress due to point load, Vertical stress distribution on horizontal plane, Isobar and pressure bulb, Vertical stress distribution on vertical plane, Vertical stress under uniformly loaded circular area, Vertical stress beneath a corner of a rectangular area, Equivalent point load method, 2:1 method, Newmark's influence chart, Vertical stress beneath line and strip load, Westergaard analysis.	6L
5.	Consolidation and Compaction: Consolidation: One-dimensional consolidation, Compressibility, Compression index, Coefficient of compressibility and volume change, Coefficient of consolidation, Degree and rate of consolidation, Time factor, settlement computation, Determination of consolidation parameters: Oedometer test. Compaction: Principle of compaction, Standard and modified proctor compaction test, Factors affecting compaction, Effect of compaction on soil properties, Field compaction methods.	8L
6.	Shear strength of soil: Concept of Shear resistance and Shear Strength of soil, Mohr circle of stress, Mohr-Coulomb Theory, Relationship between principal stresses and cohesion. Determination of shear parameters, stress-strain relationship of cohesive and cohesionless soils, Concept of critical void ratio, Sensitivity and thixotropy.	10L

5. References:

Text Book:

- Basic and Applied Soil Mechanics, Gopal Ranjan and A.S.R. Rao, New Age International Pvt. Ltd. Publishers.
- Principles of Geotechnical Engineering, B.M. Das, Thomson Brooks/Cole.
- Geotechnical Engineering, Shashi K Gulhati, Manoj Datta, The McGraw-Hill Company.

Reference Books:

- Textbook of Soil Mechanics and Foundation Engineering, V.N.S. Murthy, CBS Publication.
- Soil Mechanics and Foundations, B.C. Punmia and A.K. Jain, Laxmi Publication Pvt. Ltd.

6. Course Outcomes:

After completion of this course, students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Classify soil according to soil formation and characteristics.	Explain	Understand
CO2	Determine soil properties from basic relationships among parameters.	Determine	Apply
CO3	Examine the soil-water condition and flow characteristics through the soil.	Investigate	Analyse
CO4	Estimate the stress condition beneath the soil under an external vertical load.	Estimate	Evaluate
CO5	Estimate the degree of consolidation and settlement condition of soil under applied loading.	Estimate	Evaluate
CO6	Determine shear parameters and shear	Determine	Apply

	strength of soil from laboratory testing and mathematical formulations.		
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7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3		-	-
4	-	-		3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-
CO5	3	3	3	3	1	-	-	-	-	-	1
CO6	3	3	3	3	1	-	-	-	-	-	1

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	2	2	3
CO6	3	2	3

Course Name: Fluid Mechanics and Hydraulic Engineering

Course Code: CE-404

(Semester IV)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

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1. Course Prerequisite(s):

Students are expected to know the fundamentals of Physics, Mathematics, Engineering Mechanics, Workshop Processes and Engineering Drawing.

2. Course Learning Objectives:

The objectives of the course are to enable the student

- To understand the basic principles of fluid mechanics.
- To identify various types of flows.

- To understand boundary layer concepts and flow through pipes.
- To evaluate the performance of hydraulic turbines.
- To understand the functioning and characteristic curves of pumps.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content :

Course Name: Fluid Mechanics and Hydraulic Engineering

Course Code: CE-404

Hours per Week: 2L:1T:0P

Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Properties of Fluids and Fluid Statics : Fluid classifications, hypothesis of continuum, shear stress in a moving fluid, molecular structure of material, density, viscosity, surface tension, capillary effect, vapor pressure, compressibility and the bulk modulus, pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head, hydrostatic paradox. Fluid static, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure and surface immersed in a liquid, pressure diagrams, forces on a curved surface due to hydrostatic pressure, buoyancy, equilibrium of floating bodies, stability of a submerged body and floating bodies, determination of the metacentric height, determination of the position of the metacenter relative to the center of buoyancy.	6L +4T	24
2.	Kinematics and Dynamics of Fluid Flow : Fluid flow, Stream line, path line and streak lines and stream tubes, classification of flows- steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows, frames of reference, analyzing fluid flow, motion of a fluid particle, acceleration of a fluid particle, discharge and mean velocity, continuity of flow, continuity equations for 2-D and 3-D flow in Cartesian coordinates of system, circulation and vorticity, streamlines and the stream functions, velocity potential and potential flow, relation between stream function and velocity potential, stream function and velocity potential for uniform flow, vortex flow. Momentum and fluid flow, Momentum equation for 2-D flow along a	7L + 2T	21

	stream line, momentum correction factor, Euler's equation of motion along a stream line, mechanical energy of a flowing fluid, Bernoulli's theorem, kinetic energy correction factor, changes of pressure in tapering pipe, principle of venturimeter, orifice, rotameter, theory of notches and weirs.		
3.	Dimensional Analysis and Fluid Flow Similarities : Dimension reasoning, dimensional homogeneity, dimensional analysis using Rayleigh's method, Buckingham π -theorem, use of dimensionless numbers in experimental investigation, geometric similarity, dynamic similarity, kinematic similarity, model testing, model laws, undistorted and distorted models.	2L + 1T	7
4.	Viscous and Turbulent Flow : Reynolds' experiment, flow of viscous fluid through circular pipe-Hagen Poiseuille formula, flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, foot step and collar bearing, turbulent flow expression for coefficient of friction -DarcyWeishbach equation, moody diagram, resistance of smooth and rough pipes, shear stress and velocity distribution in turbulent flow through pipes.	2L + 2T	10
5.	Pipe Flow Analysis and Hydraulic Turbine Dynamics : Major and minor energy losses, hydraulic gradient and total energy lines, pipes in series and parallel, equivalent pipes, water hammer in pipes. Force exerted on stationary flat and curved plates held normal, force exerted on moving plate held normal and on a plate when vane is moving in direction of jet, jet striking on curved vane tangentially at one tip and leaving at other end, classification of hydraulic turbines, impulse and reaction turbines, construction, working and analysis of Pelton, Francis and Kaplan turbines, draft tube, governing of the hydraulic turbines, cavitations, performance characteristics.	6L + 2T	19
6.	Hydraulic Pumps and Hydraulic Machines: Pump classification and selection criterion, velocity vector diagrams, pump losses and efficiencies, net positive suction head, pressure rise in impeller, characteristic curves, priming. Reciprocating pumps : Working , Discharge, slip, Indicator Diagram. Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic jack, hydraulic lift, hydraulic ram, fluid couplings, fluid torque converter and air lift pump.	6L + 2T	19

5. References:

Text Books:

1. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Revised 9th Edition, Laxmi Publications (P) Ltd., 2010.
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, 9th Edition, S.K. Kataria & Sons, 2015.
3. A Textbook of Fluid Mechanics and Hydraulic Machines by R.K. Rajput, 6th Edition, S Chand & Company Ltd., 2015.

Reference Books :

1. Hydraulics and Fluid Mechanics Including Hydraulics Machines by P. N. Modi and S. M. Seth, 23rd Edition, Standard Book House, 2022.

2. Fluid Mechanics and Hydraulic Machines-Problems and Solution by K. Subramanya, 2nd Edition, McGraw Hill Education, 2018.
3. Hydraulics, Fluid Mechanics and Hydraulic Machines by R. S. Khurmi and N. Khurmi, 15th Edition, S Chand & Company Ltd., 1987.
6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To define basic terms, values and laws in the areas of fluid properties and fluid statics.	Define	Remember
CO2	To describe the kinematics and dynamics of fluids, and hydraulic design of pipe systems.	Describe	Understand
CO3	To relate to the boundary layer concept and analyze different types of losses and measurement of flow.	Relate	Analyse
CO4	To distinguish the different types of turbines and examine the performance characteristics of various turbines.	Distinguish	Analyse
CO5	To appraise the working of power absorbing devices like pumps and their performance characteristics.	Appraise	Evaluate
CO6	To recognize the working of various hydraulic machines.	Recognize	Understand

7. Mapping of Course Outcomes (CO) to Module:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	-	-	-	-
2	-	3	-	-	-	-
3	3	1	-	-	-	-
4	-	-	3	-	-	-
5	-	3	1	3	3	-
6	-	-	-	-	1	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO) :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	1	1	-	-	-	-	2
CO2	3	3	3	2	1	2	-	-	-	-	2

CO3	3	3	2	2	1	3	-	-	-	-	2
CO4	2	3	3	2	-	2	-	-	-	-	1
CO5	3	2	2	1	1	3	-	-	-	-	1
CO6	3	3	3	1	1	2	-	-	-	-	1
Average	2.83	2.83	2.5	1.67	1.0	2.17	0	0	0	0	1.5

9. Mapping of the Course Outcomes (CO) to Program Specific Outcomes (PSO):

CO	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	2
CO3	3	1	2
CO4	3	1	1
CO5	3	1	1
CO6	3	1	2

Course Name: STRUCTURAL ANALYSIS – I

Course Code: CE-405

(Semester IV)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

- Basic understanding of the mechanics of solids and mathematics.
- Knowledge of engineering materials and their behaviour under load.

2. Course Learning Objectives:

- i. Develop the ability to analyse determinate and indeterminate structures, including calculation of slopes, deflections, internal forces, and influence line diagrams for beams, frames, and arches.
- ii. Apply energy methods (strain energy, virtual work, displacement theorems) to understand and analyse structural behaviour, including cable and space structures.

3. Teaching methodology and evaluation system for the course:
 Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies; Problem-solving sessions, tutorials and Field Visits.
 Evaluation System –
 CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 Final exam: 60 marks
4. Course Content:
 Course Name: Structural Analysis – I
 Course Code: CE-405
 Hours per Week: 3L:0T:0P
 Credits: 3

Module	Topics	Lecture (42L)
1.	Structural Systems & Basic Concepts: Types of structural systems; Linearity and non-linearity in structural analysis; statically determinate and indeterminate structures; Degree of static indeterminacy; Recapitulation of shear force and bending moment diagrams.	7L
2.	Energy Methods – Strain Energy Strain energy and complementary strain energy, Strain energy due to gradually and suddenly applied loads; Strain energy due to axial force; shear force, bending, and torsion; Displacement of beams and trusses by strain energy method.	7L
3.	Virtual Work Method: Limitations of real work method, Principle of virtual work; Unit load method; Displacement of beams, frames, trusses; Effects of temperature and fabrication errors; Betti's law and Maxwell's reciprocal theorem; Castigliano's theorems and applications.	7L
4.	Slope and Deflection of Beams: Integration method; Moment area method; Conjugate beam method.	6L
5.	Moving Loads & Arches: Moving loads and influence lines; Influence line diagrams for beams and trusses; Maximum internal forces using ILD; Types of arches; Three-hinged arches and analysis; Internal force diagrams & ILD for arches	8L
6.	Advanced Structures – Space Trusses & Cables: Space trusses: introduction, supports, analysis (tension coefficient method); Cable structures: basics; Catenary and parabolic cables; Suspension bridges and stiffening girders.	7L

5. References:
- Text Book:
- Thandavamoorthy, T.S. – *Structural Analysis*, Oxford University Press.
 - Reddy, C. S. – *Basic Structural Analysis*, Tata McGraw Hill.
 - Punmia, B. C., Jain, A.K., & Jain, A.K. – *Theory of Structures*, Laxmi Publications.
 - Ramamrutham, S. & Narayan, R. – *Theory of Structures*, Dhanpat Rai Publications.
- Reference Books:
- Kinney, J.S. – *Indeterminate Structural Analysis*, Oxford & IBH Publishing.
 - Ugural, A.C. – *Structural Analysis: Understanding Behavior and Design*, CRC Press.
 - Menon, D. – *Advanced Structural Analysis*, Narosa Publishing.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe structural systems and classify various structural elements.	Describe	Understand
CO2	Examine the shear force and bending moments in statically determinate structures.	Examine	Analyze
CO3	Sketch slopes and deflections in beams, frames, and trusses using different methods.	Sketch	Apply
CO4	Use energy and virtual work methods to analyse structural behaviour.	Use	Apply
CO5	Develop and use influence line diagrams for analysing structures under moving loads.	Develop	Create
CO6	Explain the behaviour and analysis of arches, space trusses, and cable structures.	Explain	Understand

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1. Structural Systems	3	3	-	-	-	-
2. Strain Energy Method	-	-	3	3	-	-
3. Virtual Work Method	-	-	3	3	-	-
4. Slope and Deflection of Beams	-	-	3	-	-	-
5. Moving Loads & Arches	-	-	-	-	3	2
6. Advanced Structures – Space Trusses & Cables	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-
CO3	3	2	-	2	2	-	-	-	-	-	-
CO4	3	3	-	2	2	-	-	-	-	-	-
CO5	3	3	2	2	2	-	-	-	-	-	-
CO6	2	2	-	-	-	2	-	-	-	-	-

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	3	-
CO4	3	3	-
CO5	3	2	2
CO6	2	3	2

Course Name: TRANSPORTATION ENGINEERING LABORATORY
Course Code: CE-491
(Semester IV)
Category: Major
Course Broad Category: CORE ENGG (Professional Core Courses)

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1. Course Prerequisite:

A foundational understanding of civil engineering principles, along with prior coursework in transportation engineering, surveying, and materials science. A basic knowledge of traffic flow theory, highway design, and pavement materials is essential.

2. Course Learning Objectives:

- i. Students will be able to collect and analyze traffic, road, and transportation data using various laboratory equipment and software. They will learn how to interpret the data to make informed decisions in designing and optimizing transportation systems such as highways, intersections, and pavements.
- ii. The course aims to develop students' skills in conducting laboratory tests to evaluate the properties of transportation materials like asphalt, concrete, and aggregates. Students will perform tests for pavement design, material quality assessment, and durability, allowing them to understand material behavior under different traffic loads and environmental conditions.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam.

4. Course Content:

Course Name: Transportation Engineering Laboratory

Course Code: CE-491

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	14P
1.	Introduction to Highway Materials: Overview of materials & materials selection & testing.	1P
2.	Tests & Testing of Aggregates (Coarse Aggregate): Sieve analysis, Aggregate impact value, Aggregate crushing value, Los Angeles Abrasion test, Specific gravity, Flakiness and Elongation index, and Water Absorption test.	4P
3.	Tests & Testing of Bitumen: Specific Gravity test, Penetration Test, Softening point test, Flash and Fire point test, Ductility Test, Demonstration of Static and Kinematic viscosity	4P
4.	CBR value of sub-grade (Soaked and unsoaked).	2P
5.	Marshall Stability test.	1L

6.	Demonstration on Stripping value and Loss on heating tests of bitumen, Benkelman beam and bump integrator test.	2L
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7. References:

Text Book:

- "Highway Material Testing Manual" by S.K. Khanna, C.E.G. Justo, and A. Veeraragavan, Nem Chand & Bros
- "Laboratory Manual in Highway Engineering" by Ajay Kumar Duggal and Vijay Puri, New Age International Publishers

Reference Books:

- "Pavement Testing, Monitoring and Evaluation" by J. Buchanan and S. Rafeeqi, Prentice Hall
- "Transportation Engineering: An Introduction" by C. Jotin Khisty and B. Kent Lall, Pearson Education

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Examine the aggregate samples through different tests to compare the suitability for various types of highway construction.	Examine	Analyze
CO2	Execute the Specific Gravity test, Penetration test, and Static or Kinematic viscosity test on Bitumen.	Execute	Apply
CO3	Execute the Softening point test, Flash and Fire Point test and Ductility test on Bitumen.	Execute	Apply
CO4	Examine the CBR (California Bearing Ratio) values of sub-grade materials under soaked and unsoaked conditions.	Examine	Analyze
CO5	Design the bituminous mix using Marshall stability test.	Design	Create
CO6	Demonstrate the procedures for stripping value, loss on heating tests of bitumen, Benkelman beam, and bump integrator tests.	Demonstrate	Apply

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	1	-	-	-	-	3
2	2	3	-	-	-	1
3	2	3	-	3	1	1
4	1	-	-	3	1	2
5	3	2	-	-	3	-
6	-	-	3	-	-	-

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	1	-	-	3	1	1
CO2	3	1	-	-	-	1	-	-	3	1	1
CO3	3	1	-	-	-	1	-	-	3	1	1
CO4	3	2	-	-	-	1	-	-	3	2	1
CO5	3	2	-	-	-	1	-	-	3	2	1

CO6	3	1	-	-	-	1	-	-	1	1	1
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11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
CO6	3	3	1

Course Name: SURVEYING AND GEOMATICS LABORATORY

Course Code: CE-492

(Semester III)

Category: MAJOR

Course Broad Category: CORE ENGG (PC)

- Course Prerequisite: Basic knowledge of Surveying and Geomatics theory CE-402.
- Course Learning Objectives: The objective of this lab is to teach the student the practical knowledge in the field to set out any Civil Engineering work to
 - Know the principles and methods of surveying using different equipment's & methods
 - Determination of distance, area using chain, compass and leveling survey.
 - Apply surveying principles to determine areas and volumes and setting out curves.
 - Understand the concept of advanced techniques and operation of modern equipment and perform various experiments by using that.
- Teaching methodology and evaluation system for the course:
Teaching methodology - Lectures and Presentations, Interactive Discussions and Case Studies, Field Work, Guest Lectures and Group work.
Evaluation System –
- Total Marks: 100 [60(PCIA) + 40(PESE)]
- Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)
- Section 2: Practical End Semester Examination (PESE) - 40 Marks (written exam)
- Course Content:
Course Name: SURVEYING AND GEOMATICS LABORATORY
Course Code: CE-492
Hours per Week: 0L:0T:02
Credits: 1

Experiment	Topics	14L
1.	Chain Surveying: Surveying of an area by chain and Field book preparation.	1L
2.	Compass survey: Closed traverse preparation & plotting with prismatic compass.	2L
3.	Levelling: Differential levelling using dumpy level and auto level. Level book preparation, Longitudinal and cross-section and plotting.	2L

4.	Transit Theodolite: Closed traverse by transit theodolite. Preparation of drawing sheet and error elimination. Measurement of Horizontal and vertical angle by theodolite.	1L
5.	Total station: Determination of Area using total station and drawing map using tera model.	1L
6.	Contour map: Traversing using total station for drawing contour map	2L
7.	Leveling (TS): Leveling using total station.	1L
8.	Drone surveying: Basics of Drone surveying.	1L
9.	Curve Setting: Setting out curve using Total station.	1L
10.	Determination of height, remote elevation, Topographic Survey using GPS.	2L

6. References:

Text Book:

- Arora K R, Surveying (Vol 1, 2 & 3), 9th Edition, Standard Book House, Delhi, 2021.
- B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Surveying Vol I & Vol II, Laxmi Publishers, 2023.

Reference Books:

- Chandra A M., Plane Surveying, New Edition, New Age International Pvt. Ltd., Publishers, New Delhi, 2024.

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the interdependency and advancement of different surveying methods.	Explain	Understand
CO2	Explain the concepts of leveling, and perform & plot the cross & longitudinal sectioning	Explain	Understand
CO3	Identify of angles using theodolite, and calculate the distance and elevation of the given point using trigonometric leveling.	Identify	Understand
CO4	Construct the area of traverse by total station method and prepare contour maps.	Construct	Create
CO5	Identify the position of points using total station method.	Identify	Apply
CO6	Use modern equipment for curve setting and Locate the position of points using GPS.	Use	Apply

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	2	1	0	0	0	1
CO2	3	3	1	2	2	2	1	0	0	0	1
CO3	3	3	1	2	2	1	0	0	0	0	1

CO4	3	3	2	2	1	1	0	0	0	0	1
CO5	3	3	2	2	1	1	1	0	0	0	1
CO6	3	3	3	2	1	1	0	0	0	0	1

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	1
CO3	3	2	1
CO4	3	2	1
CO5	2	2	1
CO6	3	1	1

Course Name: Basic Geotechnical Engineering Laboratory

Course Code: CE-493

(Semester IV)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Geotechnical Engineering CE(PC)403

2. Course Learning Objectives:

- i. Understand Soil Properties and Classification
- ii. Perform Soil Sampling and Preparation
- iii. Conduct Standard Laboratory Tests
- iv. Analyze Soil Strength and Compressibility
- v. Evaluate Soil Permeability and Seepage
- vi. Interpret and Report Laboratory Data
- vii. Develop Problem-Solving Skills
- viii. Collaborate in a Team Environment

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks (written exam)

4. Course Content:

Course Name: Basic Geotechnical Engineering Laboratory

Course Code: CE-493

Hours per Week: 2P

Credits: 1

Experiment 1	Field identification of different types of soil as per Indian Standards [collection of field samples and identifications without laboratory testing].
Experiment 2	Determination of specific gravity of cohesionless and cohesive soils.
Experiment 3	Determination of in-situ density by core cutter method and sand replacement method and Determination of natural moisture content.

Experiment 4	Determination of relative density of soil.
Experiment 5	Determination of grain size distribution by sieve and hydrometer analysis.
Experiment 6	Determination of Atterberg limits (liquid limit, plastic limit and shrinkage limit).
Experiment 7	Determination of co-efficient of permeability by constant and variable head permeability tests.
Experiment 8	Determination of compaction characteristics of soil by standard proctor compaction test.
Experiment 9	Determining of consolidation parameters by Standard Oedometer Test or Consolidation Test

6. References:

1. Soil Mechanics Laboratory Manual by Braja Mohan Das (Oxford university press).
2. SP: 36 (Part - I and Part - II)

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Classify the types of soil and determine its natural moisture content along with specific gravity.	Classify	Understand
CO2	Execute the in-situ density of soil by core cutter and sand replacement method and determination of relative density of soil.	Execute	Apply
CO3	Classify the soil using grain size distribution curve and Atterberg limits.	Classify	Understand
CO4	Examine laboratory tests to determine permeability and compaction characteristics of soil.	Examine	Analyse
CO5	Investigate the compaction characteristics of soil.	Investigate	Create
CO6	Investigate the consolidation parameters of soil.	Investigate	Create

8. Mapping of course outcomes to module / course content

	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1	2	-	-	-	-	-
Experiment 2	3	-	-	-	-	-
Experiment 3	-	3	-	-	-	-
Experiment 4	-	3	-	-	-	-
Experiment 5	-	-	3	-	-	-
Experiment 6	-	-	3	-	-	-
Experiment 7	-	-	-	3	-	-
Experiment 8	-	-	-	-	3	-
Experiment 9						3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	1	-	3	2	-	1

CO2	3	3	1	3	-	1	-	3	2	-	1
CO3	3	3	1	3	2	1	-	3	2	-	1
CO4	3	3	1	3	-	1	-	3	2	-	1
CO5	3	3	1	3	2	1	-	3	2	-	1
CO6	3	3	2	3	2	1	-	3	2	-	1

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	1	-
CO3	3	1	-
CO4	3	1	-
CO5	3	1	-
CO6	3	1	-

Course Name: FLUID MECHANICS LABORATORY

Course Code: CE-494

(Semester IV)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Class-XII level knowledge of Physics and Mathematics, and Undergraduate-level introductory knowledge of Fluid Mechanics in Civil Engineering.

2. Course Learning Objectives:

- To calibrate and analyze flow measurement devices such as V-notches, orifice meters, and venturi meters to accurately assess fluid flow.
- To determine hydraulic coefficients and assess the performance of pumps and hydraulic machinery through experimental testing.
- To investigate minor losses in pipelines due to sudden changes in diameter and analyze their effects on fluid flow efficiency.
- To measure velocity profiles and flow phenomena using a pitot tube and study hydraulic jumps and water surface profiles for practical applications in engineering.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam.

4. Course Content:

Course Name: FLUID MECHANICS LABORATORY

Course Code: CE-494

Hours per Week: 0L:0T:2P

Credits: 1

Experiment	Topics	14 P	100 %
1.	Calibration of V-Notches, Rectangular-Notches, Trapezoidal Notch.	3P	21
2.	Calibration of Orifice meter, Venturi meter	2P	15
3.	Determination of Hydraulic Coefficient of an Orifice	1P	07
4.	Performance Test on Centrifugal Pump & Reciprocating Pump	2P	15
5.	Performance Test on Hydraulic Ram	1P	07
6.	Determination of Minor Losses in Pipes due to Sudden Enlargement and Sudden Contraction	1P	07
7.	Measurement of Velocity by using pitot tube	1P	07
8.	Performance Test on Pelton Wheel Turbine	1P	07
9.	Measurement of water surface profile for flow over Broad crested weir	1P	07
10.	Measurement of water surface profile for a hydraulic jump	1P	07

11. References/Text Book:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill

12. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Execute calibration procedures for V-notches and orifice meters to accurately measure fluid flow rates.	Execute	Apply
CO2	Test the performance characteristics of centrifugal pumps, reciprocating pumps, and Pelton wheel turbines through experimental testing.	Test	Analyse
CO3	Examine hydraulic coefficients of orifices to determine their significance in fluid flow applications.	Examine	Analyse
CO4	Investigate and quantify minor losses in pipes caused by sudden enlargement and contraction, assessing their impact on flow efficiency.	Investigate	Create
CO5	Execute and interpret water surface profiles associated with hydraulic jumps, explaining the underlying fluid dynamics.	Execute, Interpret	Apply
CO6	Compare and assess water surface profiles for flow over broad crested weirs, emphasizing practical applications in engineering design.	Compare	Analyse

13. Mapping of course outcomes to module / course content

	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	-	-	3	-	-	-

4	-	3	-	-	-	-
5	-	3	-	-	-	-
6	-	-	-	3	-	-
7	3	-	-	-	-	-
8	-	3	-	-	-	-
9	-	-	-	-	-	3
10	-	-	-	-	3	-

14. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	1	-	-	-	1	-	-	1
CO2	2	2	1	2	-	1	1	-	-	-	2
CO3	1	1	1	-	-	-	-	-	-	-	1
CO4	1	-	1	1	-	-	-	-	-	-	1
CO5	-	1	-	-	-	-	-	1	-	-	1
CO6	1	-	-	1	-	-	-	2	-	-	2

15. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	2	2	-
CO4	2	3	1
CO5	1	1	-
CO6	2	2	1

Course Name: Data Science in Civil Engineering Laboratory

Course Code: CE-481

(Semester IV)

Category: Minor

Course Broad Category: MULTIDISCIPLINARY OPEN ELECTIVES COURSE

1. Course Prerequisite:

- ☑ Basic understanding of Civil Engineering concepts.
- ☑ Familiarity with basic statistics and data analysis tools..
- ☑ Introductory knowledge of programming concepts (preferably in Python).

2. Course Learning Objectives:

- a. Leverage data to study Civil Engineering problems, identify patterns, and make actionable insights.
- b. Utilize digital and computer tools (e.g., Microsoft Excel, spatial data, data processing) for CE applications.
- c. Apply exploratory data analysis and statistical modeling to various CE domains.
- d. Develop skills in advanced analytical techniques like Logistic Regression, Principal Component Analysis (PCA), and Artificial Neural Networks (ANNs).
- e. Apply distributed computing techniques to process complex Civil Engineering data.

3. Teaching methodology and evaluation system for the course:

Teaching Methodology –

- a. Hands-on lab sessions focused on real-world civil engineering datasets.
- b. Weekly lab assignments involving data processing, analysis, and visualization using software like Python, R, and GIS.

- c. Project-based learning where students apply their knowledge to solve practical Civil Engineering problems using data science techniques.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks (written exam)

4. Course Content:

Course Name: Data Science in Civil Engineering

Course Code: CE-481

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	14L
1.	Introduction to Data Science in Civil Engineering: Overview of Data Science and its relevance to Civil Engineering, Introduction to data collection methods and types of data (spatial, temporal, etc.), Introduction to Microsoft Excel for data processing, Overview of data processing and cleaning methods, Descriptive statistics: Measures of central tendency and variability, Data visualization techniques- Histograms, scatter plots, and line charts, Introduction to Python/R for data analysis.	2L
2.	Statistical Methods for Civil Engineering Data: Hypothesis testing- Null and alternative hypotheses, Testing of hypothesis in civil engineering datasets (t-test, chi-square, F-test etc.), Correlation and regression analysis, Logistic regression for binary classification problems	2L
3.	Data Processing and Cleaning Techniques: Handling missing data, outliers, and errors in datasets, Data transformation, normalization, and feature scaling, Introduction to distributed computing and its role in large data processing.	2L
4.	Exploratory Data Analysis and Visualization: Descriptive statistics and exploratory data analysis techniques, Visualizing Civil Engineering data: histograms, scatter plots, heat maps, and GIS-based spatial data visualizations, Tools: Python (Pandas, Matplotlib), R, and QGIS.	2L
5.	Statistical Modeling for Civil Engineering Problems: Linear and non-linear regression modeling, Predictive modeling for structural health monitoring and environmental data, Case studies and applications in transportation, hydrology, and structural analysis.	2L
6.	Applications of Machine Learning in Civil Engineering: Introduction to supervised and unsupervised learning algorithms, Application of classification and clustering in transportation systems and infrastructure monitoring, Tools: Scikit-learn, TensorFlow.	2L
7.	Advanced Data Applications in Civil Engineering: Spatial data analysis for geomatics, Distributed computing for processing large civil engineering datasets, Final project: Students will choose a real-world Civil Engineering problem, analyze the data, and present actionable insights.	2L

8. References:

Text Book:

- Data Science for Civil Engineering: A Beginner's Guide By Rakesh K. Jain, Prashant Shantaram Dhotre, Deepak Tatyasaheb Mane, Parikshit Narendra Mahalle (2023) CRC Publishers.

Reference Books:

- Hastie, Trevor et al., *The Elements of Statistical Learning*, Springer.
- Douglas C. Montgomery, George C. Runger, *Applied Statistics and Probability for Engineers*, Wiley.
- Jeeva Jose, *Machine Learning*, Khanna Publishing House.
- Chopra R. - *Machine Learning*, Khanna Publishing House.
- Python and R documentation for data science libraries.

9. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe the role of data science in Civil Engineering.	Describe	Understand
CO2	Operate data processing and cleaning for Civil Engineering data.	Operate	Apply
CO3	Judge exploratory data analysis and visualize spatial and non-spatial data.	Judge	Evaluate
CO4	Use statistical models to real-world Civil Engineering problems.	Use	Apply
CO5	Implement machine learning algorithms in Civil Engineering applications.	Implement	Apply
CO6	Examine complex Civil Engineering issues using data-driven approaches.	Examine	Analyze

10. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	-	-	1	-
2	-	3	-	-	1	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	-
7	-	-	-	-	3	3

11. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	-	2	-	-	-	-	-
CO2	1	2	3		2	2	-	-	-	-	1
CO3	1	2	3	2	2	2	-	-	-	-	1
CO4	1	2	3	3	2	2	-	-	-	-	2
CO5	1	2	2	2	-	2	-	-	-	-	-
CO6	1	-	-	-	-	2	3	-	-	-	-

12. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	2	2
CO4	3	2	2
CO5	1	2	2
CO6	1	3	3

Course Name: Civil Engineering - Societal & Global Impact
Course Code:CE-482
(Semester IV)
Category: Knowledge Enhancement Course
Course Broad Category: Core Engg (Multidisciplinary Non-Credit Course- 2 (MNC))

1. Course Prerequisite:

NIL

2. Course Learning Objectives:

The course is designed to provide a better understanding of the impact, which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realize the impact that this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Giving Classroom lectures, board work, interactive session with students and sometime PowerPoint presentation.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

- Mid-Semester Evaluation and Attendance: 20 Marks
- Formative Continuous Assessment [Assignment (Case Studies/ Report writing)/Mini- Project/Group Discussions/ Presentations/Quiz] 20 Marks
- Summative Assessment. End-Semester Exam. 60 Marks

4. Course Content:

Course Name: CIVIL ENGINEERING - SOCIETAL & GLOBAL IMPACT

Course Code: CE-482

Hours per Week: 3L:0T:0P

Credits: 0

Module	Topics	42L
1.	Introduction to Course and Overview; Understanding the past to look into the future: preindustrial revolution days, agricultural revolution, first and second industrial revolutions, IT revolution; recent major civil engineering breakthroughs and innovations; present day world and future projections, ecosystems in society and in nature; the steady erosion in sustainability; global warming, its impact and possible causes; evaluating future requirements for various resources; GIS and applications for monitoring systems; human development index and ecological footprint of India vs other countries and analysis	5L
2.	Understanding the importance of civil engineering in shaping and influencing the world; the ancient and modern marvels and wonders in the field of civil engineering; future vision for civil engineering. Development of various materials of construction and methods of construction.	5L

3.	Infrastructure - Habitats, megacities, smart cities, futuristic visions; transportation (roads, railways & metros, airports, seaports, river ways, sea canals, tunnels (below ground, underwater); futuristic systems (ex, hyper loop); energy generation (hydro, solar photovoltaic), wind, wave, tidal, geothermal, thermal energy); water provisioning; telecommunication needs (towers, above-ground and underground cabling); awareness of various codes & standards governing infrastructure development; innovations and methodologies for ensuring sustainability.	10L
4.	Environment - Traditional & futuristic methods; solid waste management, water purification, wastewater treatment & recycling; flood control (dams, canals, river interlinking), multi-purpose water projects, atmospheric pollution; global warming phenomena and pollution mitigation measures, innovations and methodologies for ensuring sustainability. Environmental sustainable materials.	9L
5.	Built environment-facilities management, climate control; energy efficient built environments and LEED ratings, recycling, temperature/ sound control in built environment, security systems; intelligent/ smart buildings; role of urban arts commissions; conservation, repairs & rehabilitation of structures & heritage structures; innovations and methodologies for ensuring sustainability.	7L
6.	Civil Engineering Projects – Environmental impact analysis procedures; waste (materials, work force, equipment) avoidance/ efficiency increase; sustainable construction; advanced construction techniques for better sustainability. Project management paradigms and systems (ex. lean construction), demand and contribution of civil engineering to society; innovations and methodologies for ensuring sustainability during project development.	6L

6. References:

Text Book:

- Civil Engineering Societal & Global Impact by Dr. Shakuntala Acharya – All India Council for Technical Education Nelson Mandela Marg, Vasant Kunj, New Delhi, 110070. November 2023. ISBN: 978-81-963773-7-3.

Reference Books:

- Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M.(eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht.
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- Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application tourban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.
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- Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244.
- Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.
- Charles J A. (2009) Robert Rawlinson and the UK public health revolution. Proc ICE Eng History and Heritage. 162 Nov. Issue EH4. p 199-206

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	CO.1 Discuss the change in trends of civil engineering from the past to present and future in Indian as well as global scenario.	Discuss	Understand
CO2	CO.2 The impact, which Civil Engineering projects have on the Society and identifying the ancient and modern marvels of civil engineering to plan for a better world.	Identify	Understand
CO3	CO.3 Recognize the different infrastructural requirements of civil engineering related to megacities, smart cities, energy generation and communication	Recognize	Understand
CO4	CO.4 Classification of environmental engineering including waste managements, flood control, pollution control to build a sustainable society.	Classification	Understand
CO5	CO.5 Identify the built environment and factors influencing the quality of life ensuring sustainability.	Identify	Understand
CO6	CO.6 Understand the EIA procedures and apply advanced engineering techniques to contribute to GDP and generate employment.	Apply	Apply

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	2	-	-	-	-	1
CO2	3	3	3	2	-	2	-	-	-	-	1

CO3	3	1	-	-	1	-	-	-	-	-	-
CO4	3	2	2	2	-	3	2	1	-	2	2
CO5	2	2	3	2	-	3	1	-	1	2	2
CO6	3	3	3	3	1	3	2	2	2	2	3

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	1	1
CO3	3	1	2
CO4	2	1	2
CO5	2	1	2
CO6	3	2	3



Department of Civil Engineering
(Detailed Autonomous Syllabus)

Course Name: DESIGN OF RC STRUCTURES

Course Code: CE-501

(Semester V)

Category: MAJOR

Course Broad Category: CORE ENGG (PC)

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1. Course Prerequisite:

Solid Mechanics, Concrete Technology and Structural Analysis - I

Course Learning Objectives:

- The course focuses on different types of loads, and methods used for designing reinforced concrete structural elements, such as beams, slabs, columns, footings, and staircases, while considering serviceability criteria.
- Going through the course students would develop first-hand knowledge in preparing structural drawings, detailing, and producing accurate design calculations in the appropriate professional format for reinforced concrete structures.

2. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

- CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 - CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 - Final exam: 60 marks
- 100 Marks

3. Course Content:

Course Name: DESIGN OF RC STRUCTURES

Course Code: CE-501

Hours per Week: 3L-0T-0P

Credits: 3

Module	Topics	42L
1.	Introduction: Principles of design of reinforced concrete members- Working stress and Limit State method of design.	3L
2.	Working stress method of design: Basic concepts and IS code provisions (IS: 456 2000) for design against bending moment and shear forces of beam section.	4L
3.	Limit state method of design: Basic concepts and IS code provisions (IS: 456 2000) for design against bending moment and shear forces; concepts of bond stress and development length; Use of design aids for reinforced concrete' (SP: 16).	5L

Module	Topics	42L
4.	Beam Design by LSM: Analysis, design and detailing of singly reinforced and doubly reinforced beam sections by limit state method. Slab Design by LSM: Design and detailing of one-way and two-way slab panels as per IS code provisions. Continuous slab and beam design by LSM: Design and detailing of continuous beams and slabs as per IS code provisions.	12L
5.	Design of Staircases and Column by LSM: Types; Design and detailing of reinforced concrete dog legged staircase. Design of Columns by LSM: Design and detailing of reinforced concrete short columns of rectangular and circular cross-sections under axial load. Design of short columns subjected to axial load with moments (uniaxial and biaxial bending)– using SP16.	10L
6.	Design of Foundation by LSM: Design and detailing of reinforced concrete isolated square and combined footing as per IS code provisions by limit state method.	8 L

6. References:

Text Book:

- R.C.C. Design B.C. Punmia, Laxmi Publication.
- Concrete Technology by M. S. Shetty. – S. Chand & Co. 2004.
- R.C.C. Design & Drawing by Neelam Sharma S. K. Kataria & Sons.

IS Codes:

- IS: 456 – 2000: Plain and reinforced concrete - Code of practice.
- IS 875 Part 1: Dead Loads - Unit Weights of Building Materials and Stored Materials
- IS 875 Part 2: Imposed Loads - Live Loads and Wind Loads
- IS 875 Part 3: Wind Loads on Buildings and Structures
- IS 875 Part 4: Snow Loads
- IS 875 Part 5: Special Loads and Load Combinations
- SP: 16: Design Aid to IS 456

Reference Books:

- Fundamental Design of Reinforced Concrete by N. C. Sinha & S.K. Roy.
- Reinforced concrete S.N. Sinha TMH.
- Limit State Design of Reinforced Concrete P. C. Varghese PHI.

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand material properties and design methodologies for reinforced concrete structures.	Explain	Understand
CO2	Identify the different methods for design, basic concepts, and IS code provisions for design against bending moment and shear forces, understanding the load transfer mechanism, and perform the load combinations.	Identify	Understand
CO3	Analyse the criteria for the design of beams as per codal guidelines using the Limit State Method (LSM).	Execute	Apply
CO4	Design and detailing of one-way, two-way, and	Calculate	Analyze

	continuous slabs using the Limit State Method (LSM) as per IS code provisions.		
CO5	To analyze the load transfer mechanism in staircases and columns and design them in accordance with codal provisions.	Examine	Analyze
CO6	Understanding the different types of foundation and their suitability as per loading and design reinforced concrete isolated square and combined footings using the Limit State Method, adhering to IS code provisions.	Develop	Create

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	3	-	-	-	-
4	-	-	3	3		-
5	-	-	-		3	-
6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	1	-	-	-	-	-	2
CO2	3	2	3	3	-	1	-	-	-	-	-
CO3	3	3	3	3	-	1	-	-	-	-	2
CO4	3	3	3	3	1	-	-	-	-	-	2
CO5	3	3	3	3	-	1	-	-	-	-	2
CO6	3	3	3	3	1	1	-	-	-	-	2

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Course Name: Environmental Engineering

Course Code: CE-502

(Semester V)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

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1. Course Prerequisite(s):

Students are expected to know the fundamentals of Physics, Mathematics, Chemistry and Engineering Drawing.

2. Course Learning Objectives:

The objectives of the course are to enable the student

- To make the students conversant with sources and its demand of water
- To understand the basic characteristics of water and its determination and design of water supply lines
- To provide adequate knowledge about the water treatment processes and its design
- To learn the basics of sewage composition and its characteristics
- To depict the information about various sewage treatment processes
- To understand the knowledge about solid waste generation and disposal methods.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Environmental Engineering

Course Code: CE-502

Hours per Week: 2L:1T:0P

Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Basics of Water Supply: Requirements of water supply - Types of demand and their contribution - rate of consumption -Forecasting the population-variation in demand pattern. Sources of water - Surface and ground water. Physical, chemical and biological characteristics of water - water analysis- IS and WHO standards.	4L + 2T	14
2.	Water Treatment: Typical flow chart for ground and surface water treatments; Unit Processes- Aeration, Plain sedimentation, coagulation & flocculation, Water Softening, Filtration, Disinfection.	5L+ 3T	19
3.	Water Conveyance and Distribution: Hydraulic design of pressure pipes, Analysis of distribution network, Storage and distribution reservoirs, Capacity of reservoirs.	3L + 2T	12
4.	Basics of Sewage and Treatment Processes: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, Wastewater Treatment- Typical flow chart for municipal wastewater treatment; Primary, Secondary & Tertiary Treatments: Unit Processes Activated Sludge Process, Trickling Filter Process, Septic Tank, Advance Methods of Wastewater treatment.	6L + 4T	24

5.	Solid Waste Management: Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management.	6L + 2T	19
6.	Building Plumbing: Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.	4L + 1T	12

5. References :

Text Books:

1. Water Supply Engineering (VOL I) by Santosh Kr Garg, Khanna Publishers.
2. Sewage Disposal and Air pollution Engineering (VOL – II) by Santosh Kr Garg, Khanna Publishers.
3. Environmental Engineering, N. N. Basak, McGraw-Hill.
4. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition, 2008.

Reference Books:

1. Environmental Engineering. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, McGraw-Hill.
2. Wastewater Engineering by Metcalf & Eddy, McGraw-Hill.
3. Wastewater Engineering by B.C. Punmia & A.K. Jain, Laxmi Publications.
4. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify the various sources, characteristics of water and discuss the concept of water demand.	Identify	Understand
CO2	Interpret the water treatment concept and methods.	Interpret	Apply
CO3	Sketch the entire water distribution processes and execute the operation and maintenance of water supply.	Sketch	Apply
CO4	Design the various components of water and wastewater treatment plants.	Design	Create
CO5	Examine the sewage characteristics and design various wastewater treatment system design and operation.	Examine	Analyse
CO6	Appraise the various processing/treatment options for solid waste and study operations of building plumbing.	Appraise	Evaluate

7. Mapping of Course Outcomes (CO) to Module :

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	-	-	-	-
2	-	3	-	3	-	-
3	1	3	-	-	-	-
4	-	-	-	3	3	-
5	-	-	-	3	3	3
6	-	-	-	-	1	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO) :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	1	1	0	0	1	0	1
CO2	3	3	3	1	3	1	0	0	1	1	1
CO3	3	3	3	1	3	1	0	1	1	1	1
CO4	3	3	3	3	3	1	0	1	1	1	1
CO5	3	3	3	3	3	3	1	1	1	1	1
CO6	3	3	3	3	3	3	1	1	1	1	3
Average	3	3	2.67	2	2.67	1.67	0.33	0.67	1	0.83	1.33

9. Mapping of the Course Outcomes (CO) to Program Specific Outcomes (PSO) :

CO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	3

Course Name: STRUCTURAL ANALYSIS – II

Course Code: CE-503

(Semester V)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

- Structural Analysis-I
- Basic understanding of Mechanics of Solids and Engineering Mathematics.

2. Course Learning Objectives:

- i. Understand force and displacement methods for analysing indeterminate structures.
- ii. Apply classical methods like slope-deflection, moment distribution, and Kani's method for analysing beams and frames.
- iii. Utilise influence lines to assess the behaviour of statically indeterminate beams.
- iv. Analyse arches and curved beams subjected to different loading conditions.
- v. Implement matrix methods for structural analysis.
- vi. Understand the fundamentals of plastic analysis for structural components.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Problem-solving sessions and tutorials, Use of structural analysis software for simulations, Guest Lectures, Group projects and hands-on model analysis.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Structural Analysis – II

Course Code: CE-503

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	Lecture (42L)
1.	Force Method & Indeterminacy: Consistent deformation method (force method), degree of static and kinematic indeterminacy, compatibility conditions and determination of redundant forces, application to indeterminate beams, trusses, and frames, use of energy methods in force method problems.	7L
2.	Displacement Methods – Slope Deflection: Fundamental slope-deflection equations, application to continuous beams with and without settlement, analysis of frames with and without sway, effects of support settlement and temperature changes.	7L
3.	Moment Distribution & Kani's Method: Concept of distribution and carryover factors, application of moment distribution method to beams and frames with and without sway, effects of joint rotation and settlement, concept and iterative procedure of Kani's method, application to continuous beams and frames, advantages and limitations of Kani's method.	7L
4.	Advanced Classical Methods: Concept and derivation of column analogy method, analogous column properties and stiffness relations, application to fixed and continuous beams and rigid frames, concept of curved beams and their applications, stress distribution in curved beams based on Winkler–Bach theory, analysis of curved beams under different loading conditions.	6L
5.	Influence Lines, Arches & Approximate Methods: Concept of influence lines for statically indeterminate beams, construction of influence line diagrams for reactions, shear force and bending moment, Müller-Breslau principle and its application, influence lines for beams with fixed and continuous supports, types of arches and their classification, analysis of two-hinged and fixed arches under different loading conditions, calculation of horizontal thrust and internal forces, influence line diagrams for arches, approximate methods for lateral loads including portal method and cantilever method, assumptions and applications to multi-storey frames.	8L
6.	Matrix Methods & Plastic Analysis: Basics of flexibility and stiffness matrix methods, application of matrix methods to beams and frames, introduction to plastic analysis of structures, determination of collapse load, mechanism method for beams and frames, plastic analysis of beams and frames.	7L

5. References:

Text Book:

1. C. S. Reddy, *Basic Structural Analysis*, McGraw Hill.
2. A. K. Jain, *Advanced Structural Analysis*, Nem Chand & Bros.
3. G. S. Pandit, and Gupta, S. P., *Structural Analysis: A Matrix Approach*, McGraw Hill.

Reference Books:

1. C. K. Wang, *Indeterminate Structural Analysis*, McGraw Hill.
2. J. S. Kinney, *Indeterminate Structural Analysis*, Addison Wesley.
3. R. C. Hibbeler, *Structural Analysis*, Pearson.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Use force and displacement methods to analyse indeterminate structures.	Use	Apply
CO2	Operate classical methods like slope-deflection and moment distribution for beams and frames.	Operate	Apply
CO3	Construct influence line diagrams for statically indeterminate structures.	Construct	Create
CO4	Examine two-hinged and fixed arches under various loading conditions.	Examine	Analyze
CO5	Judge the behaviour of curved beams.	Judge	Evaluate
CO6	Implement matrix methods and plastic analysis for structural systems.	Implement	Apply

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	-	-	-	-	-
Module 2	2	3	-	-	-	-
Module 3	2	3	-	-	-	-
Module 4	-	-	-	-	3	-
Module 5	-	-	3	3	-	-
Module 6	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	2	2	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-
CO4	3	3	-	2	-	2	-	-	-	-	-
CO5	2	2	-	-	-	2	-	-	-	-	-
CO6	3	2	2	2	3	-	-	-	-	-	-

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	2	-
CO3	3	2	2

CO4	3	2	2
CO5	2	2	2
CO6	3	3	2

Course Name: FOUNDATION ENGINEERING

Course Code: CE-504

(Semester V)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Geotechnical Engineering

2. Course Learning Objectives:

- This course introduces the study of foundations under the influence of internal and external loading conditions and the application of earth retaining structures in infrastructure engineering.
- Students will also learn to predict the stability of slope and apply the different ground improvement and soil exploration techniques.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –
Attendance

Internal Assessment (40 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA1- 25 Marks written class test, 15 Marks Attendance/Assignment); [Continuous Assessment 2 (CIA2- 25 Marks written class test, 15 Marks Attendance/Assignment).

End-Semester Exam (60 Marks)- Summative Assessment.

4. Course Content:

Course Name: Foundation Engineering

Course Code: CE-504

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Earth Pressure Theory: Plastic equilibrium of soil; Lateral Earth Pressure: Earth Pressure at Rest; Active and Passive Earth Pressure; Rankine's Earth Pressure Theory for different kinds of backfill; Coulomb's Earth Pressure Theory: Wedge Method of Analysis;	4L
2.	Earth Retaining Structures: Retaining wall: Different types of retaining wall; Stability of Retaining wall; Gravity Retaining Wall & Cantilever Retaining Wall. Sheet Pile wall: Classification of sheet pile; Design of Sheet Piles: Cantilever Sheet pile & Anchor Sheet pile.	8L
3.	Site Investigation and Soil Exploration: Subsurface Exploration; Method of boring and sampling; In-situ tests: Standard Penetration Test (SPT), Static Cone Penetration Test (SCPT), Dynamic Cone Penetration Test (DCPT), Plate Load Test (PLT); Indirect method of soil exploration: Geophysical Methods – Seismic Refraction Method, Electrical Resistivity Method.	6L

4.	Shallow Foundation: Bearing Capacity: Definition; factors affecting Bearing Capacity; Modes of failure; Determination of bearing capacity of shallow foundation; Terzaghi's bearing capacity theory; Effect of depth of embedment, water table, footing shape, and eccentric load on bearing capacity; Bearing capacity as per IS:6403; Bearing Capacity from SPT, CPT, and PLT. Settlement: Settlement analysis for shallow foundation based on allowable bearing pressure as per IS:8009; Immediate and Consolidation Settlement; Depth Factor and Rigidity factor; Settlement as per IS:1904	9L
5.	Deep Foundation: Classification; Selection of deep foundation over shallow foundation; Pile Foundation: Types of piles, Method of pile installation; Load transfer mechanism in pile; Determination of load carrying capacity of piles by static and dynamic method as per IS code; Group action of pile: Pile spacing, group efficiency; Negative skin friction; Well Foundation; Pier Foundation.	9L
6.	Stability of Slope and Ground Improvement: Types of slope failures; Analysis of finite and infinite slope failure; Swedish and Friction Circle Method; Ordinary Method of Slices; Factor of Safety; Taylor Stability Number; Bishop's simplified method of stability analysis. Ground Improvement: Consolidation by pre-loading and sand drains; stone columns, Compaction by vibro-floatation, Grouting; Application of geosynthetics, ground anchors, and soil nailing.	6L

5. References:

Text Book:

- Basic and Applied Soil Mechanics, Gopal Ranjan and A.S.R. Rao, New Age International Pvt. Ltd. Publishers.
- Principles of Geotechnical Engineering, B.M. Das, Thomson Brooks/Cole.
- Geotechnical Engineering, Shashi K Gulhati, Manoj Datta, The McGraw-Hill Company.

Reference Books:

- Textbook of Soil Mechanics and Foundation Engineering, V.N.S. Murthy, CBS Publication.
- Soil Mechanics and Foundations, B.C. Punmia and A.K. Jain, Laxmi Publication Pvt. Ltd.

6. Course Outcomes:

After completion of this course, students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Determine lateral earth pressure from different earth pressure theories.	Determine	Apply
CO2	Check the stability of earth retaining structures.	Determine	Apply
CO3	Investigate subsoil conditions using various soil investigation and exploration methods.	Investigate	Analyse
CO4	Estimate the bearing capacity and settlement of a shallow foundation.	Estimate	Evaluate
CO5	Estimate the load-carrying capacity of single piles and pile groups.	Estimate	Evaluate
CO6	Predict the possibility of failure of the slope to apply ground improvement techniques.	Predict	Apply

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	-	-	-	-	-	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-
CO6	3	3	3	3	-	2	-	-	-	-	1

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	2	1
CO3	3	-	3
CO4	3	-	-
CO5	2	1	2
CO6	3	2	1

Course Name: STRUCTURAL GEOLOGY

Course Code: CE-505

(Semester V)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 1

1. Course Prerequisite:

Basic understanding of mathematics, engineering geology, undergraduate-level knowledge of solid mechanics, surveying and geomatics.

2. Course Learning Objectives:

- To explain the fundamental concepts of structural geology, including primary and secondary structures and their significance in Earth's crust deformation.
- To analyze stress and strain in rocks using mathematical and graphical methods such as Mohr's Circle and Cartesian tensors.
- To classify different types of folds, faults, and fractures, and interpret their formation mechanisms and geological significance.
- To apply structural analysis techniques to real-world geological problems, including seismic data interpretation and geological mapping.
- To evaluate the role of structural geology in applied fields, including geotechnical engineering, resource exploration, and natural hazard assessment.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam.

4. Course Content:

Course Name: Structural Geology

Course Code: CE-505

Hours per Week: 2L:1T:0P

Credits: 3

Module	Topics	42L	100%
1.	Introduction to Structural Geology: Scope and Importance, Classification, Primary and Secondary structure, Symmetry and scale of structure, classification and origin of earth structures, Planar and Linear Structures, Diastrophic and Non-Diastrophic Structures, Continental crust deformation, Unconformity: Types, Recognition, and Basement-Cover Relations.	6L	14
2.	Stress and Strain in Rocks: Rock Deformation and Stress-Strain Relationships, Cartesian tensor, Types of Stress: Normal, Shear, and Principal Axes of Stress, Stress Ellipse, Mohr Circle for Stress Analysis, Concept of Strain, Strain Ellipse, Homogeneous and Inhomogeneous Strain, Rotational and Irrotational Strain Strain Ellipsoids. Problems (Mohr Circle for Stress Analysis, Stress and Strain Calculations in Structural Geology, Brittle and Ductile Deformation: Factors Controlling Rock Behavior).	4L+ 4T	19
3.	Folds and Folding Mechanisms: Fold Morphology, Parts of fold, Classification of folds, Cause and mechanism of folding, Fold Geometry, Construction of Fold Profiles, Foliation and Lineation with Folding, Interfering Folds and Their Geological Significance, Fold Analysis in Hand Specimens, Case Studies on Folds and Their Implications.	4L+ 3T	17
4.	Fractures, Faults, and Shear Zones: Classification and Characteristics of Fractures, Fault terminology, Classification of faults, Effects of faulting, Causes of faulting, Recognition of faulting, Fault Rock Microstructures and Effects of Faulting on Outcrops, Joints and jointing, Shear Zones: Concept, Classification, Shear Sense Indicators, Time Relation between Crystallization and Deformation.	5L+ 3T	19
5.	Advanced Structural Analysis & Tectonics: Stress and Strain in 2D & 3D: Incremental Strain Analysis, Kinematics and Polyphase Deformation in Rocks Structural Styles in Different Tectonic Settings: Thrust & Fold Belts, Rifts, Strike-Slip Zones, Tectonic earthquake, seismographs, travel-time records, Gravity Tectonics and Inversion Tectonics, Structural Interpretation of Seismic Data.	5L+ 2T	17
6.	Applied Structural Geology: Mass movements, Geological and geophysical investigations, seismic methods, gravitational methods, magnetic methods, acoustic methods.	4L+ 2T	14

7. References:

Text Book:

- Structural Geology: Fundamentals and Modern Developments, Ghosh, S.K., Elsevier; First edition, 2013.
- Structural Geology, Marland P. Billings, Pearson, 2016.
- Engineering and General Geology, Singh, P. Katson Books, 2016.

Reference Books:

- Structural Geology, Haakon Fossen, Cambridge Univ Press, 2016.
- Structural Geology: an introduction to geometrical techniques, D. M. Ragan, (4th. Ed.) Cambridge University Press, 2009.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe the classification, formation, and evolution of geological structures, including folds, faults, and unconformities.	Describe	Understand
CO2	Explain the principles of stress, strain, and rock deformation, and their role in structural geology.	Explain	Understand
CO3	Demonstrate geological maps and cross-sections to interpret structural features and tectonic settings.	Demonstrate	Apply
CO4	Differentiate between brittle and ductile deformation, and assess their implications for crustal deformation processes.	Differentiate	Analyze
CO5	Appraise structural styles in different tectonic settings and their significance in seismic activity, resource exploration, and engineering geology.	Appraise	Evaluate
CO6	Design geological models using structural geology principles for practical applications in geophysics, geotechnical engineering, and seismic hazard assessment.	Design	Create

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	2	-	-	-
2	-	3	2	-	-	-
3	-	-	3	-	-	-
4	-	-	2	3	-	-
5	-	-	-	3	2	-
6	-	-	-	-	3	2

10. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	1	2	-	-	-	2
CO2	3	3	2	2	-	1	1	-	-	-	2
CO3	3	3	3	2	2	1	2	-	1	-	2
CO4	2	2	2	2	-	1	1	1	-	-	2
CO5	2	3	3	2	2	1	2	2	-	-	3
CO6	2	3	3	3	2	1	2	2	2	2	3

11. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2

CO3	3	3	3
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Course Name: ROCK MECHANICS
Course Code: CE-506
(Semester V)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE

1. Course Prerequisite:

The prerequisites of rock mechanics include foundational knowledge in geology, soil mechanics and strength of materials, engineering mathematics, structural analysis, physics, and geotechnical engineering. These areas provide essential concepts like stress, strain, elasticity, and rock formation processes.

2. Course Learning Objectives:

- i. To understand of the mechanical behavior of rock materials, rock discontinuities and rock masses.
- ii. To be able to analyze and to determine mechanical and engineering properties of rocks for engineering applications.
- iii. To provide basic knowledge of stress concentration fields, rock strength, its associated problems
- iv. Identify the type of the rock. Analyze the rock quality designation and also evaluate its strength, to evaluate the role of structural geology in applied fields.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/ assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/ assignment)

Final exam: 60 marks

100 Marks

4. Course Content:

Course Name: Rock Mechanics

Course Code: CE(PE)501C

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	100%
1.	Introduction to Rock Mechanics: Definition, Application of Rock Mechanics Composition of rocks, Engineering classification and Limitation.	6L	14
2.	Physico-mechanical Properties of Rock: physical and mechanical properties of rock material, tensile, compression and shear tests rock mass classification, rock quality designation (RQD), rock structure rating (RSR), rock mass rating (RMR), Norwegian geotechnical classification (Qsystem) geological structures, joints, folds, faults, thrust	8L	19
3.	Strength criteria for Rocks and Field Testing: Mode of failure of rock, strength, modulus and stress-strain response of rocks.	7L	17

Module	Topics	42L	100%
4.	Failure Criteria for Rock and Rock mass: Mechanics of rock failure, Coulomb, Mohr and Griffith criteria, Empirical criteria.	8L	19
5.	Ground Water: Influence of water on rock and soil behavior, Permeability of rocks, Measurement of permeability, Ground water flow in rock mass, Measurement of water pressure.	7L	17
6.	Tunneling Slopes and Foundations on Rocks: Bearing capacity of rock masses, opening in rocks, lined and unlined tunnels, pressure tunnels and tunnels for other purposes.	6L	14

7. References:

Text Book:

- Rock Mechanics, B. P. Verma
- The elements of Mechanics of Mining Ground (Vol I & II), Dr. B. S. Verma.

Reference Books:

- A text book of Geology by P. K. Mukerjee
- Hudson, J.A., Harrison, J.P. Engineering Rock Mechanics: An Introduction to the Principles, 2005.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE-506.1	Describe rock mechanics concepts and their engineering applications.	Describe	Understand
CE-506.2	Classify rock masses using RQD, RSR, RMR, and Q-systems, and assess geological structures.	Classify	Understand
CE-506.3	Demonstrate failure criteria to evaluate rock strength and stability.	Demonstrate	Apply
CE-506.4	Define tests to determine tensile, compressive, and shear strength of rocks.	Define	Remember
CE-506.5	Appraise groundwater effects on rock behavior and interpret permeability data.	Appraise	Evaluate
CE-506.6	Design tunnels, slopes, and foundations considering rock stability and bearing capacity.	Design	Create

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	2	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	3	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CE-506.1	3	2	-	-	2	1	-	-	-	-	2
CE-506.2	3	3	-	2	2	1	-	-	-	-	2

CE-506.3	3	3	2	2	2	2	-	-	-	-	2
CE-506.4	3	2	-	3	3	-	-	-	-	-	2
CE-506.5	2	3	-	2	2	2	2	-	-	-	2
CE-506.6	3	3	3	3	3	2	2	-	-	-	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CE-506.1	3	2	2
CE-506.2	3	2	2
CE-506.3	3	3	3
CE-506.4	3	3	2
CE-506.5	3	2	3
CE-506.6	3	3	2

Course Name: DESIGN OF HYDRAULIC STRUCTURES AND IRRIGATION ENGINEERING

Course Code: CE-514

(Semester V)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE (PE)

- Course Prerequisite:
Fluid Mechanics and Hydraulic Engineering.
- Course Learning Objectives:
 - Students will understand the fundamentals of irrigation, including its necessity, methods, and water requirements of crops.
 - They will analyze and design hydraulic structures such as canals, dams, spillways, and drainage systems.
- Teaching methodology and evaluation system for the course:
Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
Evaluation System –
CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
Final exam: 60 marks
- Course Content:
Course Name: Design of Hydraulic Structures and Irrigation Engineering
Course Code: CE-514
Hours per Week: 3L:0T:0P
Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Introduction to Irrigation: Definition, Necessity, Scope, Benefits of Irrigation; Types, techniques and sources of irrigation; Systems of irrigation: Surface and ground water, flow irrigation, Lift irrigation; Development of irrigation in India; Climate & Soil Factors Affecting Irrigation Efficiency.	4L	10

2.	Irrigation and Water Requirements of Crops: Crops and crop seasons in India; Water requirement of crops, Definition of duty, Delta and Base period, Relationship between Duty, Delta and Base period, kor period, Factors affecting duty of water; Net Irrigation Requirement, Field Irrigation Requirement, Gross Irrigation Requirement, Intensity of irrigation, estimation of evapotranspiration, Blaney-Criddle method, Modified Penman's method, Irrigation efficiencies, Frequency of irrigation.	6L	14
3.	Canal Irrigation: Definition, Types of canals, Alignment of canals, Alluvial and Non-alluvial canals; Design of unlined canals: Kennedy's method, Lacey's method; Lined canals: advantages, materials used, Standard lined canal sections as per BIS codes, economics of canal lining.	6L	14
4.	Land Drainage: Water logging issues in irrigation, provision of drains, design and maintenance of open drains, closed drains; Subsurface Drainage Systems; Discharge and spacing of closed drains.	4L	10
5.	Diversion Works: Definition; Layout and different components; Types of weirs and Barrages; Design of Impermeable floors – Bligh's and Lane's theories – Simple design problems. Khosla's theory – Method of independent variables, Exit gradient.	6L	14
6.	Gravity Dams: Definition; Forces acting on a Gravity dam; Modes of failures; Elementary and practical profile; Low and high gravity dams; Arch Dams (Brief Introduction); Simple analysis problems, Principal stresses; Drainage galleries.	6L	14
7.	Earthen Dams: Introduction; Types of earthen dams; Failure of earthen dams; Preliminary design; Drainage arrangements; Phreatic line; Stability analysis under sudden draw down using Swedish slip circle method; Seepage Control - cut-offs, slurry trench, sheet piling, grouting, slope protection.	6L	14
8.	Spillways: Definition; Types of Spillways; Design Principles for an Ogee Spillway; Energy dissipaters: Types and introduction to IS Standards for Stilling Basins; Energy dissipation methods.	4L	10

9. References:

Text Book:

- Irrigation Engineering and Hydraulic Structures, Santosh Kumar Garg, Khanna Publishers.
- Irrigation Engineering and Hydraulic Structures, S. K. Sharma, S Chand Publishing.
- Irrigation, Water Resources and Water Power Engineering, P. N. Modi, Standard Book House.

Reference Books:

- Irrigation and Water Power Engineering, B. C. Punmia, A. K. Jain and P. B. Lal, Laxmi Publications (P) Ltd.
- Hydraulic Structures, Novak, A. I. B. Moffat, C. Nalluri and R. Narayan P, E & FN Spon, UK, 2010.

10. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe the fundamentals of irrigation, including its necessity, types, sources, systems, and the impact of climate and soil on irrigation efficiency.	Describe	Understand
CO2	Explain the water requirements of crops by discussing duty, delta, base period, evapotranspiration methods, and irrigation efficiencies.	Explain	Understand
CO3	Design canals considering alignment principles, classification, and hydraulic design using Kennedy's and Lacey's methods along with BIS standards for lined canals.	Design	Create
CO4	Differentiate between open and closed drainage systems and examine their role in preventing waterlogging in irrigated areas.	Differentiate , Examine	Analyse
CO5	Judge diversion structures such as weirs and barrages based on Bligh's, Lane's, and Khosla's theories.	Judge	Evaluate
CO6	Appraise the stability of gravity dams, earthen dams, and spillways based on forces, failure modes, and energy dissipation methods.	Appraise	Evaluate

11. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3
7	-	-	-	-	-	3
8	-	-	-	-	-	3

12. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	3	-	-	1	-	1
CO2	3	3	1	-	-	3	-	-	1	-	1
CO3	3	3	3	2	2	3	-	-	1	2	2
CO4	3	3	2	2	1	3	-	-	1	1	2
CO5	3	3	2	2	1	3	-	-	1	1	2
CO6	3	3	3	3	2	3	-	-	1	1	2

13. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	2	1
CO3	3	3	3
CO4	3	2	2
CO5	3	3	2
CO6	3	3	3

Course Name: RAILWAY AND AIRPORT ENGINEERING

Course Code: CE-515

(Semester V)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 2

1. Course Prerequisite:

Basic understanding of Class-XII level knowledge of Physics, Mathematics, undergraduate-level knowledge of Strength of Materials, Transportation Engineering, Surveying and Geomatics.

2. Course Learning Objectives:

- To understand railway engineering fundamentals, including the classification of Indian Railways, track gauge, permanent way components, and maintenance practices for railways and high-speed trains.
- To analyze railway track alignment and geometric design, covering alignment selection, engineering surveys, stress distribution, gradients, curves, and superelevation.
- To examine railway infrastructure, signaling, drainage, and track maintenance.
- To develop knowledge in airport engineering and air traffic management, focusing on airport layout, runway and taxiway design, air traffic control, demand forecasting, and terminal operations.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam.

4. Course Content:

Course Name: Railway and Airport Engineering

Course Code: CE-515

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	100%
1.	Introduction to Railway Engineering: Zonal classification of Indian Railways; Railway track gauge; Classification of Indian Railways based on Speed Criteria; Permanent Way (P-way): Components– Rails, Rail joints, Sleepers, Ballast, Fastenings, Subgrade; maintenance of railways and high-speed trains.	4L	10

2.	Railway Track Alignment and Engineering Survey: Alignment of railway lines; Factors in selection of good alignment; engineering surveys and construction of new lines; Track Stresses: Wheel loads, Dynamic effect of wheel loads, Stresses due to track irregularities, Additional stresses on curves: Stresses in Sleepers; Stresses in Ballast: Pressure in the subgrade: Stress formulae, creep of rails.	8L	19
3.	Railway Geometric Design: Gradient, Speed, Degree of Curve, Superelevation, Transition curve, Widening of gauge on curves, Shift	6L	14
4.	Railway Points and Crossings, Station and Yards; signaling and interlocking, Track junctions and simple track layouts, track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track.	8L	19
5.	Airport Engineering: Airport Site Selection; Airport layout; Functions and planning of the Airfield components—runway, taxiway and Aprons, hanger, terminal building and control tower; Design of Runway and Taxiway; Runway orientation: Wind rose diagrams.	10L	24
6.	Air Traffic Management: Air traffic control and surveillance facilities; Air travel demand forecasting, Airfield lighting; Function of Airport Passenger and Cargo Terminal.	6L	14

7. References:

Text Book:

- A Textbook of Railway Engineering, Saxena S. P. & Arora S. P; Dhanpat Rai & Sons, 2013.
- Railway Engineering, M.M Agarwal, Satish Chandra, Oxford University Press India, 2013.
- Airport Planning & Design, Khanna S. K, Arora M. G & Jain S. S.; Nemchand Brothers, 2016.

Reference Books:

- Railway Transportation: Engineering, Operation and Management, S. Ponnuswamy, Narosa Press, 2016.
- Airport Engineering: Planning, Design, and Development of 21st-Century Airports, Ashford, John Wiley, 2016.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Classify different railway track components and their functions to ensure efficient and safe railway operations.	Classify	Understand
CO2	Interpret track alignment and geometric design parameters to optimize railway performance, minimize stresses, and enhance passenger comfort.	Interpret	Apply
CO3	Use principles of track maintenance and signaling systems to improve railway safety, operational efficiency, and infrastructure sustainability.	Use	Apply
CO4	Design and plan airport facilities, including runways and taxiways, considering site selection, wind patterns, and airfield layout.	Design	Create
CO5	Appraise air traffic management systems and forecasting techniques to optimize air travel operations and improve airport efficiency.	Appraise	Evaluate

CO6	Assemble modern technologies in railway and airport infrastructure to enhance transportation efficiency, sustainability, and safety.	Assembles	Create
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9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	2	-	-	-
2	2	3	2	-	-	-
3	2	3	-	-	-	-
4	2	2	3	-	-	2
5	-	-	-	3	2	2
6	-	-	-	2	3	2

10. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	2	-	2	-	-	-	2
CO2	3	3	2	2	2	-	1	-	-	-	2
CO3	3	2	3	2	3	1	2	-	1	1	2
CO4	3	3	3	2	3	2	3	-	2	1	2
CO5	3	3	2	2	3	1	2	-	-	1	3
CO6	3	3	3	2	3	2	2	2	2	2	3

11. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	3

Course Name: Environmental Laws, Policies and Impact Assessment

Course Code: CE-516

(Semester V)

Category: Major

Course Broad Category: CORE ENGG (Program Elective Course-2 PE)

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1. Course Prerequisite(s):

Students are expected to know the fundamentals of Physics, Mathematics, and Chemistry.

2. Course Learning Objectives:

The objectives of the course are to enable the student

- To explain the role of law, policy, and institutions in the conservation and management of natural resources, as well as in pollution control.
- To understand and analyze environmental laws and policies at both national and international levels.

- To develop skills for interpreting laws, policies, and judicial decisions related to the environment.
- To define and classify environmental impacts along with relevant terminology.
- To understand the Environmental Impact Assessment (EIA) procedure.
- To explain the methodology of Environmental Impact Assessment (EIA).

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Environmental Laws, Policies and Impact Assessment

Course Code: CE-516

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Basic Concepts in Environmental Law. An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Stockholm conference; Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislation and basic concepts.	6	14
2.	Forest, Wildlife and Biodiversity related laws Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino etc.	5	12
3.	Prevention and Control of Water & Air Pollution: Water Act, 1974 and Air Act, 1981 –Pollution Control Board and its powers and functions- offences and penalties -Remedies in case of water and air pollution, Noise Pollution and its control: Noise Pollution (Regulation & Control) Rules, 2000, Wildlife Protection Act, 1972: Hunting – Trade in Animal articles – Authorities under Wild Life Protection Act- Role of Judiciary on wild life protection, Forest Conservation Act, 1980 – Judicial Approach.	8	19
4.	International Law and Environmental Protection: Sustainable Development–International conventions in the development of Environmental Laws and its Policy - From Stockholm to Johannesburg Declaration (Rio) -Trans-boundary Pollution Hazards & Regulation; Common Law aspects of Environmental Protection – Criminal Law and environment.	8	19
5.	Basic of EIA: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle		

	and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.	10	24
6.	EIA Methodologies and Impact Identification Public consultation, Post monitoring, Data collection for Air Quality Impact analysis, Environmental health impact assessment, Environmental risk analysis, Economic valuation methods, Cost-benefit analysis.	5	12

5. References:

Text Books:

1. Divan S. and Rosencranz A. (2005) Environmental Law and Policy in India, 2nd ed., Oxford, New Delhi.
2. Leelakrishnan P. (2008) Environmental Law in India, 3rd ed., Lexis Nexis, India.
3. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002.
4. Anjaneyulu. Y and Manickam.V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.

Reference Books :

1. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
2. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.
3. Sanjay Upadhyay and VidehUpadhyay - Handbook on Environmental Laws..

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify new law and apply existing law in the rapidly evolving legal context for environmental law.	Identify	Understand
CO2	Discuss in depth knowledge of the specialist area of environmental law and associated disciplinary areas	Discuss	Understand
CO3	Examine the different causes of pollution and legal remedies to control it on national level.	Examine	Analyse
CO4	Compare laws relating to environmental aspect on a national level and its comparison with other countries.	Compare	Analyse
CO5	Explain the concepts about the Environmental Impact Assessment (EIA).	Explain	Understand
CO6	Appraise the subjects which must be considered in EIA projects.	Appraise	Evaluate

7. Mapping of Course Outcomes (CO) to Module:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	-	-	-	-
2	-	3	-	3	-	-
3	1	3	3	-	-	-
4	-	-	-	3	3	-

5	-	-	-	-	3	3
6	-	-	-	-	1	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO) :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	0	1	0	3	3	0	0	0	1
CO2	3	3	0	1	0	3	3	0	0	0	1
CO3	3	3	3	1	0	3	3	0	0	0	1
CO4	3	3	3	1	0	3	3	0	0	0	1
CO5	3	3	3	3	3	3	0	0	0	0	3
CO6	3	3	3	3	3	3	0	0	0	0	3
Average	3	3	2	3.33	1	3	2	0	0	0	3.33

9. Mapping of the Course Outcomes (CO) to Program Specific Outcomes (PSO) :

CO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	2
CO6	3	3	3

Course Name: R.C Design Sessional

Course Code: CE-581

(Semester 5th)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Students should have knowledge about RCC design of various structural components and building structures.

2. Course Learning Objectives:

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

1. Design various structural components of RCC.
2. understand the structural members, loading conditions, and their behavior under various scenarios.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –: Lab-based experiments demonstrations, discussions on testing procedures, hands-on practice with testing equipment, and real-life case studies.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

PCIA : 60 Marks (Includes practical performance, reports, and viva voce after each experiment.)

PESE : 40 Marks (Final comprehensive practical examination covering the entire syllabus.)

4. Course Content:

Course Name: R.C Design Sessional

Course Code: CE-581

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	14P	Coverage (100%)
Module 1.	General Considerations: - General overview on different methods of design, such as Working Stress Method, Limit State Method etc. - Design principles of R.C.C. sections using the Limit State method. - Loads and stresses as per IS code provisions. - Discussion on different types of loads (e.g., wind load, dead load, live load) as per IS 875.	2P	14%
Module 2.	Design and Detailing of Rectangular and T-Beams: - Simply supported Beam - Cantilever Beam - Continuous Beam - Typical detailing with the help of software preferably in CAD.	3P	21%
Module 3.	Design and Detailing of Rectangular & Circular Columns and Footings: - Columns: Short and slender columns, axially and eccentrically loaded. - Footings: Isolated and combined footing design. - Typical detailing with the help of software preferably in CAD.	3P	21%
Module 4.	Design and Detailing of Slabs: - Simply supported one-way slab - Two-way slab. - Typical detailing with the help of software preferably in CAD.	2P	14%
Module 5.	Design and Detailing of Staircase	1P	7%
Module 6.	Design of Multi-Storied RCC Framed Buildings: Layout planning and structural design of a small RCC framed building using STAAD PRO	2P	14%

6. References/Text Books:

1. R.C.C Design: Punmia, Jain, Jain
2. Design of Steel Structures - S.K. Duggal, Tata McGraw Hill
3. Reinforced Cement Concrete Design - Nilam Sharma

7. Course Outcomes: After going through this course, the students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)591.1	Implement Limit State Method principles for RCC design as per IS codes.	Implement	Apply
CE(PC)591.2	Design and detail rectangular and T-beams using CAD software.	Design	Create
CE(PC)591.3	Contrast and design short/slender columns and footings, using CAD for detailing.	Contrast	Analyze
CE(PC)591.4	Design and detail one-way and two-way slabs using CAD software.	Design	Create

CE(PC)591.5	Develop and detail staircase designs ensuring structural safety.	Develop	Create
CE(PC)591.6	Integrate RCC design concepts to analyze multi-storied buildings using STAAD PRO.	Integrate	Create

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	-	-	-	-	-
Module 2	-	3	-	-	-	-
Module 3	-	-	3	-	-	-
Module 4	-	-	-	3	-	-
Module 5	-	-	-	-	3	-
Module 6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	2	-	2	-	-	-	2
CO2	3	2	3	-	3	-	2	-	-	2	2
CO3	3	3	3	2	3	-	2	-	-	2	2
CO4	3	2	3	-	3	-	2	-	-	2	2
CO5	2	-	3	-	2	-	-	-	-	2	-
CO6	3	2	3	2	3	2	2	-	-	3	3

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	2	2	2
CO6	3	3	3

Course Name: Engineering Economics, Estimation & Costing Sessional

Course Code: CE-582

(Semester 5th)

Category: Major

Course Broad Category: CORE ENGG (PC)

1. Course Prerequisite:

Undergraduate level knowledge of drawing & detailing and 10+2 level knowledge of basic calculations.

Course Learning Objectives:

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

- Understand the quantity estimation and prepare bill of quantity of different structures & projects.
- Prepare the cost estimation, understand the scheduled of rates, tendering process and arbitration.
- Predict the probable overall cost before commencement of a project.

2. Teaching methodology and evaluation system for the course:

Teaching methodology -

Discussions on the different procedures of estimation, hands-on practice with pen & paper as well as in software (spreadsheet etc.) and real-life case studies.

Evaluation System -

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks

Section 2: Practical End Semester Examination (PESE) - 40 Marks

3. Course Content:

Course Name: Engineering Economics, Estimation & Costing Sessional

Course Code: CE-582

Hours per Week: 0L:1T:2P

Credits: 2

Modules	Topics	28P
Module 1	Quantity Surveying: Types of estimates, approximate estimates, items of work, unit of measurement, unit rate of payment	2P
Module 2	Quantity estimate of a single storied building	4P
Module 3	Bar bending schedule	4P
Module 4	Details of measurement and calculation of quantities with cost, bill of quantities, abstract of quantities	4P
Module 5	Estimate of quantities of road, Underground reservoir, Surface drain, Septic tank	4P
Module 6	Estimate of Analysis and schedule of rates: Earthwork, brick flat soling, DPC, PCC and RCC, brick work, plastering, flooring and finishing, tank	4P
Module 7	Specification of materials: Brick, cement, fine and coarse aggregates	2P
Module 8	Specification of works: Plain cement concrete, reinforced cement concrete, first class brickwork, cement plastering, pointing, white washing, colour washing, distempering, lime punning, painting and varnishing	2P
Module 9	Valuation: Values and cost, gross income, outgoing, net income, scrap value, salvage value, market value, Book Value, sinking fund, capitalized value, Y. P., depreciation, obsolescence, deferred income, freehold and leasehold property, mortgage, rent fixation, valuation table.	2P

5. Text/References Books:

- Estimation by M. Chakraborty.
- Quantity Survey, Estimation and Valuation by B. N. Dutta

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain about Quantity Surveying, different types of estimates, items of work and their units.	Explain	Understand
CO2	Analyze the schedule of rates	Analyze	Analysis
CO3	Prepare the specification of materials & works.	Prepare	Application
CO4	Prepare bar bending schedule for RCC structure	Prepare	Application
CO5	Interpret the fundamental concept of valuation	Interpret	Evaluation
CO6	Estimate the detailed quantity of material consumption and abstracts for constructions for single storied building, road, Underground reservoir, Surface drain, Septic tank	Estimate	Evaluation

7. Mapping of course outcomes to module / course content

Modules	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	3	2	2	3	3
Module 2	3	2	3	3	3	2
Module 3	3	2	3	2	3	2
Module 4	3	3	2	2	2	2
Module 5	3	2	3	2	2	3
Module 6	3	3	2	2	3	3
Module 7	3	2	2	2	2	2
Module 8	3	2	3	3	2	3
Module 9	3	3	3	3	2	2

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3							2			1
CO2			2				3				2
CO3		3		1		1					
CO4						2					2
CO5	3				2	2	2				1
CO6	3	1		2	2		2				

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	1	1	-
CO2	1	1	-

CO3	1	1	1
CO4	1	1	1
CO5	1	1	1
CO6	1	1	1

Course Name: Applications of Artificial Intelligence in Civil Engineering

Course Code: CE-583

(Semester V)

Category: Minor

Course Broad Category: Multidisciplinary Open Electives Course

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics; Undergraduate level knowledge of Data Science in Civil Engineering, Problem Solving Using Python and MATLAB, and Basic understanding of Civil Engineering subjects.

2. Course Learning Objectives:

- To introduce AI applications in civil engineering, covering structural, geotechnical, environmental, and transportation domains.
- To apply data preprocessing techniques, including cleaning, normalization, and feature extraction, for civil engineering datasets.
- To implement machine learning models such as regression, decision trees, random forests, SVMs, and clustering for predictive analysis.
- To develop AI-based optimization techniques for infrastructure management and traffic analysis, including genetic algorithms and deep learning.
- To analyze real-world AI case studies, ethical considerations, and regulatory challenges in civil engineering applications.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Applications of Artificial Intelligence in Civil Engineering

Course Code: CE-583

Hours per Week: 0L:0T:2P

Credits: 2

Module	Topics	14P	100%
1.	Overview of AI applications in civil engineering domains (structural, geotechnical, traffic, construction). Installation and setup of AI development tools (Python, TensorFlow, Scikit-learn, MATLAB).	1P	7

2.	Hands-on experience with civil engineering datasets (structural, geotechnical, environmental, traffic). Data cleaning, normalization, and feature extraction using Python (Pandas, NumPy).	2P	14
3.	Introduction to probabilistic reasoning for decision-making in civil engineering. Implementing Bayesian networks and Monte Carlo simulations for risk assessment.	2P	7
4.	Model evaluation and implementing linear regression and decision trees for predicting structural performance and material strength.	1P	7
5.	Training random forests and support vector machines (SVM) for soil classification and pavement condition assessment.	1P	7
6.	K-means clustering for traffic pattern analysis.	1P	7
7.	Implementing Artificial Neural Networks (ANNs) for crack detection in structures. Image processing using Convolutional Neural Networks (CNNs) for detecting concrete defects.	2P	14
8.	Implementing genetic algorithms (GA) for optimizing transportation networks and construction scheduling. Computer vision for real-time vehicle detection and traffic flow analysis.	2P	14
9.	AI-based flood forecasting and disaster response planning using historical climate data.	1P	7
10.	Analyzing real-world case studies: AI in bridge construction, water treatment optimization, and smart infrastructure. Discussion on future AI trends, ethical considerations, and regulatory aspects in civil engineering.	1P	7

11. References:

Text Book:

- Artificial Intelligence in civil engineering, Abhilasha Deshmukh Rashmi G, Sangita P, Deepa P, RLK Enterprises.
- Neural Networks, Fuzzy logic, and Genetic Algorithms Synthesis and Applications, S. Rajasekaran, G.A. Vijayalakshmi Pai, PHI Learning Pvt. Ltd, Delhi.

12. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Use AI applications in civil engineering and set up AI development tools.	Use	Apply
CO2	Relate civil engineering datasets for data-driven decision-making.	Relate	Analyse
CO3	Implement machine learning techniques for classification, prediction, and clustering in civil engineering.	Implement	Apply
CO4	Develop AI-driven models for structural health monitoring, traffic management, and construction optimization.	Develop	Create
CO5	Implement AI techniques for disaster management, environmental forecasting, and risk assessment.	Implement	Apply

CO6	Appraise case studies on AI applications in infrastructure, considering ethical and legal aspects.	Appraise	Evaluate
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13. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	2	2	-	-
3	-	2	2	2	3	-
4	-	2	3	2	-	-
5	-	2	3	2	-	-
6	-	-	3	2	2	-
7	-	-	2	3	-	-
8	-	-	2	3	-	-
9	-	-	2	2	3	2
10	-	-	-	-	2	3

14. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	2	-	-	-	-	-	2
CO2	3	3	2	2	3	-	1	-	-	-	2
CO3	3	3	3	2	3	-	1	-	-	-	2
CO4	3	3	3	3	3	2	2	-	2	2	2
CO5	3	2	2	3	2	2	2	-	2	2	2
CO6	3	2	2	2	2	2	1	2	-	2	2

15. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
CO6	3	3	3

Course Name: 3D PRINTING TECHNOLOGY IN CIVIL ENGINEERING

Course Code: CE-584

(Semester V)

Category: Value Added Courses

Course Broad Category: Multidisciplinary Non-Credit Course- 3 (MNC)

1. Course Prerequisite:

- Basic knowledge of Engineering Materials.

2. Course Learning Objectives:

- Understand the fundamentals of 3D printing and its applications in civil engineering.
- Learn about different 3D printing technologies and materials used in construction.
- Explore the design and structural aspects of 3D-printed buildings and components.
- Analyze the advantages, limitations, and sustainability aspects of 3D printing in construction.
- Gain practical insights into digital modeling and automated fabrication processes.
- Evaluate case studies and real-world applications of 3D printing in civil engineering.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam

4. Course Content:

Course Name: 3D Printing Technology in Civil Engineering

Course Code: CE-584

Hours per Week: 3L:0T:0P

Credits: 0

Module	Topics	Lecture (42L)
1.	Introduction to 3D Printing in Civil Engineering 1.1 History and evolution of 3D printing 1.2 Basics of additive manufacturing 1.3 Importance in the construction industry	5L
2.	3D Printing Technologies for Construction 2.1 Extrusion-based 3D printing. 2.2 Powder bed fusion. 2.3 Binder jetting and other emerging techniques.	6L
3.	Materials for 3D Printing in Civil Engineering 3.1 Cementitious materials and printable concrete 3.2 Alternative sustainable materials 3.3 Reinforcement techniques in 3D-printed structures	6L
4.	Design and Modeling for 3D Printing 4.1 CAD modeling for 3D printing 4.2 Software tools for design and simulation 4.3 Structural considerations in 3D printing	5L
5.	Automation and Robotics in 3D Printing 5.1 Role of robotics in automated construction 5.2 Integration of sensors and AI in 3D printing	5L
6.	Sustainability and Economic Aspects 6.1 Environmental impact and material efficiency 6.2 Cost analysis and feasibility of 3D-printed buildings	5L
7.	Challenges and Future Trends 7.1 Structural integrity and quality control issues 7.2 Regulatory and standardization challenges 7.3 Future prospects of 3D printing in infrastructure	5L
8.	Case Studies and Real-World Applications 8.1 Examples of 3D-printed buildings and bridges 8.2 Lessons from large-scale 3D printing projects	5L

5. References:

Text Book:

- I. Buswell, R. A., *3D Concrete Printing: Machine and Mix Design*, CRC Press.
- II. Lim, S., Le, T., & Webster, J., *3D Printing for Construction*, Springer.
- III. Khoshnevis, B., *Automated Construction: 3D Printing in the Built Environment*, Elsevier

Reference Books:

- I. Ma, G., Li, Z., & Wang, L., *3D Printing in Civil Engineering*, Taylor & Francis.
- II. Gibson, I., Rosen, D. W., & Stucker, B., *Additive Manufacturing Technologies*, Springer.
- III. Kruth, J. P., *Principles of 3D Printing and Digital Fabrication*, Wiley.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamentals of 3D printing and its importance in civil engineering.	Explain	Understand
CO2	Identify various 3D printing technologies and materials used in construction.	Identify	Understand
CO3	Develop CAD models and designs for 3D-printed structures.	Develop	Create
CO4	Judge the sustainability and cost-effectiveness of 3D printing in construction.	Judge	Evaluate
CO5	Examine case studies and real-world applications of 3D printing.	Examine	Analyze
CO6	Solve the challenges and future trends in automated construction.	Solve	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	2	1	-	-	-
Module 2	2	3	2	-	-	-
Module 3	-	2	2	2	-	-
Module 4	-	1	3	2	-	-
Module 5	-	-	2	2	-	1
Module 6	-	-	-	3	2	2
Module 7	2	-	-	2	2	3
Module 8	2	2	2	2	2	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	-	-	2	-	2	2	2
CO2	2	3	2	2	2	-	2	-	1	2	2
CO3	1	2	3	3	2	-	1	-	1	2	2
CO4	1	2	3	3	2	3	2	-	2	1	1
CO5	1	1	1	2	-	2	2	2	2	1	1
CO6	1	1	-	-	-	2	2	1	2	1	1

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	2	3	2
CO4	2	3	3
CO5	1	3	2
CO6	3	3	2

Course Name: Environmental Engineering Laboratory
Course Code: CE-591
(Semester V)
Category: Major
Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

- Basic Knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Engineering.
- Basic knowledge of Physics & Chemistry laboratory procedure.

2. Course Learning Objectives:

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

- i. To understand the principles and significance of environmental lab testing for water and wastewater.
- ii. To perform standard procedures for analyzing physical, chemical, and biological water quality parameters.
- iii. To evaluate the efficiency of water and wastewater treatment methods through experiments.
- iv. To apply environmental standards for assessing water, wastewater, and air pollution levels.
- v. To analyze experimental results and compare them with standard permissible limits.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –: Hands-on Laboratory session, Lab-based experiments demonstrations, discussions on testing procedures, hands-on practice with testing equipment, and Problem-solving sessions, Presentations, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks : 100 [60(PCIA) + 40(PESE)]

PCIA : 60 Marks (Includes practical performance, reports, and viva voce after each experiment).

PESE : 40 Marks (Final comprehensive practical examination covering the entire syllabus).

4. Course Content:

Course Name: Environmental Engineering Laboratory

Course Code: CE-591

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	14P	Coverage (%)
Experiment 1	Determination of pH and Turbidity for a given sample of water and wastewater.	1P	15
Experiment 2	Determination of Electrical Conductivity for a given sample of water and wastewater.	1P	05
Experiment 3	Determination of Total Solids, Suspended Solids, Dissolved Solids and Volatile solids in a given sample of water and wastewater.	1P	05
Experiment 4	Determination of carbonate, bi-carbonate and hydroxide Alkalinity for a given sample of water and wastewater.	1P	05
Experiment 5	Determination of Acidity for a given sample of water and wastewater.	1P	05
Experiment 6	Determination of Hardness for a given sample of water and wastewater.	1P	05

Experiment 7	Determination of concentration of Iron and Arsenic in a given sample of water and wastewater.	1P	15
Experiment 8	Determination of concentration of Chlorides in a given sample of water and wastewater.	1P	05
Experiment 9	Determination of the Optimum Alum Dose for a given sample of wastewater through Jar Test.	1P	05
Experiment 10	Determination of the Chlorine Demand and Break-Point Chlorination for a given sample of water and wastewater.	1P	15
Experiment 11	Determination of amount of Dissolved Oxygen (DO) in a given sample of water and wastewater.	1P	05
Experiment 12	Determination of the Biochemical Oxygen Demand (BOD) for a given sample of water and wastewater.	1P	05
Experiment 13	Determination of the Chemical Oxygen Demand (COD) for a given sample of wastewater.	1P	05
Experiment 14	Determination of Coliform Bacteria through MPN Test in given sample of water and wastewater.	1P	05

5. References/Text Books:

1. Environmental Engineering Water Supply Engineering, Santosh Kumar Garg, Khanna Publishers.
2. Environmental Engineering Laboratory Manual, Dr. S.K. Panigrahi, L. Mohanty, S.K. Kataria & Sons.
3. Lab Manual for Environmental Engineering (Volume 1), Baranitharan B, CreateSpace Independent Publishing Platform; 2nd edition (12 August 2016).

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Demonstrate the ability to execute standard laboratory procedures for analyzing physical, chemical, and biological characteristics of water and wastewater.	Demonstrate	Apply
CO2	Interpret key water quality parameters such as turbidity, pH, conductivity, solids, alkalinity, and acidity to assess their impact on water usability.	Interpret	Apply
CO3	Examine the presence of chemical constituents like iron, chlorides, and residual chlorine in water samples to evaluate their significance in water treatment.	Examine	Analyse
CO4	Execute laboratory techniques to implement and demonstrate water treatment processes, including coagulation, flocculation, and breakpoint chlorination, for effective purification.	Execute	Apply
CO5	Compare the organic pollution levels in wastewater by determining Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) to assess contamination levels.	Compare	Analyse

CO6	Investigate microbial contamination in water by conducting coliform detection tests and evaluate water safety using the Most Probable Number (MPN) method.	Investigate	Create
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7. Mapping of course outcomes to module / course content

Experiments	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1.	3	-	-	-	-	-
Experiment 2.	3	-	-	-	-	-
Experiment 3.	3	-	-	-	-	-
Experiment 4.	-	3	-	-	-	-
Experiment 5.	-	3	-	-	-	-
Experiment 6.	-	-	3	-	-	-
Experiment 7.	-	-	3	-	-	-
Experiment 8.	-	-	3	-	-	-
Experiment 9.	-	-	-	3	-	-
Experiment 10.	-	-	-	3	-	-
Experiment 11.	-	-	-	-	3	-
Experiment 12.	-	-	-	-	3	-
Experiment 13.	-	-	-	-	3	-
Experiment 14.	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	1	-	-	2	-	-	2	-	-
CO2	3	2	2	-	2	3	-	1	1	-	-
CO3	3	2	2	-	-	3	-	1	1	-	-
CO4	3	-	2	-	2	3	-	1	1	-	-
CO5	3	1	2	-	2	3	-	1	1	-	-
CO6	3	1	2	-	-	3	-	1	1	-	-
Average	3	1	1.83	-	1	2.83	-	0.83	1.17	-	-

9. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	1
CO3	3	2	1
CO4	3	2	2
CO5	3	2	1
CO6	3	2	1

Course Name: Advanced geotechnical and geology laboratory
Course Code: CE-592
(Semester V)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE- 1 (PE)

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1. Course Prerequisite:

Geotechnical Engineering CE(PC)493

2. Course Learning Objectives:

- i. Demonstrate knowledge of unconfined compressive strength and shear strength parameters of soil through various laboratory tests.
- ii. Analyze the shear strength properties of soil using direct shear, vane shear, and triaxial tests.
- iii. Determine the California Bearing Ratio (CBR) of soil and understand its significance in pavement design.
- iv. Understand the procedure and interpretation of the Standard Penetration Test (SPT) for subsurface soil investigation.
- v. Classify common minerals and rocks based on physical properties in hand specimens.
- vi. Analyze geological structures such as folds, faults, and inclined beds through models and maps.
- vii. Demonstrate skills in reading and interpreting geological maps showing different structural features.
- viii. Develop proficiency in identifying minerals and rock textures using petrographic microscopes.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam

4. Course Content:

Course Name: Advanced geotechnical and geology laboratory

Course Code: CE-592

Hours per Week: 2P

Credits: 1

Experiment 1	Determination of unconfined compressive strength of soil by unconfined compression test.
Experiment 2	Determination of shear strength parameters of soil by direct shear test.
Experiment 3	Determination of undrained shear strength of soil by vane shear test.
Experiment 4	Determination of shear strength parameters of soil by unconsolidated undrained triaxial test.
Experiment 5	Determination of California Bearing Ratio (CBR) of soil.
Experiment 6	Standard Penetration Test.
Experiment 7	Identification of minerals and rocks in hand specimen.
Experiment 8	Study of crystals and geologic structures with the help of models.
Experiment 9	Interpretation of geological maps: horizontal, vertical, uniclinal, folded and faulted structures.
Experiment 10	Microscopic study of rocks and minerals

6. References:

1. Soil Mechanics Laboratory Manual by Braja Mohan Das (Oxford university press).
2. SP: 36 (Part - I and Part - II)
3. Engineering geology laboratory manual by M T M Reddy.

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Investigate the shear strength parameters of soil by using UCS, Vane Shear, Direct Shear & Triaxial Test.	Investigate	Create
CO2	Investigate the California Bearing Ratio (CBR) standard penetration value of soil	Investigate	Create
CO3	Relate the observed physical properties of minerals and rocks to their classification and identify them using a standard reference.	Relate	Analyse
CO4	Examine the relationship between crystal structure and external form using models and diagrams, identifying unit cells and crystal systems. Also, Examine the models to visualize and interpret various geologic structures (folds, faults, unconformities), demonstrating an understanding of their formation processes.	Examine	Analyse
CO5	Relate the geological structures through drawing the cross sections from the geological maps.	Relate	Analyse
CO6	Examine thin sections of rocks and minerals under a microscope, identifying individual mineral constituents based on their optical properties.	Examine	Analyse

8. Mapping of course outcomes to module / course content

	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1	3	-	-	-	-	-
Experiment 2	3	-	-	-	-	-
Experiment 3	3	-	-	-	-	-
Experiment 4	3	-	-	-	-	-
Experiment 5	-	3	-	-	-	-
Experiment 6	-	3	-	-	-	-
Experiment 7	-	-	3	-	-	-
Experiment 8	-	-	-	3	-	-
Experiment 9	-	-	-	-	3	-
Experiment 10	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	1	-	3	2	-	1
CO2	3	3	1	3	-	1	-	3	2	-	1
CO3	3	3	1	3	2	1	-	3	2	-	1

CO4	3	3	1	3	-	1	-	3	2	-	1
CO5	3	3	1	3	2	1	-	3	2	-	1
CO6	3	3	2	3	2	1	-	3	2	-	1

10. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	1	-
CO3	3	1	-
CO4	3	1	-
CO5	3	1	-
CO6	3	1	-



Department of Civil Engineering
(Detailed Autonomous Syllabus)

Course Name: DESIGN OF STEEL STRUCTURES

Course Code: CE-601

(Semester VI)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Class-XII level knowledge of Mathematics and Geometry; Strength of Materials; Solid Mechanics; Structural Analysis; Design of RC Structure

2. Course Learning Objectives:

- Students will be able to learn the fundamental concepts, design philosophies (Limit State Design, Working Stress Design), and codal provisions related to the design of steel structures as per relevant standards.
- Students will be able to develop the ability to analyze and design structural elements such as beams, columns, tension members, connections, and frames, ensuring stability, strength, and serviceability under different loading conditions.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Design of Steel Structures

Course Code: CE-601

Hours per Week: 2L:1T:0P

Credits: 3

Module	Topics	28L+14T
1.	Materials and Specification: Rolled steel sections, mechanical properties of steel and their specifications for structural use. Codes of practices. Design of Steel structures using tubular, rectangular and square section.	2L+1T
2.	Structural connections: Riveted, welded and bolted including High strength friction grip bolted joints. – types of riveted & bolted joints, assumptions, failure of joints, efficiency of joints, design of bolted, riveted & welded joints for axial load. Eccentric connection: - Riveted & bolted joints subjected to torsion & shear, tension & shear, design of riveted, bolted & welded connection.	4L+2T

3.	Design of Tension members: Design of tension members, I.S code provisions. Permissible stresses, Design rules, Examples.	6L+3T
4.	Design of Compression members: Effective lengths about major & minor principal axes, I.S code provisions. Permissible stresses, Design rules, Design of one component, two components and built-up compression members under axial load. Examples. Built up columns under eccentric loading: Design of lacing and batten plates, Different types of Column Bases- Slab Base, Gusseted Base, Connection details.	6L+3T
5.	Design of Beams: Permissible stresses in bending, compression and tension. Design of rolled steel sections, plated beams. simple Beam end connections, beam -Column connections. I.S code provisions.	4L+2T
6.	Design of Girders: Design of Plate girders, Design of webs & flanges, Concepts of curtailment of flanges – Riveted & welded web stiffeners, web flange splices - Riveted, welded& bolted. Design gantry girder considering lateral buckling – I.S code provisions.	6L+3T

5. References:

IS Codes:

- IS 800 – 2007(Latest Revised code)
- IS 875 – I (1987), II (1987), -III (2015), -IV(1987), V (1987)
- S.P.: 6(1) – 1964 Structural Steel Sections

Reference Books:

- S.K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited, 2017. (ISBN: 9789351343493/9351343499).
- V.L. Shah and V. Gore, Limit State Design of Steel Structures IS:800-2007, Structures Publication, 2012. (ISBN: 8190371754).

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify the material properties of structural steel.	Identify	Remember
CO2	Describe different bolted and welded connections, analyze and design them for axial and eccentric loads.	Describe	Understand
CO3	Compare different steel sections subjected to axial tension following Indian codes of practices.	Compare	Analyze
CO4	Sketch rolled and built-up compression members along with base connection subjected to axial compression, bending and tension.	Sketch	Apply
CO5	Sketch Beams and various connections related to beam.	Sketch	Apply
CO6	Assess different components of girder system, calculate lateral and vertical loads acting on the system	Assess	Evaluate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	1	1	0	0	0	1	2
CO2	3	3	3	2	1	2	0	0	0	2	2
CO3	3	3	3	3	1	1	0	1	1	1	3
CO4	3	3	3	3	1	1	0	1	1	1	3
CO5	3	3	3	3	1	1	0	1	1	1	3
CO6	3	3	3	3	1	1	0	1	1	1	3

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Course Name: HYDROLOGY & WATER RESOURCES ENGINEERING

Course Code: CE-602

(Semester VI)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Fluid Mechanics and Hydraulic Engineering.

2. Course Learning Objectives:

- Students will understand precipitation, evapotranspiration, infiltration, runoff, and streamflow measurement in hydrology.
- They will apply hydrological methods for flood estimation, groundwater flow, and flood routing.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Hydrology & Water Resources Engineering

Course Code: CE-602

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Introduction Precipitation: Definition of hydrology; Importance of hydrology; Global water availability; India's water availability; Practical applications of hydrology; Hydrologic cycle; Concept of catchment; Water budget equation; Definition of precipitation; Forms and types of precipitation; Measurement of rain fall; Optimum number of rain gauge stations; Consistency of rainfall data; Computation of mean rainfall; Estimation of missing rainfall data; Presentation of precipitation data (moving average curve, mass curve, rainfall hyetographs, intensity – duration - frequency curves); Probability Analysis of Rainfall Data.	9L	21
2.	Losses from Precipitation: Introduction; Evaporation: Definition, Process, factors affecting, measurement using IS Class A Pan; Estimation using empirical formulae; Evapotranspiration (ET); Infiltration: Definition, factors affecting infiltration capacity, measurement (double ring infiltrometer). Horton's infiltration equation, infiltration indices.	7L	17
3.	Runoff Hydrographs: Runoff: Definition; Components. Factors affecting. Rainfall - runoff relationship using simple regression analysis; Hydrographs: Definition; Components of Hydrograph; Unit hydrograph and its derivation from simple storm hydrographs; Base flow separation. S - curve and its uses.	7L	17
4.	Stream Flow Measurement: Introduction; Measurement of stage; Measurement of discharge by Area-Velocity Method, Moving Boat Method, Dilution Technique, Electromagnetic Method, Ultrasonic Method; Indirect Methods: Flow Measuring Structures, Slope Area Method; Simple stage discharge relation.	6L	14
5.	Ground Water Hydrology and Well Hydraulics: Scope and importance of ground water hydrology; Aquifer Parameters: Specific Yield, Specific Retention, Storage Coefficient, Transmissivity; Steady radial flow into wells in unconfined and confined aquifers; Types of wells, Methods of construction.	6L	14
6.	Floods: Concept of flood as a natural hazard; Estimation of flood discharge in a river – rational method, empirical formulae, unit hydrograph method; flood frequency studies – return period; Flood Control Measures.	2L	5

7.	Flood Routing: Concept of flood routing in channels and through a reservoir, Hydrologic vs Hydraulic Routing: Differences, Applications, and Methods; Basic routing equations; reservoir routing – Modified Pul's method; channel routing – Muskingum method.	5L	12
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8. References:

Text Book:

- Engineering Hydrology, K. Subramanya, McGraw Hill Education (India) Private Limited.
- Hydrology for Engineers, Ray Linsley, Max Kohler, Joseph L. Paulhus, McGraw-Hill Education.
- Water-Resources Engineering, David Chin, Pearson.

Reference Books:

- Engineering Hydrology, R. Srivastava and A. Jain, McGraw Hill Education (India) Private Limited
- Ground Water, H.M. Raghunath, New Age International Pvt Ltd Publishers.

9. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe hydrology, precipitation, rainfall measurement, and probability analysis of rainfall data.	Describe	Understand
CO2	Explain losses from precipitation, including evaporation, evapotranspiration, and infiltration.	Explain	Understand
CO3	Differentiate runoff components, rainfall-runoff relationships, and hydrograph types.	Differentiate	Analyse
CO4	Use various streamflow measurement techniques, including velocity-area and indirect methods.	Use	Apply
CO5	Judge groundwater hydrology parameters, well hydraulics, and types of wells.	Judge	Evaluate
CO6	Appraise flood estimation, flood control, and flood routing methods.	Appraise	Evaluate

10. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3
7	-	-	-	-	-	3

11. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	2	-	-	1	-	1
CO2	3	3	1	-	-	3	-	-	1	-	1
CO3	3	3	2	2	1	3	-	-	1	1	2
CO4	3	3	3	2	2	3	-	-	1	2	2

CO5	3	3	2	2	1	3	-	-	1	1	2
CO6	3	3	3	3	2	3	-	-	1	1	2

12. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	2	1
CO3	3	2	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	3

Course Name: CONSTRUCTION ENGINEERING & MANAGEMENT

Course Code: CE-603

(Semester VI)

Category: Major

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

- Civil Engineering Materials

2. Course Learning Objectives:

- a. Understand the principles and processes involved in construction engineering and project management.
- b. Learn about different types of construction methods, equipment, and materials.
- c. Develop skills in planning, scheduling, and controlling construction projects.
- d. Analyze the cost estimation, budgeting, and financial management aspects of construction projects.
- e. Explore safety, quality control, and risk management in construction projects.
- f. Gain insights into modern construction management techniques, including Building Information Modeling (BIM).

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Problem-solving sessions and tutorials, Use of software for project Management, Guest Lectures, and Group Projects.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Construction Engineering & Management

Course Code: CE-603

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	Lecture (42L)
1.	Introduction to Construction Management: Objectives of construction projects, methods of project management, phases of a construction project, role of a construction engineer and manager, building bye-laws and regulatory framework.	6L
2.	Construction Methods and Equipment Selection of construction methods, earthmoving, excavation and tunnelling techniques, earthwork equipment, hoisting equipment,	7L

Module	Topics	Lecture (42L)
	automation in construction practices.	
3.	Project Planning and Scheduling Work breakdown structure and network fundamentals, program evaluation and review technique (PERT), critical path method (CPM), project crashing techniques, updating of schedules and resource allocation.	8L
4.	Cost Estimation and Financial Management Types of cost estimates, rate analysis and quantity surveying, budgeting techniques, financial planning and cost control in construction projects.	6L
5.	Quality, Safety and Risk Management: Construction quality standards and specifications, inspection and testing methods, safety management and accident prevention, identification and assessment of risks, risk mitigation strategies, contractual and legal risk management.	7L
6.	Modern Trends and Project Management Tools: Building Information Modeling (BIM), lean construction and sustainability practices, application of AI, IoT and automation in construction management, case studies of successful and failed projects, use of project management software tools such as Primavera and MS Project, practical applications of project management principles.	8L

5. References:

Text Book:

- A. Chitkara, K. K., *Construction Project Management: Planning, Scheduling, and Controlling*, McGraw-Hill.
- B. Peurifoy, R. L., Schexnayder, C. J., *Construction Planning, Equipment, and Methods*, McGraw-Hill.
- C. Halpin, D. W., *Construction Management*, Wiley.

Reference Books:

- A. Kerzner, H., *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, Wiley.
- B. Jha, K. N., *Construction Project Management: Theory and Practice*, Pearson.
- C. Hendrickson, C., *Project Management for Construction*, Prentice Hall.
- D. Eastman, C. M., *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*, Wiley.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamentals of construction engineering and project management.	Explain	Understand
CO2	Identify various construction methods, equipment and its purpose.	Identify	Understand
CO3	Develop project planning and scheduling using software tools like MS Project and Primavera.	Develop	Create
CO4	Execute cost estimation and financial management for construction projects.	Execute	Apply
CO5	Examine construction quality, safety, and risk management strategies.	Examine	Analyze
CO6	Appraise modern trends and emerging technologies like BIM in construction management.	Appraise	Evaluate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	-	-	-	-	-
Module 2	-	3	-	-	-	2
Module 3	-	2	3	2	-	2
Module 4	-	-	2	3	-	-
Module 5	-	-	2	2	3	2
Module 6	-	-	2	-	2	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	2	-	-	-	-	-
CO2	3	2	2	-	2	2	-	-	-	2	-
CO3	3	3	2	2	3	-	-	-	-	3	-
CO4	3	2	2	-	2	-	-	-	-	3	-
CO5	2	3	-	2	-	3	2	-	-	-	-
CO6	2	2	2	2	3	2	-	-	-	2	2

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	2	-
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	2	2	3
CO6	2	3	3

Course Name: INTRODUCTION TO FINITE ELEMENT ANALYSIS

Course Code: CE-604

(Semester VI)

Category: Minor

Course Broad Category: CORE ENGG (Program Elective Courses)

1. Course Prerequisite:

Solid Mechanics, Structural Analysis – I, Structural Analysis –II, Problem Solving Using Python and MATLAB

2. Course Learning Objectives:

This is an introductory course in the finite element method. The course learning objectives are:

- (a) To provide the fundamental concepts of the theory of the finite element method
- (b) To expose aspects of the application of the method to realistic civil engineering problems
- (c) Introduce to general purpose finite element software codes and software

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks.

4. Course Content:

Course Name: Introduction to Finite Element Analysis

Course Code: CE-604

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	100 %
1.	Introduction To FEM: Introduction - Limitations of methods of structural analysis - Mathematical modelling of physical Problem - Concept of FEM through perimeter of circle – History, merit and demerits and applications of FEM – FEM based software – Steps involved in FEM as applicable to Structural mechanics problems.	4L	10
2.	Choice Of Displacement Models: Introduction – Discretization - Choice of Elements shapes - Choice of displacement model - Requirements Ideal displacement model - Factors affecting nature and degree of polynomial for displacement models. FORMULATION OF SHAPE FUNCTION AND STRAIN DISPLACEMENT MATRIX: Introduction – Properties of Shape Functions - Methods of Determination – Shape functions for 1D bar and beam element, 2D CST element.	8L	20
3.	Element Stiffness Matrix And Assembly: Introduction - Element Stiffness Matrix based on minimization of total potential Energy and Principle of virtual work, Strong and weak forms, Essential vs. natural boundary conditions Stiffness Matrix for 2 noded truss element, 2 noded Beam element, 3 noded CST - Assemblage of Element Stiffness Matrices and load matrix- Static Condensation	8L	20
4.	1D Bar And Truss Using FEM: Introduction - Analysis of stepped bars and tapered bars- Analysis of plane Truss - Truss with initial Strain/Rise in Temperature	4L	10
5.	Beams And Plates Using FEM: Introduction - Analysis of simply supported beam – Analysis of propped cantilevers, fixed beams, and continuous beams for various loadings, Generalization to two dimensions - Membrane, plane strain and plane stress problems Triangular and quadrilateral elements - Isoparametric elements - Axisymmetric problems, Introduction to analysis of plates for in-plane loading.	8L	20
6.	Introduction to General purpose finite element codes and software: Codes for beams and truss through MATLAB and Python, Familiarization with software e.g. ANSYS, ABACUS, Free Open Source FEM software	8L	20

7. References:

Text Book:

- Reddy, J.N., “Introduction to Finite Element Method”, Mc Graw Hill, 4th Edition, 2020.
- Bhavikatti, S.S. “Finite Element Analysis” New Age international, 3rd Edition, 2015.

Reference Books:

- Chandrapatula, T.R, Belegundu, A.D, “Introduction to Finite Elements in Engineering”, 4th Edition, 2015
- Klaus-Jurgen Bathe, “Finite Element Methods”, Prentice Hall 1st Edition 2003
- Hutton, D, “Fundamentals of Finite Element Analysis”, McGraw Hill, 2017

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the basics of FEM	Explain	Understand

CO2	Explain the shape functions and strain displacement matrix	Explain	Understand
CO3	Prepare element stiffness matrix and assemble them.	Prepare	Apply
CO4	Solve problems of bars and trusses using FEM	Solve	Apply
CO5	Solve problems of beams and plates using FEM	Solve	Apply
CO6	Examine different problems using FEM codes and software	Examine	Analyse

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	2
CO2	3	3	3	3	1	-	-	-	-	-	1
CO3	3	3	3	3	1	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	2
CO6	3	3	3	3	3	-	-	-	-	-	2

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3
CO6	2	2	3

Course Name: EATHQUAKE ENGINEERING

Course Code: CE-605

(Semester VI)

Category: Minor

Course Broad Category: CORE ENGG (Program Elective Courses)

1. Course Prerequisite:

Structural Analysis – I, Structural Analysis –II, Design of Reinforced Concrete Structures, Design of Steel Structure

2. Course Learning Objectives:

This is an introductory course in the domain of earthquake engineering. The course learning objectives are:

- (a) To impart the knowledge of behavior of civil engineering structures during earthquakes.
- (b) To explain seismic analysis of framed and masonry structures.
- (c) To introduce the concepts of ductile detailing.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks.

4. Course Content:

Course Name: Earthquake Engineering

Course Code: CE-605

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Introduction to seismology Fundamentals of earthquake engineering, plate tectonics, Causes of earthquakes, types of earthquakes, important earthquake parameters such as magnitude and intensity, Philosophy of earthquake resistant design	4L
2.	Concept of single degree of freedom Systems Concept of natural frequency and degree of freedom, Equation of motion for single degree of freedom (SDOF) system, Concepts of response of SDOF systems (free, forced, undamped and damped), concept of resonance.	8L
3.	Response of multi degree of freedom Systems Concept of response spectrum, Equations of motion for multi degree of freedom (MDOF) systems, Natural frequencies and mode shape for MDOF systems, Normalization of modes, Dynamic analysis and calculation of base shear of MDOF systems by response spectrum method as per IS 1893, Modal combinations.	8L
4.	Seismic analysis of buildings Concepts of floor diaphragms and lateral load resisting systems, Importance of strength, stiffness, ductility and configuration, various structural irregularities, calculation of centre of mass, centre of stiffness and eccentricity, lateral- torsional analysis of building as per seismic coefficient Method, Calculation for base shear and its distribution along height.	8L
5.	Ductile Design and detailing Importance of ductile detailing, capacity design concept, strong column weak beam theory, Concepts of ductile detailing and design of beams and columns as per IS: 13920.	6L

6.	Seismic analysis & design of masonry buildings Seismic detailing of masonry buildings as per IS: 4326, Provision of various types of bands and vertical reinforcements, Calculation for rigidity of masonry wall, Concept of lateral load analysis of masonry building. Structural controls, Introduction to base isolation and dampers, Introduction to reinforced masonry structures.	8L
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7. References:

Text Book:

- Mario Paz, *“Structural Dynamics - Theory and Computations”*, Pearson Education
- Pankaj Agarwal & Manish Shrikhande, *“Earthquake Resistant Design of Structures”*, Prentice Hall of India, New Delhi
- S. K. Duggal, *“Earthquake Resistant Design of Structures”*, Oxford university Press

Reference Books:

- Chopra A. K., *“Dynamics of Structures”*, Pearson Education, New Delhi
- Ray W. Clough & Joseph Penzien, *“Dynamics of Structures”*, McGraw Hill
- IS: 1893 - Indian Standard Criteria for Earthquake Resistant Design of Structures
- IS: 4326 - Indian Standard Code of Practice for Earthquake Resistant Design & Construction of Buildings
- IS:13920 - Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
- IS:13827 - Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings
- IS:13828 - Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings
- IS:13935 - Indian Standard Guidelines for Repair and Seismic Strengthening of Buildings.
- SP 22 - Explanatory Handbook on Codes for Earthquake Engineering

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Comprehend the Basics of Seismology and Earthquake Engineering	Comprehend	Understand
CO2	Illustrate the Single Degree of Freedom (SDOF) Systems	Illustrate	Analyze
CO3	Assess the Behavior of Multi-Degree of Freedom (MDOF) Systems	Assess	Evaluate
CO4	Perform Seismic Analysis of Buildings	Perform	Apply
CO5	Design Earthquake-Resistant Structures with Ductile Detailing:	Design	Create
CO6	Design Seismic-Resilient Masonry Buildings	Design	Create

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	3	3	2	1	1	2
CO2	3	3	3	3	2	1	1	-	-	-	2
CO3	3	3	3	3	2	1	1	-	-	-	2
CO4	3	3	3	3	3	3	2	-	-	-	3
CO5	3	3	3	3	2	2	2	-	-	-	2
CO6	3	3	3	3	2	2	2	-	-	-	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	2	2
CO6	3	2	2

Course Name: SOIL DYNAMICS AND MACHINE FOUNDATION

Course Code: CE-606

(Semester VI)

Category: Minor

Course Broad Category: Program Elective Courses

1. Course Prerequisite:

Geotechnical Engineering, Foundation Engineering, Earthquake Engineering.

2. Course Learning Objectives:

- This course introduces the behavior of soils under cyclic and dynamic loading, specifically focusing on the determination of dynamic shear modulus, damping characteristics, and the assessment of liquefaction potential using field and laboratory data.
- Students will also learn to design block foundations for reciprocating and impact machinery, ensuring compliance with Indian Standard (IS) codes for permissible vibration amplitudes and frequency limits.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

Attendance

Internal Assessment (40 Marks)- Formative Continuous Assessment [Continuous Assessment 1(CIA1- 25 Marks written class test, 15 Marks Attendance/Assignment); [Continuous Assessment 2(CIA2- 25 Marks written class test, 15 Marks Attendance/Assignment).

End-Semester Exam (60 Marks)- Summative Assessment.

4. Course Content:

Course Name: Soil Dynamics and Machine Foundation.

Course Code: CE-606

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Introduction to Soil Dynamics: Nature of dynamic loads; Vibrations of elementary systems (Free and Forced vibrations); Undamped and Damped single degree of freedom (SDOF)	4L

Module	Topics	42L
	systems; Resonance and its significance; Vibration measuring instruments (Seismographs and Accelerometers).	
2.	Dynamic Soil Properties: Stress-strain behaviour of cyclically loaded soils; Dynamic shear modulus and Damping ratio; Factors affecting dynamic properties. Correlation between G_{max} and SPT/CPT values.	8L
3.	Liquefaction of Soils Phenomenon of liquefaction; Peak and residual strength; Pore pressure development under cyclic loading; Evaluation of liquefaction potential (Seed and Idriss method); Factors affecting liquefaction; Mitigation measures and ground improvement techniques	6L
4.	Machine Foundations - General Requirements Types of machines and their vibrations (Reciprocating, Impact, and Rotary); General criteria for design of machine foundations; Permissible amplitudes and frequencies; Indian Standard (IS) code provisions for machine foundation design.	9L
5.	Analysis and Design of Block Foundations Barken's method of analysis; Linear elastic weightless spring method; Determination of coefficient of elastic uniform compression (C_u); Design of foundations for reciprocating machines; Design of foundations for impact machines (Hammers).	9L
6.	Vibration Isolation and Control Theory of vibration isolation; Active and Passive isolation; Methods of isolation (Trench isolation, use of springs and rubber pads); Case studies on vibration-induced damage and remedial measures	6L

5. References:

Text Book:

Soil Dynamics and Machine Foundation, Swami Saran, Galgotia Publications Pvt. Ltd.

6. Course Outcomes:

After completion of this course, students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Interpret the behavior of Single Degree of Freedom (SDOF) systems under free and forced vibrations to determine critical parameters like resonance and damping.	Apply	Apply
CO2	Estimate dynamic soil properties, such as shear modulus and damping ratio, using laboratory results and correlations with field tests like SPT and CPT.	Estimate	Evaluate
CO3	Assess the liquefaction potential of saturated cohesionless soils using the Seed and Idriss method and propose appropriate ground improvement techniques	Assess	Evaluate
CO4	Implement Indian Standard (IS) code provisions and design criteria to satisfy permissible amplitude and frequency	Implement	Apply

	requirements for various machine types.		
CO5	Design block foundations for reciprocating and impact machines using Barken's method and linear elastic weightless spring theory.	Design	Analyse
CO6	Develop vibration isolation strategies, choosing between active and passive methods, to protect sensitive structures and mitigate dynamic interference.	Develop	Create

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3		-	-
4	-	-		3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	1	-	-	-	-	-	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	1
CO4	3	3	3	2	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	2
CO6	3	3	3	3	-	2	-	-	-	-	3

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	2	-
CO4	3	-	-
CO5	2	2	-
CO6	3	3	-

Course Name: Industrial Waste Water Management

Course Code: CE-614

(Semester VI)

Category: Major

Course Broad Category: CORE ENGG (Program Elective Course-4 PE)

1. Course Prerequisite(s):

Students are expected to know the fundamentals of Mathematics, Chemistry, Environmental Engineering, Fluid Mechanics, and Biology for Engineers.

2. Course Learning Objectives:

The objectives of the course are to enable the student

- Differentiate between the quality standards for domestic and industrial water needs, as well as the quantity of wastewater generated.
- Comprehend industrial processes, water consumption patterns, and wastewater production.
- Develop an understanding of appropriate treatment methods for industrial wastewater.
- Learn about the operational challenges associated with common effluent treatment plants.
- Acquire knowledge of various techniques and strategies to minimize wastewater generation, along with the application of physico-chemical and biological treatment methods for the recovery, reuse, and disposal of industrial wastewater.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content :

Course Name: Industrial Waste Water Management

Course Code: CE-614

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Introduction General Characteristics of Industrial effluents, Effects on Environment – ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and on to land for irrigation.	4L	10
2.	Sources of Pollution Physical, Chemical, Organic & Biological properties of Industrial Wastes, Difference between industrial & municipal waste waters, Effects of industrial effluents on sewers and Natural water Bodies.	6L	14
3.	Pre & Primary Treatment Equalization, Proportioning, Neutralization, Oil separation by Floating-Waste Reduction-Volume Reduction-Strength Reduction.	8L	19
4.	Waste Treatment Methods Nitrification and De-nitrification, Phosphorous removal, Heavy metal removal, Membrane Separation Process, Air Stripping and Absorption Processes, Special Treatment Methods, Disposal of Treated Waste Water.	8L	19
5.	Industrial Effluents: Composition, Sources, and Treatment Characteristics and Composition of waste water and Manufacturing Processes of Industries like Sugar, Characteristics and Composition of Industries like Food processing Industries, Steel, and Petroleum Refineries.	10L	24
6.	Wastewater Management in Textile, Tannery, and Mineral Processing Industries	6L	14

	Characteristics and Composition of Industries like Textiles, Tanneries, Atomic Energy Plants and other Mineral Processing Industries, Joint Treatment of Raw Industries waste water and Domestic Sewage, Common Effluent Treatment Plants(CETP), Location, Design, Operation and Maintenance Problems – Economical aspects.		
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5. References:

Text Books:

1. Rao, M.N. & Dutta, A.K. "Waste Water Treatment", 3rd Edition, IBH Publishers, 1982.
2. Patwardhan-" Industrial Waste Water Treatment"- PHI learning Pvt. Ltd, 2009.
3. Mark J. Hammer, Mark J. Hammer Jr., "Water & Wastewater Technology", Prentice Hall of India.
4. N.L. Nemerow –Theories and practices of Industrial Waste Engineering.

Reference Books :

1. Metcalf & Eddy, "Wastewater engineering Treatment disposal reuse", Tata McGraw Hill.
2. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill.
3. C. Fred Gurnham" Industrial Waste Water Control", (Revised for publication January 28, 1977) 31 May, 2007.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Examine the characteristics of industrial effluents and their effects on environment including their tolerance limits.	Examine	Analyse
CO2	Describe the basic principles of industrial waste water treatment by physical methods.	Describe	Understand
CO3	Discuss the sources, characteristics and treatment of industrial wastes.	Discuss	Understand
CO4	Identify the sources, characteristics and treatment of major industrial waste of Thermal Power Plants, Oil Refineries, Steel mills and Cement industries.	Identify	Understand
CO5	Examine the sources, characteristics and treatment of Chemical industrial wastes.	Examine	Analyse
CO6	Appraise the economic aspects of joint treatment of industrial and domestic wastewater.	Appraise	Evaluate

7. Mapping of Course Outcomes (CO) to Module:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	-	3	-	-	1	-
4	-	3	1	-	-	-
5	-	-	3	3	3	-
6	-	-	-	-	-	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO) :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	3	-	-	-	-	2
CO2	3	3	1	-	-	3	-	-	-	-	1
CO3	3	2	1	3	-	3	-	-	-	-	1
CO4	3	2	2	2	-	3	-	-	-	-	2
CO5	3	3	2	3	2	3	-	-	-	1	2
CO6	1	2	3	2	2	3	-	-	-	1	3
Average	2.67	2.5	1.50	1.67	0.67	3	0	0	0	0.33	1.83

9. Mapping of the Course Outcomes (CO) to Program Specific Outcomes (PSO) :

CO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	3	2
CO5	3	3	2
CO6	3	3	3

Course Name: CONSTRUCTION EQUIPMENTS AND AUTOMATION

Course Code: CE-615

(Semester VI)

Category: MAJOR

Course Broad Category: ELECTIVE (PE)

1. Course Prerequisite:

Concrete Technology Sustainable and Green Construction.

Course Learning Objectives:

- Identify various types of construction equipment and recognize emerging trends and innovations in automation within the industry.
- Select and analyze appropriate construction equipment, including drones, based on site conditions, project requirements, capabilities, and limitations.

2. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

3. Course Content:

Course Name: CONSTRUCTION EQUIPMENTS AND AUTOMATION

Course Code: CE-615

Hours per Week: 3L-0T-0P

Credits: 3

Module	Topics	42L
1.	Introduction: Distinctive features, necessity, and significance of construction equipment in projects; emerging trends and innovations in construction technology.	4L
2.	Construction Equipment: Excavating equipment, pavers, rollers, plastering machines, cranes and hoists, concrete batching plants, hauling and conveying equipment; analysis of capacity, feasibility, safety, and owning and operating costs of various construction equipment.	7L
3.	Emerging trends in construction automation: necessity, challenges, and benefits; automated equipment and machinery for construction; automation in canal lining, highway construction, and concrete technology.	8L
4.	Drones in construction: Photogrammetry, real-time project monitoring, aerial mapping, land surveying, quantity and quality assessment, structural health monitoring, and underwater surveying.	7L
5.	Robotics: Introduction to robotics in construction; benefits in terms of time, cost, quality, and safety; applications in bricklaying, demolition, material handling, structural steel cutting, rebar tying and bending, formwork production, and 3D printing of building and infrastructure components.	9L
6.	Application of advanced technologies in construction automation: Building Information Modeling (BIM), Virtual Reality (VR), Augmented Reality.	7 L

6. References:

- Construction Equipment and Management, S. C. Sharma, Khanna Book Publishing Company.
- Construction Equipment and Machinery, Dr. S. Jude Sujatha, Mrs. P.V. Reshma Raj and Mr. V. Ruban Daniel, San publication.
- Automation in Construction Industry, Dr. J. R. Pitroda, Prof. J. M. Rathod, lipbook store.
- Construction Planning, Methods and Equipment, R.L. Peurifoy, McGraw Hill, 2011.
- Construction Project management, Theory & Practice, Kumar NeerajJha, Pearson Education India.
- BIM and Construction Management: Proven Tools, Methods, and Workflows by Brad Hardin, Dave McCool, John Wiley & Sons.
- Construction equipment and its planning and application Mahesh Varma Metropolitan Book Co.
- Robotics and Automation in Construction, Open access peer- reviewed edited volume.
- Automation in Construction Management: Automated management of Construction Materials using RFID Technology, JavadMajrouhiSardroud, Scholars' Press.
- Enhancing BIM Methodology with VR Technology, Open access peer.

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Basic understanding of construction equipment's in construction projects	Recognize	Understand
CO2	Derive feasibility of specific equipment in different project conditions.	Relate	Understand
CO3	Selection of Automation techniques in construction industry and applicability in engineering solutions.	Execute	Apply
CO4	Select suitable drone technology for surveying, project management and structural health monitoring.	Calculate	Analyze
CO5	Analyze benefits of robotics versus conventional construction equipment.	Relate	Analyze

CO6	Classify application of Virtual Reality, Augmented Reality, BIM in construction industry.	Formulate	Create
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8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	2	1	-	-	-	1	1
CO2	3	3	3	1	2	1	-	-	-	1	-
CO3	3	2	2	2	1	1	-	-	-	1	1
CO4	2	2	2	1	3	-	-	-	-	-	-
CO5	3	2	2	1	3	1	-	-	-	-	-
CO6	3	2	3	2	3	-	-	-	-	1	1

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Course Name: STRUCTURAL HEALTH MONITORING AND REHABILITATION

Course Code: CE-616

(Semester VI)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE

1. Course Prerequisite:

Class-XII knowledge of Physics and mathematics; Undergraduate level knowledge of Structural Engineering.

2. Course Learning Objectives:

- This course will enable students to assess the health of structures using different techniques of SHM and identify suitable SHM techniques for the in-service performance of structures.
- Students will also learn to decide the appropriate strengthening & retrofitting techniques to regain structural strength.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks.

4. Course Content:

Course Name: Intelligent Transportation Systems

Course Code: CE-616

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Need of Structural Health Monitoring, Definition & Concept of SHM, SHM & Biomimetic Comparison of SHM with NDT, Factors affecting the health of structures, SHM scheme, various steps in SHM, damage diagnostic methods, challenges in SHM.	6L
2.	Methodologies and Monitoring Principles, Local & Global Techniques for SHM, Static & Dynamic Field Testing, Short & Long-Term Monitoring, Active & Passive Monitoring. , Concrete strength assessment –Rebound hammer test – Ultrasonic pulse velocity tests, penetration resistance, pullout tests, core sampling and testing, chemical tests – carbonation, chloride, content and corrosion problem.	8L
3.	Instruments for SHM, Data Acquisition Systems-Types, Hardware & It's Components. Basics of Sensors, Transducers & Actuators, Classification of Sensors, and Characteristics & Working Principles of Various Types of Sensors	6L
4.	Vibration Control & SHM Damage Diagnostic methods based on vibration response, Ambient Vibration Test, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method, Experimental modal analysis, operational modal analysis and combined methods.	8L
5.	Numerical Methods & Demonstration of Dynamic Properties of Structures for Damage Detection & SHM, Acoustic Emission Technique, Electromechanical Impedance Technique, Wave Propagation Based Techniques, Fibre Optics Based Techniques, Remote & Wireless SHM Techniques, IoT Application in SHM, Artificial Intelligence & Machine Learning in SHM.	8L
6.	Introduction to deterioration of structures, Case studies of structural damages & failures, Need of Retrofitting, Current scenario of infrastructure through case studies. <i>Concept of Repair & Retrofitting of Structures:</i> Case studies of structural & foundation failure, performance problems, causes of distress in structural members, design and material deficiencies, and factors causing extensive Deterioration in buildings and bridges <i>Structural Assessment:</i> Conditional Evaluation, Damage Assessment Procedure, Principles of Structural Assessment, Classification & levels of assessment.	6L

7. References:

Text Book:

- Daniel Balageas, Peter Fritzen, Alfredo Guemes, "Structural Health Monitoring", John Wiley & Sons, 2006.
- Bhattacharjee, J, "Concrete Structures Repair Rehabilitation And Retrofitting", CBS Publishers & Distributors, New Delhi
- Charles R Farrar, and Keith Worden, Structural Health Monitoring: A Machine Learning Perspective, John Wiley & Sons, first edition, 2012-2013.

- Nagayama, T. and Spencer Jr, B.F., 2007, Structural health monitoring using smart sensors, Newmark Structural Engineering Laboratory. University of Illinois at Urbana-Champaign

Reference Books:

- Malhotra, V.M. and Carino, N.J., "Handbook on Non-destructive Testing of Concrete", CRC Press.
- IS 15988: 2013 Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings -Guidelines"

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To Discuss the fundamentals of structural dynamic	Discuss	Understand
CO2	To Explain the needs and challenges of Structural Health Monitoring (SHM).	Explain	Understand
CO3	To Examine various methods of damage detection.	Examine	Analyze
CO4	To Solve the conditional assessment & techniques for strengthening and retrofitting of structures	Solve	Apply
CO5	To Use the Structural Health Monitoring technique for building.	Use	Apply
CO6	To Use the Structural Health Monitoring techniques for bridge	Use	Apply

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	3	2	-	-	-
2	3	3	3	-	-	-
3	2	3	3	-	-	-
4	2	3	2	3	2	2
5	2	2	2	3	2	2
6	2	2	2	3	3	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	1	-	-	-	-	2
CO2	3	3	2	2	2	2	1	-	-	-	2
CO3	3	3	3	3	2	2	2	1	-	-	2
CO4	3	3	3	3	3	2	2	2	-	-	3
CO5	3	3	3	3	3	3	2	2	-	-	3
CO6	3	3	3	3	3	3	2	2	-	-	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	3
CO3	2	3	3
CO4	2	2	3

CO5	2	2	3
CO6	2	2	3

Course Name: BIOLOGY FOR ENGINEERS

Course Code: CE-681

(Semester- 6th)

Course Broad Category: CORE ENGG (Program Elective Course)

Course Prerequisite:

- Class-X-XII level knowledge of Biology and Bio-Environmental Science.
- Undergraduate level introductory knowledge of Bio- Engineering.

1. Course Learning Objectives:

- This course imparts basic knowledge of biology, evolution, general awareness of environmental pollution effects and bio-engineering's aspects that provides the basic ideas among the engineering students for a better foundation of technical education.
- To provide fundamentals among the upcoming young engineers and to carry out advanced technical and machinery research projects in biology and allied domains.

2. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures , Practical's and Presentations, Interactive Discussions and Case Studies and d Field Visits.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Biology for Engineers

Course Code: CE-681

Hours per Week: 0L:0T:2P

Credits:1

Module	Topics	14 P
1	INTRODUCTION OF SOIL Study of some physicals and chemicals criteria of the soil. Physical properties – temperature, humidity.	1P
2	Chemical properties – electric method, measuring pH, colorimetric method	1P
3	SOIL MICROORGANISMS Isolations and enumerations of soil microorganisms.	1P
4	FRUITING GLIDING BACTERIA FROM SOIL Isolation of Fruiting Gliding Bacteria	1P

5	MICROORGANISMS DECOMPOSES CRUDE OIL Microbial decomposition (bacterial effects) of crude oil	1P
6	Microbial decomposition (fungal effects) of crude oil	1P
7	Microbial decomposition (algal effects) of crude oil	1P
8	Environmental Management Principles: Perspectives, concerns and management strategies; Policies and legal aspects.	1P
9	Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment-Case studies (International Airport, thermal power plant)	1P
10	Biostatistics Introduction to Biostatistics:-Terms used, types of data ;Measures of Central Tendencies-Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data-Hypothesis testing and ANNOVA(single factor)	1P
11	Ecology Ecosystems-Components, types, flow of matter and energy in an ecosystem; Community ecology-	1P
12	Characteristics, frequency, life forms, and biological spectrum Ecosystem structure-Biotic and a- biotic factors, food chain, food web, ecological pyramids;	1P
13	BOD OF WATER / WASTE WATER SAMPLE Determination of BOD[Biological Oxygen Demand] of water or waste water sample.	1P
14	Isolation of microorganism from waste water sample.	1P

6. Reference Books:

1. Biology: A global approach: Campbell, N.A. ;Reece, J.B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R.B. Pearson Education Ltd
2. OutlinesofBiochemistry,Conn,E.E;Stumpf,P.K;Bruening,G;Doi,R.H.JohnWileyandSons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender , R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.MJ.P. Harley and C.A.Klein 1995 .2nd edition Wm, C.Brown Publishers LifeSciences ,Vol.I &II,PathfinderPublications.

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Define the physical properties and chemical properties individually of soil.	Define	Remember
CO2	Discuss the laws to control the environmental pollution and ecology of the bio-environments.	Discuss	Understand
CO3	Examine the microbial enzymatic decomposes ability.	Examine	Analyse
CO4	Explain about the Biostatistics Calculations	Explain	Understand
CO5	Justify BOD calculation from water sample from different areas.	Justify	Evaluate
CO6	Investigate the microorganisms of waste water sample.	Investigate	Create

6. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	2
2	3	-	-	-	-	2
3	3	-	-	-	-	2
4	2	-	-	-	-	3
5	3	-	-	-	-	2
6	-	3	-	-	-	2
7	-	3	-	-	-	2
8	-	-	3	-	-	2
9	-	-	3	-	-	2
10	-	-	2	-	3	2
11	-	-	-	3	-	-
12	-	-	-	3	-	-
13	-	-	2	2	-	-
14	-	-	2	-	-	3

7. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	2	2	-	-	-	-	-	1
CO2	2	2	-	2	2	-	-	-	-	-	1
CO3	1	1	1	2	3	-	-	-	-	1	2
CO4	2	1	1	2	1	-	-	-	-	-	1
CO5	1	2	2	3	3	1	1	-	1	2	2
CO6	1	2	1	2	2	1	-	-	1	2	3

8. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	1	1	3
CO4	2	1	2
CO5	1	2	3
CO6	1	2	3

Course Name: CAREER PLANNING AND SKILL DEVELOPMENT
Course Code: CE-682
(Semester VI)
Category: Knowledge Enhancement
Course Broad Category: Multidisciplinary Non-Credit Course- 4 (MNC)

1. Course Prerequisite:

- Basic communication skills (verbal and written)
- Awareness of career opportunities in civil engineering and allied fields
- Willingness to develop soft skills, technical skills, and employability skills.

2. Course Learning Objectives:

- a. Understand career opportunities in civil engineering and interdisciplinary domains.
- b. Develop effective communication, leadership, and teamwork skills.
- c. Enhance technical proficiency and digital literacy for career growth.
- d. Learn resume writing, interview preparation, and job application strategies.
- e. Explore entrepreneurship, higher studies, and research opportunities.
- f. Build networking skills and industry connections for career advancement.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Career Planning And Skill Development

Course Code: CE-682

Hours per Week: 3L:0T:0P

Credits: 0

Module	Topics	Lecture (42L)
1.	Career Exploration and Goal Setting 1.1 Introduction to career planning 1.2 Career opportunities in civil engineering, public sector, private sector, and research 1.3 Role of interdisciplinary skills in career growth 1.4 Setting SMART career goals	6L
2.	Communication and Presentation Skills 2.1 Verbal and non-verbal communication 2.2 Public speaking and presentation skills 2.3 Writing emails, reports, and professional correspondence 2.4 Effective storytelling and elevator pitch	6L
3.	Resume Building and Personal Branding 3.1 Resume formats and content optimization 3.2 Cover letter writing and job application techniques 3.3 LinkedIn profile creation and networking strategies 3.4 Personal branding and online presence management	5L

4.	Interview Skills and Group Discussions 4.1 Types of interviews (technical, HR, behavioral) 4.2 Common interview questions and answers 4.3 Case study-based group discussions 4.4 Mock interviews and feedback sessions	5L
5.	Technical Skill Development 5.1 Digital tools and software proficiency (MS Excel, AutoCAD, STAAD Pro/SAP200, Primavera, BIM etc.) 5.2 Importance of data analytics and AI in civil engineering 5.3 Certifications and online learning platforms (Coursera, edX, Udemy etc.)	5L
6.	Entrepreneurship, Higher Studies, and Research Opportunities 6.1 Pathways for entrepreneurship and startup ecosystem 6.2 Higher education and scholarship opportunities in India and abroad 6.3 Research methodologies and technical paper writing 6.4 Funding agencies and grants for research and innovation	5L
7.	Leadership, Teamwork, and Workplace Ethics 7.1 Leadership styles and decision-making skills 7.2 Importance of teamwork and conflict resolution 7.3 Time management and productivity hacks 7.4 Professional ethics and workplace culture	5L
8.	Industry Exposure and Networking 8.1 Industry trends and future skill requirements 8.2 Alumni interaction and mentoring sessions 8.3 Site visits and hands-on workshops 8.4 Career planning roadmap and final reflections	5L

9. References:

Text Book:

- Shiv Khera, *You Can Win*, Macmillan India.
- Dale Carnegie, *How to Win Friends and Influence People*, Simon & Schuster.
- Jeffrey Gitomer, *The Sales Bible: The Ultimate Sales Resource*, HarperCollins.

Reference Books:

- Richard N. Bolles, *What Color is Your Parachute?*
- Stephen R. Covey, *The 7 Habits of Highly Effective People*.
- Thomas H. Davenport, *Big Data at Work: Dispelling the Myths, Uncovering the Opportunities*.
- Industry reports on emerging civil engineering careers.

10. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify various career opportunities in civil engineering and interdisciplinary domains.	Identify	Understand
CO2	Develop effective communication and presentation skills for professional growth.	Develop	Create
CO3	Design a strong resume, cover letter, and online professional presence.	Design	Create
CO4	Demonstrate interview skills, group discussion techniques, and networking abilities.	Demonstrate	Apply
CO5	Demonstrate technical proficiency in relevant digital tools and software.	Demonstrate	Apply

CO6	Explain leadership, teamwork, ethics, and entrepreneurship for career success.	Explain	Understand
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11. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	-	1	1	-	-
Module 2	-	3	2	2	-	2
Module 3	2	2	3	2	2	-
Module 4	-	3	2	3	-	-
Module 5	-	-	-	1	3	-
Module 6	3	-	-	1	3	3
Module 7	1	2	-	2	-	3
Module 8	3	2	2	3	2	3

12. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	1	2	1	-	-	-	3	2	3
CO2	1	2	1	-	1	-	-	-	3	3	3
CO3	1	1	2	-	1	-	-	-	2	2	3
CO4	1	1	1	-	-	-	1	-	2	2	3
CO5	1	1	1	-	3	-	1	-	2	1	2
CO6	1	1	1	-	-	-	3	2	3	3	3

13. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	3	2
CO4	2	3	2
CO5	1	3	2
CO6	2	3	3

Course Name: BUILDING INFORMATION MODELING

Course Code: CE-691

(Semester VI)

Category: Major

Course Broad Category: CORE ENGG (PC)

1. Course Prerequisite:

Undergraduate level knowledge of Building Planning and Computer-Aided Civil Engineering Drawing, Construction Engineering & Management, Design of RC Structures & Design of Steel Structures, and basic knowledge of isometric structures and engineering graphics fundamentals.

2. Course Learning Objectives:

- To understand the Fundamentals of BIM and Software Applications.
- To develop Architectural and Structural Models Using BIM Tools.
- To integrate MEP (Mechanical, Electrical, and Plumbing) Components into BIM Models.
- To perform quantity estimation and generate construction documentation.

- v. To visualize the designs in real time within the 3D modeling environment.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Building Information Modeling

Course Code: CE-691

Hours per Week: 0L:0T:2P

Credits: 1

Module/ Experiments	Topics	14P	100%
1.	Introduction to BIM and Revit Software Setup: Overview of BIM and Revit: Evolution, Features, Model Visualization, and System Requirements	1	07
2.	Fundamentals of Revit and 3D Model Creation: Basic Concepts in Revit, Exploring Architectural, Structural, and Components Tabs, Importing CAD Files, Creating a 3D Model	2	14
3.	Architectural Modeling and Level of Development (LoD) Implementation: Level of Development (LoD) and its Types, Developing Architectural Models from Lower LoD to Higher LoD	3	21
4.	Structural Modeling and Reinforcement Detailing in BIM: Creating Structural Models (RCC & Steel), Preparation of Bar Bending Schedule (BBS)	3	21
5.	MEP (Mechanical, Electrical, and Plumbing) Modeling and Integration in BIM: Creating Plumbing Models and Integrating Them into Architectural Models	2	14
6.	Quantity Estimation, Costing, and GFC Documentation in BIM	2	14
7.	Interference/Clash Check Using Revit and Navisworks, BIM Coordination, and Digital Twin Applications	1	09

8. References:

- BIM Handbook by Chuck Eastman ET. AL., WILEY Publisher.
- An introduction to Building Information Modeling (BIM) by “The Institution of Structural Engineers BIM Panel”.
- Building Information Modeling by Construction Manager’s Library - ERASMUS.

9. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe BIM fundamentals, evolution, and Revit software features.	Describe	Understand
CO2	Sketch 3D architectural and structural models with LoD concepts.	Sketch	Apply

CO3	Demonstrate RCC and steel models with reinforcement detailing and BBS.	Demonstrate	Apply
CO4	Integrate MEP systems into BIM for coordinated design.	Integrate	Analyze
CO5	Appraise quantity estimation, costing, and Good for-construction (GFC) drawings for project execution.	Appraise	Evaluate
CO6	Perform clash detection using Revit/Navisworks and explore Digital Twin.	Perform	Evaluate

10. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	2	3	2	-	-	-
3	-	3	-	-	-	-
4	-	3	3	-	-	-
5	-	-	-	3	-	-
6	-	-	-	-	3	-
7	-	-	-	-	-	3

11. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	2	-	-	-	1	-	1
CO2	2	-	2	-	3	2	-	-	1	-	2
CO3	2	-	2	-	3	-	-	-	1	-	2
CO4	2	2	3	-	3	2	-	-	1	2	2
CO5	-	-	2	-	2	2	-	-	1	2	2
CO6	-	2	2	2	3	1	-	-	1	2	3

12. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	1	-	1
CO2	2	1	2
CO3	2	1	2
CO4	2	2	3
CO5	1	1	2
CO6	1	2	3

Course Name: HYDROLOGY & WATER RESOURCES ENGINEERING LABORATORY

Course Code: CE-692

(Semester VI)

Category: Major

Course Broad Category: CORE ENGG (PC)

1. Course Prerequisite:

Fluid Mechanics and Hydraulic Engineering, Hydrology and Water Resources Engineering.

2. Course Learning Objectives:

- i. This course familiarizes the students with the operational principles and field applications of various meteorological and hydrological instruments, including rain gauges, double-ring infiltrometers, evaporimeters, and sunshine recorders.
- ii. Students will also learn to calculate and evaluate the spatial distribution of rainfall over a basin using standard engineering techniques over a delineated catchment area.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Hydrology & Water Resources Engineering Laboratory

Course Code: CE-692

Hours per Week: 0L:0T:2P

Credits: 1

Experiment	Topics	28P
1	Catchment Area delineation (Manually and using DEM).	10P
2	Calculation of average rainfall over a catchment area with the arithmetic mean method, Thiessen Polygon Method, and Isohyetal Method.	10P
3	Use of different types of Rain gauges.	2P
4	Use of the infiltration rate using the Double Ring Infiltrometer.	2P
5	Measurement of evaporation using an evaporimeter.	2P
6	Measurement of bright sunshine hours using a sunshine recorder.	2P

5. References:

- a. Chow, V. T. (1964). Handbook of Applied Hydrology. McGraw-Hill.
- b. Gupta, H. V., Sorooshian, S., & Yapo, P. O. (1999). Hydrologic Modeling. American Geophysical Union.
- c. Linsley, R. K., Franzini, J. B., Freyberg, D. L., & Tchobanoglous, G. (1992). Water Resources Engineering. McGraw-Hill.

6. Course Outcomes:

After completion of this course, students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Develop a diagram of the catchment area for any water body from the given information.	Develop	Create
CO2	Calculate the average rainfall over a catchment.	Calculate	Analyse
CO3	Measure the rainfall data using different types of rain gauges.	Measure	Evaluate
CO4	Measure the rate of infiltration of water through the soil.	Measure	Evaluate
CO5	Measure the evaporation using an evaporimeter.	Measure	Evaluate
CO6	Measure the sunshine hours on a particular day.	Measure	Evaluate

7. Mapping of course outcomes to module/course content

Experiment	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	3	-	-	-	-	-
4	3	-	-	3	-	-
5	-	3	-	-	3	-
6	-	3	-	-	-	3

5. Mapping of the Course Outcomes to Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	0	3	0	1	0	1	2	1
CO2	3	3	2	1	0	2	2	0	2	2	1
CO3	3	2	0	1	3	0	2	0	3	2	1
CO4	3	2	0	0	3	0	2	0	3	2	1
CO5	3	2	0	0	3	0	2	0	3	2	1
CO6	3	1	0	1	3	1	2	0	3	2	1

6. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	1	-
CO3	3	1	-
CO4	3	1	-
CO5	3	1	-
CO6	3	3	-

Course Name: Computational Tools and Software Laboratory in Civil Engineering

Course Code: CE-693

(Semester 6th)

Category: Major

Course Broad Category: Program Elective Course- 3 (PE)

1. Course Prerequisite:

Concrete Technology, Geotechnical Engineering, Foundation Engineering, Design of RC Structure, Structural Analysis, Design of Hydraulic Structure, Building Planning, and Computer-Aided Civil Engineering Drawing.

2. Course Learning Objectives:

- iii. This course introduces the concept of design and analysis of different kinds of civil engineering structures and phenomena through different computer-based software packages.
- iv. Students will also increase their proficiency in the software-based analysis of civil engineering problems.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –

Provide a theoretical knowledge and familiarize with different tools and menus.

Hands-on practice in the lab on various structures.

Real-life model preparation and design of small structural projects, integration with other projects.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Computational Tools and Software Laboratory in Civil Engineering.

Course Code: CE-693

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	28P
1.	Introduction to Computational Tools and Software: overview of computational tools in civil engineering, types of software used in different areas of civil engineering (structural, geotechnical, hydraulic, transportation, environmental, etc.), Software installation, configuration, and interface overview.	3P
2.	Structural Analysis using STAADPro: Basic structural model creation, Structural analysis, interpretation of results, and design of simple structures; Wind analysis, Seismic analysis, different load combinations as per Indian Standards, and complete design of multistoried buildings by using STAAD.Pro	5P
3.	Structural Analysis using ETABS: Multistoried building model creation, analysis, and design of steel and concrete structures.	5P
4.	Critical model creation in SAP2000: Wind analysis, Seismic analysis, different load combinations as per Indian Standards, and complete design of RCC tanks by using SAP2000.	5P
5.	Slope stability and Foundation settlement analysis using PLAXIS: Geotechnical analysis of different slopes; Settlement analysis of shallow foundation using Plaxis3D and Plaxis2D.	5P
6.	Hydraulic and Hydrological analysis using HEC-RAS software: Hydrological design, model, & analyse water networks using HEC-RAS.	5P

5. Course Outcomes:

After completion of this course, students will be able to

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify the Engineering Software and its configuration.	Identify	Understand
CO2	Design Civil Engineering Structures via STAAD.Pro.	Design	Analyse
CO3	Model Steel and Concrete Systems in ETABS.	Model	Evaluate
CO4	Assess Specialized Infrastructures in SAP2000.	Assess	Evaluate
CO5	Estimate the Geotechnical Stability of Slopes and Settlement of Shallow Foundations in PLAXIS.	Estimate	Evaluate
CO6	Simulate the Hydraulic and Hydrologic Network Model HEC-RAS.	Simulate	Evaluate

6. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3		-	-

4	-	-		3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

7. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	-	-	-	2
CO2	3	3	3	-	3	-	-	-	-	-	2
CO3	3	2	3	-	3	-	-	-	-	-	2
CO4	3	3	3	-	2	-	-	-	-	-	1
CO5	3	3	2	-	3	-	-	-	-	-	2
CO6	3	2	2	-	3	1	-	-	-	-	1

8. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	3
CO3	3	2	3
CO4	3	1	2
CO5	2	2	2
CO6	3	1	2

Course Name: Advanced Technologies and Monitoring Systems Laboratory

Course Code: CE-694

(Semester VI)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 4 (PE)

1. Course Prerequisite:

Fundamentals of Structural and Geotechnical Engineering, Proficiency in statistical analysis, MATLAB, or Python, Basic understanding of Non-Destructive Testing (NDT) Techniques, Basic understanding of Material Testing and Pavement Analysis.

2. Course Learning Objectives:

- To develop proficiency in non-destructive testing (NDT) methods.
- To apply advanced monitoring techniques for structural and geotechnical evaluation.
- To integrate smart technologies for real-time infrastructure monitoring.
- To analyze pavement and bituminous material performance.
- To evaluate material behavior under accelerated conditions.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Passing criteria: 50% and above

PCIA (60 marks): Continuous Assessment, Attendance, Viva.

Practical End Semester Examination (40 Marks): Written test.

4. Course Content:

Course Name: Advanced Technologies and Monitoring Systems Laboratory

Course Code: CE-694

Hours per Week: 0L:0T:2P

Credits: 1

Experiment	Topics	14P	100%
1.	Non-Destructive Testing (NDT) of Concrete: Rebound Hammer Test for Surface Hardness	1P	07
2.	Ultrasonic Pulse Velocity (UPV) Test for Concrete Quality and Homogeneity Assessment	1P	07
3.	Combined Rebound Hammer and UPV Testing for Structural Integrity Evaluation of Buildings	1P	07
4.	Accelerated Curing Tank: Evaluating Early Strength Gain in Concrete Specimens	1P	07
5.	Ultrasonic Pulse Velocity (UPV) Test on Concrete under Accelerated Curing Conditions	1P	07
6.	Dynamic Cone Penetration Test (DCPT) for Soil Layer Strength and Stiffness Evaluation	1P	07
7.	Soil Moisture and Pressure Sensor Interface with Raspberry Pi for Geotechnical Stability Analysis	1P	07
8.	Calibration and Testing of Strain Gauges and Accelerometers for Structural Monitoring	1P	07
9.	Real-Time Data Logging and Analysis Using DAQ Systems	1P	07
10.	Aerial surveying in civil engineering using IZI Fly Drone	1P	07
11.	Modified Roughness Evaluation Using MERLIN for Pavement Surface Profiling	1P	07
12.	Indirect Tensile Strength Test of Bituminous Mix for Tensile and Cracking Resistance Analysis	1P	07
13.	Real-Time Pavement Health Monitoring: Integration of Temperature and Strain Sensors with Raspberry Pi	1P	07
14.	Centrifuge Extractor Test: Separation of Liquid and Solid Particles in Bituminous Materials	1P	09

15. References: NA

16. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Implement NDT techniques (Rebound Hammer, UPV) for concrete quality assessment.	Implement	Apply
CO2	Examine soil properties using DCPT and sensor-based geotechnical monitoring.	Examine	Analyze
CO3	Demonstrate real-time data acquisition using DAQ systems and sensors.	Demonstrate	Apply
CO4	Appraise pavement roughness, bituminous mix performance, and tensile strength.	Appraise	Evaluate

CO5	Formulate aerial surveying techniques using drones and smart monitoring technologies to enhance civil infrastructure assessment and analysis.	Formulate	Create
CO6	Develop skills in calibration, data interpretation, and decision-making for civil engineering applications.	Develop	Create

17. Mapping of course outcomes to module / course content

Experiment	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	2
2	3	-	-	-	-	2
3	3	-	-	-	-	2
4	2	-	-	-	-	3
5	3	-	-	-	-	2
6	-	3	-	-	-	2
7	-	3	-	-	-	2
8	-	-	3	-	-	2
9	-	-	3	-	-	2
10	-	-	2	-	3	2
11	-	-	-	3	-	-
12	-	-	-	3	-	-
13	-	-	2	2	-	-
14	-	-	2	-	-	3

18. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	2	2	-	-	-	-	-	1
CO2	2	2	-	2	2	-	-	-	-	-	1
CO3	1	1	1	2	3	-	-	-	-	1	2
CO4	2	1	1	2	1	-	-	-	-	-	1
CO5	1	2	2	3	3	1	1	-	1	2	2
CO6	1	2	1	2	2	1	-	-	1	2	3

19. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	2
CO3	1	1	3
CO4	2	1	2
CO5	1	2	3
CO6	1	2	3



Department of Civil Engineering
(Detailed Autonomous Syllabus)

Course Name: INTELLIGENT TRANSPORTATION SYSTEMS

Course Code: CE-701

(Semester VII)

Category: Minor

Course Broad Category: CORE ENGG (Professional Core Courses)

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics and Geography; Undergraduate level introductory knowledge of Transportation Engineering.

2. Course Learning Objectives:

- This course will enable students to have an awareness and scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control.
- Students will also learn how Intelligent transport systems (ITS) involve the application of information technology and telecommunications to control traffic, inform travellers and drivers, operate public transport, automating payments, handle emergencies and incidents, operate commercial fleets and freight exchange, and automate driving and safety.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Intelligent Transportation Systems

Course Code: CE-701

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Basic elements of intelligent transportation systems (ITS): focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), process of video data collection	8L
2.	Telecommunications in ITS – The importance of telecommunications in the ITS system, information management, and traffic management centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.	7L
3.	ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS)	7L

4.	ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, and Information Management.	8L
5.	Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.	6L
6.	ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility, Travel demand management: electronic toll collection, and ITS and road-pricing.	6L

7. References:

Text Book:

- Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House.
- Pradip Kumar Sarkar, Amit Kumar Jain, “Intelligent Transport Systems”, PHI Learning Publishers
- Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)” ITS Hand Book 2000.
- Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.

Reference Books:

- US Department of Transportation, “National ITS Architecture Documentation”, 2007 (CDROM).
- Turban. E and Aronson. J. E, “Decision Support Systems and Intelligent Systems”

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To discuss the historical background and evolution of intelligent transportation systems (ITS).	Discuss	Understand
CO2	To describe the role of ITS and its benefits and challenges in improving the transportation experiences of users and system managers.	Describe	Understand
CO3	To use the engineering applications of ITS and ITS architecture.	Use	Apply
CO4	To appraise the technological requirements and suggest the appropriate systems in various functional areas of ITS	Appraise	Examine
CO5	To execute the knowledge of ITS standards and specifications.	Execute	Apply
CO6	To implement the ITS applications in various transportation modes to improve their safety and efficiency.	Implement	Apply

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	2	2	3	-
6	-	-	2	2	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	3	-	-	-	-	-	-	-	3
CO2	-	-	3	2	-	-	-	-	-	-	3
CO3	-	2	3	2	-	-	-	-	-	-	2
CO4	-	2	3	3	-	-	-	-	-	-	2
CO5	-	2	3	2	-	-	-	-	-	-	3
CO6	-	-	3	-	-	-	-	-	-	-	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	2
CO3	3	1	1
CO4	3	2	1
CO5	2	2	2
CO6	3	1	2

Course Name: PAVEMENT MATERIALS

Course Code: CE-702

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics, Numerical Methods and Geography; Undergraduate level introductory knowledge of Transportation Engineering.

2. Course Learning Objectives:

- The objective of the course is to teach students the essential components and materials used in pavement, and interactions between different materials and layers.
- The course aims to provide students with fundamental tests on pavement materials and to understand their properties.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Pavement Materials

Course Code: CE-702

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Introduction: Basic road construction materials: Types of basic materials, Suitability of different materials depending on their availability and characteristics, Economic, Environmental, and Social issues of material usage, Life cycle analysis, and its use in design	10L

2.	Soil: Classification; Index & Engineering properties of soil, Properties of sub-grade; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Introduction to Soil Stabilization: Physical and Chemical Modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. CBR, Plate Load test, resilient modulus, DCPT	5L
3.	Aggregate: Characterization: Origin, classification, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical sieve methods and Shape factor in mix design	7L
4.	Bitumen Binders: Different types, properties and uses, Tests on bitumen, Rheological and pavement performance-related properties, and Criteria for selection of different binders. Marshall Method of mix design, Additives & Modifiers in Bituminous mixes, problems on mix design	7L
5.	Cement: Requirements, design of mix for CC pavement, use of additives, IRC specifications & Tests, joint filler and sealer materials.	7L
6.	The modern trend of using Modified, Sustainable and Environment-friendly materials: Geo-Synthetics: Geo-synthetic clay liner – Construction details – Geo Synthetic Materials – Functions – Property characterization Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term aging and its effect on bitumen performance Plastic waste: Types of polymer, the applicability of polymer-based waste product in different layers of pavement	6L

7. References:

Text Book:

- Khanna, S. K., Justo, C. E. G., and Veeraraghavan, A., "Highway Engineering", Nem Chand & Bros
- Huang, Y. H., "Pavement Analysis and Design", Pearson Education, India
- Sustainable Highways, Pavements and Materials: An Introduction" by Kasthurirangan Gopalakrishnan, Createspace Independent Pub

Reference Books:

- "Life Cycle Cost Analysis in Pavement Design-Interim Technical Bulletin", Federal Highway Administration
- "Pavement Engineering: Principles and Practice" by Rajib B Mallick and Tahar El-Korchi, CRC Press

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To identify the engineering properties and characteristics of the different materials that concern the pavement engineer	Identify	Understand
CO2	To use the modern testing techniques of soil, granular and bituminous materials for pavement analysis and design	Use	Apply
CO3	To implement the use of different superlative aggregate tests and requirements	Implement	Apply
CO4	To solve the design mix of rigid pavement	Solve	Apply

CO5	To discuss the relationship between key materials and their properties along with the behavior of pavement component systems.	Discuss	Understand
CO6	To select the proper pavement techniques, the deflection of pavements, and methods of maintenance of pavements.	Select	Evaluate

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	3	2	2	2	0	2	2	2
CO2	3	2	3	3	2	2	1	0	3	3	2
CO3	3	2	3	3	2	2	1	0	3	3	2
CO4	3	3	3	3	3	2	3	0	2	2	3
CO5	3	3	3	3	3	2	3	0	2	2	3
CO6	3	3	3	3	3	2	3	0	2	3	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	0	0	0
CO3	1	1	1
CO4	1	1	1
CO5	2	2	2
CO6	0	0	0

Course Name: TOTAL STATION AND GPS SURVEY

Course Code: CE-703

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics, and Geography; Undergraduate level introductory knowledge of Surveying and Geomatics.

2. Course Learning Objectives:

- The student will learn advanced surveying terms using a total station. Following the concept lecture, there will be hands-on field exercises
- The course aims to provide students with tests to help acquire the practical understanding and basic skills needed to work in the surveying industry.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: TOTAL STATION AND GPS SURVEY

Course Code: CE-703

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Introduction to advanced surveying: Concepts, Importance & Necessity of advanced surveying, Study of different surveying methods and instruments, Maps Projections and types, Coordinate Systems and Transformations.	6L
2.	Introduction of GPS: Concepts, Mechanism, and Pre-requirements of the GPS Survey, Coordinate and time systems, Satellite orbital motions, GPS observables, Estimation procedures, Propagation medium, Methods of post-processing GPS data, Instrument handling and setting, Fieldwork, Survey data post-processing, Survey data applications.	6L
3.	Use of GPS in Topographical Survey, Base, Rover, GPS Connections and Settings, Field Work: Point data collection (Easting, Northing, and Height), Electronic Distance Measurement Survey, Area Measurement Survey Height Measurement Survey, Survey Data Post Processing Survey Data Applications.	6L
4.	Introduction to Total Station: Principle and Function, REM, RDM, Use of Total station for data processing and analysis, Fieldwork: Point data collection (Easting, Northing and Height),	7L
5.	Electronic Distance Measurement Survey, Area Measurement Survey Height Measurement Survey, Survey Data Post Processing, Survey Data Applications.	7L
6.	Reconnaissance – Route surveys for highways, railways and waterways – Hydrographic survey- Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge – Mine surveying Equipment – Weisbach triangle – Tunnel alignment and setting out – Transfer of azimuth – Gyro Theodolite – Shafts and audits - Cadastral survey- Legal – Real – Tax cadastre – Land record system – Settlement procedure – deformation studies.	10L

7. References:

Text Book:

- Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin
- R. Subramanian, Surveying and Levelling, Oxford University Press
- Alfred Leick, GPS satellite surveying, John Wiley & Sons
- Basak, N. N.: Surveying and Levelling, Tata McGraw-Hill Education, Delhi

Reference Books:

- Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
- "Textbook of Surveying" by C. Venkatramaiah, University Press Publishers

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To Explain the concepts, importance, and necessity of advanced surveying, including different surveying methods, instruments, and coordinate transformations.	Explain	Understand
CO2	To Use GPS principles for topographical surveying, coordinate determination, and post-processing of survey data.	Use	Apply
CO3	To Operate Total Station for accurate data collection, electronic distance measurement, area and height surveys, and post-processing applications	Operate	Apply
CO4	To Execute reconnaissance and route surveys for highways, railways, and waterways, including hydrographic surveys and river current measurements.	Execute	Apply
CO5	To Organize mine surveying techniques, including tunnel alignment, transfer of azimuth, and the use of specialized equipment.	Organize	Analyze
CO6	To Demonstrate cadastral surveys for legal, tax, and land records, incorporating settlement procedures and deformation studies for land management.	Demonstrate	Apply

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	1	1	1	1
2	2	3	2	1	1	1
3	2	2	3	2	1	1
4	-	-	2	3	-	-
5	-	-	-	2	3	-
6	-	-	-	-	2	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	1	1	1	1	2	3
CO2	3	3	2	2	3	1	2	1	2	2	3
CO3	3	3	3	2	3	1	2	1	2	2	3
CO4	2	3	3	3	3	2	3	1	2	2	3
CO5	2	3	3	3	3	2	2	1	2	2	3
CO6	2	2	3	3	3	3	3	2	2	2	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	2
CO3	2	3	3
CO4	2	2	3
CO5	2	2	3

CO6	2	2	3
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Course Name: AIR AND NOISE POLLUTION CONTROL

Course Code: CE-704

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 5 (PE)

1. Course Prerequisite:
Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering
2. Course Learning Objectives:
 - i. To develop an understanding of air pollutants, their sources, classification, and effects on human health, vegetation, and materials, while analyzing atmospheric phenomena such as photochemical smog, ozone layer depletion, acid rain, greenhouse effect, and global warming
 - ii. To familiarize students with air and noise pollution measurement techniques, air quality standards, and control methods, including the design of pollution mitigation strategies for gaseous and particulate pollutants, noise pollution assessment, and regulatory compliance.
3. Teaching methodology and evaluation system for the course:
Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
Evaluation System –
CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
Final exam: 60 marks
4. Course Content:
Course Name: Air and Noise Pollution and Control
Course Code: CE-704
Hours per Week: 3L:0T:0P
Credits: 3

Module	Topics	42L
1.	Air Pollutants Sources; Classification; Effects on Human, Vegetation, Material Effects of Air pollution on Atmosphere: Photochemical Smog, Ozone Layer Depletion, Acid Rain, Greenhouse Effect and Global Warming	6L
2.	Air Pollutants Dispersion and Meteorology Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height Harnessing Solar Energy, Sustainable Water utilization in Construction Processes, Rainwater Harvesting and Greywater Recycling, Automatic Controls in Water Supply and Transportation Management. Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern	8L

3.	Air Quality and Control of Air Pollution Methods of Measurement: Gaseous pollutants, Particulate pollutants Air Quality Standards and Indices: Ambient Air Quality Standard, NAAQS, Emission Standard, Air Quality Indices Control of Gaseous Pollutants: Adsorption, Absorption, Condensation Control of Particulate Pollutants: Settling chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators Control of Pollution from Automobiles	14L
4.	Basics of Noise and Its Measurement Basics of Acoustics; Sound Pressure, Power and Intensity and their Interrelations Noise Level; Interrelation between Noise, Pressure, Power and Intensity Levels; Noise Meter; Noise Networks; Frequency Band Analysis; Decibel Addition Measurement of Community Noise: LN, Leq, Ldn,, LNP	8L
5.	Source and Effect of Noise Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes	2L
6.	Noise Pollution Control Noise Standards and Limits; Methods of Noise Pollution Control	4L

7. References:

Reference Books:

- Air Pollution and Control, Keshav Kant, Rajni Kant, Khanna Publishing House
- Environmental Engineering, S.C. Sharma, Khanna Publishing House
- Introduction to Environmental Engineering and Science, Masters, G.M., Ela, W.P., Prentice Hall / Pearson
- Environmental Engineering: A Design Approach., Sincero, A., Sincero, G., Prentice Hall
- Environmental Engineering. Volume-1 and Volume-2., Garg, S.K., Khanna Publishers
- Air Pollution, Rao, M.N., Rao, H.V.N., Tata McGraw Hill

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the basic concepts and terminologies regarding air pollution and noise pollution.	Explain	Understand
CO2	Demonstrate the physics of air pollution and noise pollution.	Demonstrate	Apply
CO3	Use the methods to solve the air pollution and noise pollution measurements.	Use	Apply
CO4	Examine different concepts of air and noise pollution for solving mathematical Problems.	Examine	Analyse
CO5	Examine air and noise quality with allowable standards and limits.	Examine	Analyse
CO6	Select and design proper techniques for air pollution, noise pollution, and control.	Select and Design	Creat

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	3	-	-	-	-
3	-	3	3	3	3	3
4	-	-	3	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	-	2	-	-	-	-	-
CO2	1	2	3		2	2	-	-	-	-	1
CO3	1	2	3	2	2	2	-	-	-	-	1
CO4	1	2	3	3	2	2	-	-	-	-	2
CO5	1	2	2	2	-	2	-	-	-	-	-
CO6	1	-	-	-	-	2	3	-	-	-	-

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	2
CO3	3	1	2
CO4	3	1	3
CO5	2	1	2
CO6	3	1	2

Course Name: PRESTRESSED CONCRETE

Course Code: CE-712

(Semester VII)

Category: MAJOR

Course Broad Category: ELECTIVE (PE)

1. Course Prerequisite:

Solid Mechanics, Concrete Technology, Structural Analysis I and II and Design of RC Structures.

Course Learning Objectives:

- The course focuses on different types of loads, and methods used for designing reinforced concrete structural elements, such as beams, slabs, columns, footings, and staircases, while considering serviceability criteria.
- Going through the course students would develop first-hand knowledge in preparing structural drawings, detailing, and producing accurate design calculations in the appropriate professional format for reinforced concrete structures.

2. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

Total Marks: 100 [40(CIA) + 60% of (ESE)]

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks.

3. Course Content:

Course Name: PRESTRESSED CONCRETE

Course Code: CE-712

Hours per Week: 3L-0T-0P

Credits: 3

Module	Topics	42L
1.	Losses in Prestress: Analysis of PSC flexural members –Basic concepts- Ultimate strength in flexure –Codal provisions. Losses in Prestress: Losses in Prestress –Codal provisions. Deflections of prestressed concrete members.	12L
2.	Shear and Torsional Resistance: Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending. Limit State Design Criteria: Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability. Design of Prestressed Concrete Section: for Flexure & methods by Lin and Magnel.	12L
3.	Anchorage Zone stresses in post tensioned members: Stress distribution in end block, anchorage zone reinforcement.	5L
4.	Statically Indeterminate Structures: Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments.	5L
5.	Composite Construction of Prestressed and In-situ Concrete: Types, Analysis of Stresses.	4L
6.	Prestressed Concrete Poles and Sleepers: Design of Sections for Compression and Bending. Introduction to Partial Prestressing.	4 L

6. References:

Text Book:

- Prestressed Concrete N. Krishna Raju TMH.
- Prestressed Concrete Ramamuthram Dhanpat Rai Publishing Company.
- Prestressed Concrete Srikant Vanakudre Khanna Publishing House.
- Fundamentals of Prestressed Concrete N.C.Sinha and S.K.Roy S. Chand.

IS Codes:

- IS: 1343: 2012 : Prestressed Concrete — Code of Practice

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the basic concepts of prestressed concrete members, losses in prestress and its deflection properties.	Identify	Understand
CO2	Develop the design criteria of prestressed concrete section for flexure and shear properties.	Develop	Create
CO3	Design the anchorage zone stress for post-tensioned members.	Design	Create
CO4	Use the methods for analysis of Statically Indeterminate Structures	Use	Apply

CO5	Explain the composite construction of prestress and In- situ concrete.	Explain	Understand
CO6	Design the prestressed concrete poles and sleepers and introduction of partial prestressing.	Design	Create

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	-	-	-	-	-	-	1
CO2	3	2	2	3	-	-	-	-	-	-	-
CO3	3	2	3	3	-	-	-	-	-	-	-
CO4	3	2	3	3	-	-	-	-	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	-
CO6	3	2	3	1	-	-	-	-	-	-	-

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	3
CO6	3	2	3

Course Name: TRAFFIC ENGINEERING AND MANAGEMENT

Course Code: CE-713

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE

1. Course Prerequisite:

Class-XII level knowledge of Physics, Mathematics; Undergraduate level introductory knowledge of Road Geometry and Traffic Engineering.

2. Course Learning Objectives:

- Students will gain insights into various traffic components, assess traffic characteristics, and analyze related issues.
- Students will acquire the skills to design and conduct traffic surveys, enabling them to collect, analyze, and interpret traffic data effectively.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Traffic Engineering and Management

Course Code: CE-713

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Introduction – Objectives and scope of traffic engineering – Components of road traffic: vehicle, driver and road – Road user and vehicle characteristics and their effect on road traffic – Traffic manoeuvre	6L
2.	Traffic Stream Characteristics – Relationship between Speed, Flow and Density. Objectives, methods, equipment, data collection, analysis and interpretation (including case studies) of (a) Speed and delay, (b) Origin and destination, (c) Parking, (d) Accident and other studies.	10L
3.	Traffic operation and management, Design, Regulation and Management of Traffic Engineering Facilities: Control of traffic movements through time sharing and space sharing concepts, Intersection: traffic signal design, traffic signs and markings, Design of T, roundabout, mini-roundabout and other forms of at-grade crossings including provision for safe crossing of pedestrians and cyclists – Grade separated intersections; Road accidents and safety measures.	10L
4.	Bus stop location and bus bay design – Road lighting – Regulations on vehicles, drivers and traffic – Planning and design of traffic management measures: one-way streets, reversible lanes and roadways, turn regulation, transit and carpool lanes – Planning and design of pedestrian facilities – Traffic calming.	6L
5.	Traffic Control Devices and Environmental Control: Different methods of signal design – Redesign of existing signals including case studies – Signal coordination.	6L
6.	Air and Noise pollution of different transport modes – Visual impacts – Impacts on land development -Technological approaches to improving environment. Urban planning; Transport Demand Analysis.	4L

7. References:

Text Book:

- “Traffic Engineering and Transportation Planning”, Kadiyali, L.R., Khanna Publishers
- “Transportation Engineering & Planning”, Papacostas, C.S., and Prevedouros, P. D., Prentice Hall India
- “Traffic & Highway Engineering”, Graber, N.J., and Hoel, L.A., Brooks/Cole
- “Transportation Engineering; An Introduction”, Khisty, C.J., and Lal, B. K., Prentice-Hall India

Reference Books:

- Mannering, F.L., Kilareski, W.P., and Washburn, S.S., “Principles of Highway Engineering and Traffic Analysis”, Wiley India
- Khanna, S. K., Justo, C. E. G., and Veeraraghavan, A., “Highway Engineering”, Nem Chand & Bros

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To explain the characteristics of traffic flow, traffic studies, capacity analysis and LOS, principles of traffic control devices and road accident study	Explain	Understand
CO2	To describe the principles of transportation planning, design of public transportation system	Describe	Understand
CO3	To use the traffic signals and traffic signs for road safety	Use	Apply
CO4	To examine the effectiveness of signalized and unsignalized intersections	Examine	Analyze
CO5	To relate the impact of traffic engineering decisions on environmental sustainability and urban development	Relate	Analyze
CO6	To support the effectiveness of Transportation planning in enhancing traffic efficiency and safety.	Develop	Evaluate

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	2	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	-	-	-
5	2	-	2	3	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	-	-	2	-	-	-	-
CO2	3	2	3	3	-	-	2	-	-	-	1
CO3	3	2	3	3	3	-	2	-	-	-	1
CO4	3	2	-	3	-	-	2	-	-	-	2
CO5	3	2	-	3	3	-	2	-	-	-	-
CO6	3	2	-	3	-	-	2	3	-	-	-

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	1	2
CO4	2	1	2
CO5	2	1	2
CO6	2	1	2

Course Name: RAINWATER HARVESTING
Course Code: CE-714
(Semester VII)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE (PE)

1. Course Prerequisite:
Fluid Mechanics and Hydraulic Engineering.
2. Course Learning Objectives:
 - i. Students will understand traditional and modern rainwater harvesting methods, water availability, and runoff estimation.
 - ii. They will apply rainwater harvesting techniques for sustainable water management and analyze policies, challenges, and future prospects.
3. Teaching methodology and evaluation system for the course:
 Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
 Evaluation System –
 CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 Final exam: 60 marks
4. Course Content:
 Course Name: Rainwater Harvesting
 Course Code: CE-714
 Hours per Week: 3L:0T:0P
 Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	Rainwater Harvesting in Ancient India: Traditional Rainwater Harvesting Systems (Stepwells, Tanks, Baolis, Kunds, Jhalaras, Johads, Bamboo Drip Irrigation); Indigenous Knowledge & Water Conservation Practices; Relevance in Modern Water Management.	6L	14
2.	Water Crisis and the Need for Rainwater Harvesting: Global & Indian Water Scenario; Causes of Water Scarcity; Depletion of Groundwater; Rainwater Harvesting as a Solution; Case Studies from Water-Stressed Regions.	7L	17
3.	Rainfall Availability and Runoff Estimation: Hydrological Cycle; Precipitation Measurement & Analysis; Estimation of Rainwater Potential; Runoff Coefficients; Factors Affecting Runoff; Rainfall-Runoff Relationship.	6L	14

4.	Rainwater Harvesting Techniques and Infrastructure: Catchment Areas (Rooftops, Open Lands); Collection & Conveyance Systems (Gutters, Pipes); Storage Systems (Tanks, Ponds, Percolation Pits, Check Dams); Recharge Structures (Wells, Trenches, Aquifer Recharge).	8L	19
5.	Inter-Basin Water Transfer and Large-Scale Water Management: Concept of Inter-Basin Water Transfer; Major River Linking Projects in India; Surface Water vs. Groundwater Management; Impact on Agriculture & Urban Development; Environmental and Social Impacts.	8L	19
6.	Policies, Challenges, and Future Prospects: Government Policies & Regulations; BIS Standards; Incentives & Financial Support; Challenges in Implementation; Climate Change Impact on Rainwater Harvesting; Future Technologies & Smart Water Management Solutions.	7L	17

7. References:

Text Book:

- Rainwater Harvesting, G. N. Virupaksha, Khanna Publishing House.
- Rainwater Harvesting: The Collection of Rainfall and Runoff in Rural Areas, Arnold Pacey, Practical Action Pub.

Reference Books:

- Engineering Hydrology, K. Subramanya, McGraw Hill Education (India) Private Limited.
- Water Law in India: An Introduction to Legal Instruments, Philippe Cullet, Sujith Koonan, OUP India.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe traditional rainwater harvesting systems in ancient India.	Describe	Understand
CO2	Explain the need for rainwater harvesting and water scarcity issues.	Explain	Understand
CO3	Analyze rainfall availability and runoff estimation methods.	Analyze	Apply
CO4	Use rainwater harvesting techniques for collection, storage, and recharge.	Use	Apply
CO5	Judge the impact of inter-basin water transfer on water management.	Judge	Evaluate
CO6	Appraise government policies and challenges in rainwater harvesting.	Appraise	Evaluate

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	3	3	-	1	-	1	2
CO2	3	1	-	-	3	3	-	1	-	1	3
CO3	3	2	2	1	3	3	-	1	1	2	3
CO4	3	3	2	2	2	3	-	1	2	2	3
CO5	3	2	2	1	3	3	-	1	1	2	3
CO6	3	3	3	2	3	3	-	1	1	2	3

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	0
CO2	3	2	1
CO3	3	2	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	3

Course Name: BRIDGE ENGINEERING

Course Code: CE-722

(Semester VII)

Category: Major

Course Broad Category: CORE ENGG (Professional Elective Courses)

1. Course Prerequisite:

Design of RC Structures (CE(PC)501), Structural Analysis – I (CE(PC)503), Design of Steel Structures (CE(PC)604)

2. Course Learning Objectives:

- Students will be able to learn the types, components, and classifications of bridges, along with the principles of structural analysis and design as per relevant codes.
- Students will be able to develop the ability to analyze loads (dead, live, seismic, wind, and impact) and design various bridge components, including superstructure, substructure, and bearings, ensuring strength, stability, and durability.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Bridge Engineering

Course Code: CE-722

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
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1.	Introduction: Definition and basic forms, components of a typical bridge, classification of bridges, site investigation, bridge hydrology and hydraulics. Loads: I.R.C loads, impact factors, wind loads, longitudinal forces, lateral forces and centrifugal forces. Bearings: Types of bearings, details of bearing, joints, design examples	6L
2.	Design of reinforced concrete solid slab bridge: Introduction, general design features, economic span, effective width method, simply supported and cantilever slab bridges, analysis and design.	6L
3.	Design of box culvert bridge: Introduction, design method and design example.	6L
4.	Design of a T beam bridge: Introduction, components, design of interior panel of slab, longitudinal and cross girders, Pigeaud's method, design example.	8L
5.	Design of composite bridge: General aspects, method of construction, analysis of composite section, shear connectors, design of composite beam.	8L
6.	Design of steel bridges and cable stayed bridge: General features, types of stress, design of railway truss bridge and plate girder bridge.	8L

5. References:

IS Codes:

- Relevant IRC and IS codes

Reference Books:

- N. Krishnaraju, Prestressed Concrete Bridges, CBS Publisher.
- Aswani, Vazirani & Ratwani, Design of concrete bridges, 2012, Khanna Publishers.
- Ponnuswamy, Bridge engineering, McGrawHill.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamental concepts of bridge engineering by describing bridge components, classifications, site investigations, hydrology, and various loads, including IRC specifications.	Explain	Understand
CO2	Demonstrate reinforced concrete solid slab bridges using the effective width method, ensuring compliance with design standards and economic span considerations.	Demonstrate	Apply
CO3	Implement structural design principles to box culvert bridges by implementing appropriate design methods and performing calculations for real-world applications.	Implement	Apply
CO4	Demonstrate the structural behavior of T-beam bridges by designing interior panels, longitudinal and cross girders, and using Pigeaud's method for analysis.	Demonstrate	Apply

CO5	Examine composite bridges by analyzing composite sections, selecting appropriate shear connectors, and ensuring structural stability.	Examine	Analyze
CO6	Select steel and cable-stayed bridges by understanding different stress types, truss bridge behavior, and plate girder bridge design principles.	Select	Evaluate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	3	1	1	1	2	3
CO2	3	3	2	2	2	3	0	0	1	1	2
CO3	3	3	2	2	2	3	0	0	1	1	2
CO4	3	3	3	3	2	3	0	0	1	1	2
CO5	3	3	3	3	2	3	0	0	1	1	2
CO6	3	3	2	2	2	3	1	1	1	2	2

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
CO6	3	2	1

Course Name: GROUND IMPROVEMENT TECHNIQUE

Course Code: CE-723

(Semester VII)

Category: Major

Course Broad Category: CORE ENGG (Professional Elective Courses)

1. Course Prerequisite:

Geotechnical Engineering, Foundation Engineering

2. Course Learning Objectives:

- To introduce various problematic soils and familiarize students with ground improvement techniques, including mechanical modification methods such as deep compaction, blasting, vibro-compaction, dynamic tamping, and compaction piles.

- To develop an understanding of ground improvement through drainage, dewatering, and grouting techniques, with a focus on the design of dewatering systems and stabilization of expansive soils.
- To enhance students' knowledge of soil reinforcement techniques, including the concept of reinforced earth and the application of geosynthetics.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Ground Improvement Technique

Course Code: CE-723

Hours per Week: 3L:0T:0P

Credits: 3

Module	Topics	42L
1.	Introduction: General principles of ground improvement, Factors affecting ground improvement methods, Different types of problematic soils, Emerging trends in ground Improvement	6L
2.	Mechanical Stabilization: Shallow and deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and compaction control, Deep compaction and Vibratory methods, Dynamic compaction.	8L
3.	Hydraulic Modification: Ground Improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, Vacuum consolidation, Electro-kinetic dewatering, design and construction methods.	6L
4.	Modification by Admixtures: Cement stabilization and cement columns, Lime stabilization and lime columns. Stabilization using bitumen and emulsions, Stabilization using industrial wastes, Construction techniques and applications.	8L
5.	Grouting: Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.	6L
6.	In Situ Soil Treatment Methods: Soil nailing and ground anchors, rock anchoring, micro-piles, design methods, construction techniques, Functions and applications of geosynthetics – geotextiles, geogrids, geomembranes; soil reinforcement using strips, bars and geosynthetics.	8L

5. References:

Text Book:

- Ground Improvement Techniques: Dr. P. Purushothanma Raj, Laxmi Publications (P) Ltd.
- Nihar Ranjan Patra : Ground Improvement Techniques ; Vikas Publishing house

Reference Books:

- Engineering Principles of Ground Modification: Manfred R. Hanusmann, McGraw-Hill publication.
- S. K. Gulhati and M. Datta, "Geotechnical Engineering", Tata McGraw Hill

6. Course Outcomes:

Course	Details/Statement	Action Verb	Knowledge
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Outcomes			Level
CE-723.1	Identify the type of problems in problematic soils and to suggest different ground improvement techniques to solve these problems.	Identify	Understand
CE-723.2	Design the importance and suitability of shallow and deep compaction techniques like use of different rollers, dynamic tamping, explosion etc.	Design	Create
CE-723.3	Define traditional dewatering system methods and design of drainage and dewatering systems for various civil engineering problems. Design the preloading and vertical drain systems for consolidations.	Define	Remember
CE-723.4	Implement the admixtures like cement and lime for treating expansive soil.	Implement	Apply
CE-723.5	Discuss the importance and suitability of different grouting techniques and grout materials used frequently for underground and foundation constructions.	Discuss	Understand
CE-723.6	Describe the in-situ soil improvement techniques such as use of ground anchors, rock bolts, micro-piles, soil nails, various geo-synthetic materials etc. and to introduce the design and construction techniques of those in-situ soil improvement techniques.	Describe	Understand

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	2	-	-	2	-	2
CO2	3	3	3	2	3	2	-	-	2	-	3
CO3	3	3	3	3	3	2	-	-	2	-	3
CO4	3	3	2	2	2	2	-	-	2	-	2
CO5	3	2	2	2	2	2	-	-	2	-	2
CO6	3	3	3	3	3	3	-	-	3	-	3

9. Mapping to PSO-

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	3
CO3	3	3	3
CO4	3	3	2
CO5	3	2	3
CO6	3	3	3

Course Name: CONTRACT MANAGEMENT
Course Code: CE-724
(Semester VII)
Category: Major
Course Broad Category: Program Elective Course- 7 (PE)

1. Course Prerequisite:
Engineering Economics and Project Planning
2. Course Learning Objectives:
 - i. Understand the principles, types, legal frameworks, procurement strategies, and formation processes of construction contracts, including bidding and execution aspects.
 - ii. Develop skills in contract administration, dispute resolution, claims and risk management, financial aspects, and application of modern technologies in contract management.
3. Teaching methodology and evaluation system for the course:
 Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Problem-solving sessions and tutorials, Guest Lectures and Group projects.
 Evaluation System –
 CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)
 Final exam: 60 marks
4. Course Content:
 Course Name: Contract Management
 Course Code: CE-724
 Hours per Week: 3L:0T:0P
 Credits: 3

Module	Topics	Lecture (42L)
1.	Fundamentals of Contract Management: Importance of contract management in construction, elements of a valid contract, principles of contract law and legal frameworks, roles and responsibilities in contract environments, overview of construction contract lifecycle.	7L
2.	Types of Construction Contracts: Fixed-price contracts, cost-plus contracts, unit price contracts, turnkey contracts, design-build contracts, EPC (Engineering, Procurement and Construction) contracts, comparative analysis and suitability of contract types.	7L
3.	Contract Formation and Procurement: Tendering process, preparation of bid documents, bid evaluation techniques, negotiation and award of contracts, procurement strategies in public and private sectors, ethical considerations in procurement.	7L
4.	Contract Administration and Risk Management: Roles and responsibilities of contract managers, contract documentation and compliance requirements, change orders and contract amendments, identification and mitigation of contract risks, performance bonds, insurance provisions, delay penalties and liquidated damages.	7L
5.	Dispute Resolution and Financial Aspects: Causes of disputes in construction contracts, arbitration, mediation and litigation processes, claims management and settlement procedures, contract financing and payment terms, taxation aspects and legal liabilities, case studies on contract failures and best practices.	7L

Module	Topics	Lecture (42L)
6.	Technology and Modern Practices in Contract Management: Digital contract management tools, use of software platforms in contract administration, role of artificial intelligence and blockchain in contract management, integration of technology in procurement and execution, case studies on technology-driven contract management practices.	7L

5. References:

Text Book:

1. Jimmie Hinze, *Construction Contracts*, McGraw-Hill.
2. Peter S. Reinhardt, *Construction Contract Law*, Routledge.
3. D. Chappell, *Construction Contracts: Questions and Answers*, Routledge.

Reference Books:

1. FIDIC, *Conditions of Contract for Construction (Red Book)*.
2. John Murdoch & Will Hughes, *Construction Contracts: Law and Management*, Taylor & Francis.
3. S. Keoki Sears, *Construction Project Management: A Practical Guide to Field Construction Management*, Wiley.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamentals of contract management and legal principles.	Explain	Understand
CO2	Identify and apply various types of contracts used in construction projects.	Identify	Understand
CO3	Develop procurement strategies and contract administration plans.	Develop	Create
CO4	Investigate contract disputes, claims, and risk management strategies.	Investigate	Create
CO5	Examine financial and legal aspects of construction contracts.	Examine	Analyze
CO6	Judge modern trends and technologies in contract management	Judge	Evaluate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	-	-	-	-	-
Module 2	2	3	-	-	-	-
Module 3	-	2	3	-	-	-
Module 4	-	-	3	3	2	-
Module 5	-	-	-	3	3	2
Module 6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	2	2	-	-	-	-
CO2	2	2	2	-	-	2	-	-	-	2	-
CO3	2	3	3	2	2	2	2	2	2	3	-
CO4	2	3	2	2	-	3	2	2	-	2	-
CO5	2	3	2	-	-	2	2	-	-	2	-

CO6	2	2	2	2	3	2	-	-	-	2	2
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9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	2	-
CO2	2	2	2
CO3	3	2	3
CO4	2	2	3
CO5	2	2	3
CO6	2	3	3

Course Name: INDIAN TOWN PLANNING AND ARCHITECTURE

Course Code: CE-732

(Semester VII)

Category: Minor

Course Broad Category: Indian Knowledge System

1. Course Prerequisite:

- Basics of Town Planning.
- Sustainable Development and Environmental Considerations

2. Course Learning Objectives:

- A. Understand the historical evolution of town planning and architecture in India.
- B. Analyze the principles of Vastu Shastra and traditional planning concepts.
- C. Explore ancient Indian cities, their planning layouts, and architectural significance.
- D. Compare traditional Indian town planning with modern urban planning approaches.
- E. Investigate sustainable and climate-responsive architectural practices in historical Indian cities.
- F. Develop an appreciation for heritage conservation and the role of IKS in contemporary urban design.

3. Teaching methodology and evaluation system for the course:

Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Problem-solving sessions and tutorials, Guest Lectures Field Visits and Group projects.

Evaluation System –

CIA1: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

CIA2: 40 MARKS (25 marks written class test, 15 marks Attendance/assignment)

Final exam: 60 marks

4. Course Content:

Course Name: Indian Town Planning And Architecture

Course Code: CE-732

Hours per Week: 2L:0T:0P

Credits: 2

Module	Topics	Lecture (28L)
1.	Introduction and Evolution of Indian Planning Definition and significance of town planning, evolution of Indian architecture and urban planning, role of Indian Knowledge Systems (IKS) in town planning, overview of traditional and modern planning concepts in India.	4L

2.	Ancient Indian Urban Planning Urban planning in Indus Valley Civilization including Harappa and Mohenjo-Daro, planning principles in Vedic period, Buddhist and Mauryan town planning models, features of ancient Indian settlements and infrastructure systems.	5L
3.	Vastu Shastra and Traditional Planning Fundamentals of Vastu Shastra, mandala concept and its application in site planning, orientation and spatial organization, proportions and design principles in ancient Indian architecture, integration of Vastu principles in settlements.	5L
4.	Medieval, Colonial and Post-Independence Planning Mughal and Rajput town planning characteristics, colonial urban development under British, Portuguese and French influences, transformation of Indian cities during post-independence period, transition from traditional to modern planning systems.	4L
5.	Temple Architecture and Vernacular Settlements Dravidian, Nagara and Vesara styles of temple architecture, traditional housing and settlement patterns across different regions of India, use of local materials and construction techniques, climatic responsiveness and sustainability in vernacular architecture.	5L
6.	Modern Planning, Heritage and Case Studies Smart cities and integration of sustainability principles from traditional Indian towns, application of GIS, BIM and digital tools in urban planning, conservation of heritage towns and monuments, adaptive reuse of heritage structures, role of government policies in heritage management, case studies including Jaipur, Chandigarh and revitalization of historic towns.	5L

7. References:

Text Book:

- A. Satish Chandra, *History of Architecture and Town Planning in India*, CBS Publishers.
- B. V. S. Pramar, *Design Fundamentals in Architecture*, Somaiya Publications.
- C. V. Doshi, *Traditional Indian Architecture: A Study of Its Typology*, Oxford & IBH.

Reference Books:

- A. Percy Brown, *Indian Architecture (Buddhist and Hindu Periods)*.
- B. James Fergusson, *History of Indian and Eastern Architecture*.
- C. S. K. Joshi, *Town Planning and Sustainable Development in India*.
- D. *Ancient Indian Architecture* – ASI (Archaeological Survey of India) Reports.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the evolution of Indian town planning and architectural principles.	Explain	Understand
CO2	Contrast the concepts of Vastu Shastra and its impact on traditional planning.	Contrast	Analyze
CO3	Compare ancient and modern town planning methodologies.	Compare	Analyze
CO4	Explain the role of sustainability in historical Indian architecture.	Explain	Understand
CO5	Critique the significance of heritage conservation and urban revitalization.	Critique	Evaluate
CO6	Use GIS, BIM, and digital tools in contemporary urban planning with IKS integration	Use	Apply

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	-	2	-	-	-
Module 2	3	-	3	2	-	-
Module 3	2	3	2	2	-	-
Module 4	2	-	3	-	2	-
Module 5	-	2	-	3	2	-
Module 6	-	-	2	2	3	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	2	-	-	-	-	-
CO2	2	3	-	-	-	2	-	-	-	-	-
CO3	2	3	2	2	-	2	-	-	-	-	-
CO4	2	2	-	-	-	3	2	-	-	-	-
CO5	2	3	2	2	-	3	2	-	-	-	-
CO6	2	2	2	2	3	2	-	-	-	2	2

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	2	2
CO3	2	2	2
CO4	2	2	3
CO5	2	2	3
CO6	2	2	3

Course Name: DISASTER PREPAREDNESS & PLANNING

Course Code: CE-781

(Semester VII)

Category: SKILL ENHANCEMENT COURSE

Course Broad Category: MULTIDISCIPLINARY NON-CREDIT COURSE

1. Course Prerequisite:

Class-XII level knowledge of Indian Geography and Undergraduate level knowledge of Environmental Engineering, Geotechnical Engineering, Hydrology & Water Resources Engineering.

2. Course Learning Objectives:

- To understand the fundamental concepts of disasters, hazards, vulnerability, risks, and their impact on society and the environment.
- To understand different types of disasters, including natural and man-made, with a focus on India's hazard and vulnerability profile.
- To understand the impacts of disasters on physical, social, economic, and political structures, along with the influence of climate change.
- To examine disaster risk reduction strategies, including prevention, mitigation, preparedness, and response measures.
- To understand accessibility and emergency services for differently-abled individuals in disaster management contexts.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam

4. Course Content:

Course Name: Disaster Preparedness & Planning

Course Code: CE-781

Hours per Week: 3L:0T:0P

Credits: 0

Module	Topics	42L	100%
1.	Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation.	4L	10
2.	Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.	8L	20
3.	Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.	8L	20
4.	Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief, and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs, and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India, and the activities of the National Disaster Management Authority.	10L	24
5.	Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.	6L	13
6.	Accessibility in Disaster Contexts and Emergency Services for Differently Abled publics (Accessibility in Context of Disaster Preparedness, Response, Mitigation and reconstruction)	6L	13

7. References:

Text Book:

- Disaster Management, S.C. Sharma, Khanna Publishing House, 2022.
- Disaster Risk Reduction in South Asia, Pradeep Sahni, Prentice Hall, 2004.

Reference Books:

- Handbook of Disaster Management: Techniques & Guidelines, Singh B.K, Rajat Publication, 2008.
- <http://ndma.gov.in/> (Home page of National Disaster Management Authority)
- <http://www.ndmindia.nic.in/> (National Disaster management in India, Ministry of Home Affairs).

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Classify different types of disasters and their causes	Classify	Understand
CO2	Identify the impacts of disasters on environmental, social, and economic systems.	Identify	Understand
CO3	Demonstrate disaster risk reduction strategies and policies, considering preparedness, mitigation, and response measures.	Demonstrate	Apply
CO4	Use scientific and engineering approaches to disaster management, focusing on risk assessment and mitigation.	Use	Apply
CO5	Examine the role of environmental factors and sustainable development in disaster response and recovery.	Examine	Analyse
CO6	Appraise accessibility and emergency services for vulnerable populations in disaster management.	Appraise	Evaluate

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	-	3	-	-	-	-
4	-	-	3	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	2
CO2	2	3	2	2	-	2	3	-	-	-	2
CO3	-	2	3	2	2	2	3	-	2	2	2
CO4	3	2	2	3	3	2	2	-	-	-	3
CO5	2	2	2	-	-	3	3	-	-	-	2
CO6	-	-	2	-	-	2	2	2	2	2	2

11. Mapping to PSO

CO	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	2	2

CO4	3	3	2
CO5	3	3	2
CO6	2	2	-

Course Name: PAVEMENT MATERIALS LABORATORY

Course Code: CE-791

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE

Course Prerequisite:

Undergraduate level knowledge of Transportation Engineering, Basic Geotechnical Engineering Laboratory, Pavement Materials and Concrete Technology Laboratory.

1. Course Learning Objectives:

By the end of the course, students will be able:

- i. To understand the characteristics and properties of various materials used in pavement construction.
- ii. To gain practical knowledge through testing of materials like aggregates, bitumen, soil, and other pavement components.
- iii. To interpret and analyze the test results for their suitability in pavement construction.
- iv. To develop skills in preparing material specifications and quality control tests.

2. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory sessions, Lab-based experiment demonstrations, discussions on testing procedures, hands-on practice with testing equipment, Problem-solving sessions, Presentations, Lab Reports and Data Interpretation.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam

3. Course Content:

Course Name: Pavement Material Laboratory

Course Code: CE-791

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	14P
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Experiment 1	Grain Size Analysis – Sieve Analysis and Job Mix Calculation	1P
Experiment 2	Modified Proctor Compaction Test	1P
Experiment 3	California Bearing Ratio (CBR) Test on Stabilized Soil	1P
Experiment 4	Unconfined Compressive Strength (UCS) Test on Stabilized Soil	1P
Experiment 5	Impact Value Test on Aggregates and Shape Test	1P
Experiment 6	Los Angeles Abrasion Test	1P
Experiment 7	Water Absorption & Specific Gravity Test	1P
Experiment 8	Penetration Test and Softening Point Test on Bitumen	1P
Experiment 9	Ductility Test and Flash and Fire Point Test on Bitumen	1P
Experiment 10	Bitumen Content by Centrifuge Extractor	1P
Experiment 11	Design of RAP-Bituminous Mix and Marshall Stability Test	1P
Experiment 12	Modified Bitumen Performance Testing	1P
Experiment 13	Moisture Susceptibility Testing of Bituminous Mixes	1P
Experiment 14	Test on Concrete for Pavement	1P

4. References:

IS 2386 (Part I to Part VIII) – Indian Standard Methods of Test for Aggregates

IS 1203 – Methods of Test for Bitumen

IS 2720 (Part 1 to Part 16) – Methods of Test for Soils

IS 6241 – Methods of Test for Bituminous Mixes

IRC 37 – Guidelines for the Design of Flexible Pavements

Text Book:

- Khanna, S. K., Justo, C. E. G., and Veeraraghavan, A., "Highway Engineering", Nem Chand & Bros
- Huang, Y. H., "Pavement Analysis and Design", Pearson Education, India
- Sustainable Highways, Pavements and Materials: An Introduction" by Kasthurirangan Gopalakrishnan, Createspace Independent Pub

Reference Books:

- "Life Cycle Cost Analysis in Pavement Design-Interim Technical Bulletin", Federal Highway Administration
- "Pavement Engineering: Principles and Practice" by Rajib B Mallick and Tahar El-Korchi, CRC Press

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To Identify the properties and classification of aggregates and bitumen used in pavement construction.	Identify	Understand
CO2	To Use the aggregates and bituminous materials to determine their suitability in pavements through laboratory tests.	Use	Apply
CO3	To Use bituminous mixtures and evaluate their properties based on stability and performance requirements.	Use	Apply

CO4	To Execute soil and concrete testing for pavements and analyze their bearing capacity, strength, and suitability for construction.	Execute	Apply
CO5	To Implement the knowledge of compaction, CBR, and other soil tests to determine the suitability of subgrade materials.	Implement	Apply
CO6	To Relate the practical aspects of pavement materials testing and their impact on the design and durability of pavements.	Relate	Analyze

6. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	2	1	2	2
2	1	2	1	3	3	2
3	3	3	2	1	1	2
4	3	3	2	1	1	2
5	2	2	3	1	1	3
6	1	1	2	3	2	3

7. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	1	2	1	2	2	3
CO2	3	3	2	3	3	2	2	1	2	2	3
CO3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	3	3	2	3	2	2	1	2	2	3
CO5	2	3	3	3	3	2	3	1	2	2	3
CO6	3	3	3	3	3	2	3	2	2	2	3

8. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3
CO6	2	3	3

Course Name: Total Station and GPS Survey Laboratory

Course Code: CE-792

(Semester 7th)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE

1. Course Prerequisite:

- Basic Knowledge and understanding about surveying.
- Fundamental knowledge of GPS.

2. Course Learning Objectives:

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

1. Perform advanced survey using a total station.
2. Glide and control a drone for image capturing for surveying properly.
3. Understand about GPS.

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam

3. Course Content:

Course Name: Total Station and GPS Survey Laboratory

Course Code: CE-792

Hours per Week: 0L:0T:2P

Credits: 1

Module	Topics	14P
Experiment 1	Introduction to Total Station & GPS: Understanding instrument components, functions and set up procedures.	1P
Experiment 2	Coordinate Systems & Transformations: Practical demonstration of different coordinate systems and their transformations.	1P
Experiment 3	Determine of area using Total Station.	1P
Experiment 4	Determining Easting, Northing and Height using Total Station	1P
Experiment 5	Contouring using Total Station	1P
Experiment 6	Determination of Remote height using Total Station	1P
Experiment 7	Stake out using Total Station	1P
Experiment 8	Electronic Distance & Gradient measurement with a total station.	1P
Experiment 9	Curve Setting Using Total Station	1P
Experiment 10	Drone surveying with GPS	1P
Experiment 11	Using a stereoscope to view aerial photos	1P
Experiment 12	Conducting surveys for area calculations using GPS techniques.	1P
Experiment 13	Post Processing of GPS Data: Processing field data using software tools for accuracy enhancement.	1P
Experiment 14	Hydrographic & Route Surveying: Conducting river surveys, route alignments for highways and railway applications.	1P

6. References:

Text Book:

- Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin
- R. Subramanian, Surveying and Levelling, Oxford University Press
- Alfred Leick, GPS satellite surveying, John Wiley & Sons
- Basak, N. N.: Surveying and Levelling, Tata McGraw-Hill Education, Delhi

Reference Books:

- Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
- "Textbook of Surveying" by C. Venkatramaiah, University Press Publishers

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
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CO1	To Explain the principles, components, and setup procedures of Total Station and GPS for surveying applications.	Explain	Understand
CO2	To Use coordinate systems and transformation techniques for accurate geospatial data representation.	Use	Apply
CO3	To Execute terrain mapping and area calculations using Total Station and GPS, including contouring, remote height determination, and stake-out procedures.	Execute	Apply
CO4	To Operate Total Station for precise distance, gradient measurements, and curve setting in surveying applications.	Operate	Apply
CO5	To Implement drone-based surveying and aerial photogrammetry techniques for geospatial analysis.	Implement	Apply
CO6	To Examine hydrographic and route surveys for infrastructure projects, including data post-processing for accuracy enhancement.	Examine	Analyze

8. Mapping of course outcomes to module/course content

Experiments	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1.	3	2	2	2	1	1
Experiment 2.	3	3	2	2	1	1
Experiment 3.	2	2	3	2	1	1
Experiment 4.	2	2	3	2	1	1
Experiment 5.	1	1	3	2	1	1
Experiment 6.	1	1	3	2	1	1
Experiment 7.	1	1	2	2	1	1
Experiment 8.	1	1	1	3	1	1
Experiment 9.	1	1	1	3	1	1
Experiment 10.	1	1	1	1	3	2
Experiment 11.	1	1	2	1	3	2
Experiment 12.	1	2	3	2	2	2
Experiment 13.	1	2	2	2	2	3
Experiment 14.	1	1	2	1	1	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	1	1	1	1	3	3
CO2	3	3	2	2	3	1	2	1	2	2	3
CO3	3	3	3	2	3	1	2	1	2	2	3
CO4	2	3	3	3	3	2	3	1	2	2	3
CO5	2	2	2	2	2	2	2	2	2	2	2
CO6	2	2	3	3	3	3	3	2	2	2	3

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	2
CO3	2	3	3
CO4	2	3	3
CO5	1	3	3
CO6	2	2	3

Course Name: Basic AIR AND NOISE POLLUTION CONTROL LABORATORY

Course Code: CE-793

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 5 (PE)

1. Course Prerequisite:

Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering and Air and Noise Pollution Control

2. Course Learning Objectives:

- i. Understand Soil Properties and Classification
- ii. Perform Soil Sampling and Preparation
- iii. Conduct Standard Laboratory Tests
- iv. Analyze Soil Strength and Compressibility
- v. Evaluate Soil Permeability and Seepage
- vi. Interpret and Report Laboratory Data
- vii. Develop Problem-Solving Skills
- viii. Collaborate in a Team Environment

3. Teaching methodology and evaluation system for the course:

Teaching methodology – Hands-on Laboratory Sessions, Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.

Evaluation System –

Total Marks: 100 [60(PCIA) + 40(PESE)]

Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks (Continuous assessment, Attendance, viva)

Section 2: Practical End Semester Examination (PESE) - 40 Marks Written Exam

4. Course Content:

Course Name: Air and Noise Pollution Control Laboratory

Course Code: CE-793

Hours per Week: 2P

Credits: 1

Experiment 1	Sampling of PM ₁₀ in Ambient Air and Determination of its Concentration
Experiment 2	Sampling of PM _{2.5} in Ambient Air and Determination of its Concentration

Experiment 3	Measurement of Sulphur Dioxide (SO ₂) Concentration in Ambient Air
Experiment 4	Measurement of Nitrogen Dioxide (NO ₂) Concentration in Ambient Air
Experiment 5	Measurement of Carbon Monoxide (CO) Concentration in Ambient Air (if applicable in the manual)
Experiment 6	Measurement of Hydrocarbons in Ambient Air (if applicable in the manual)
Experiment 7	Noise Level Measurement and Ambient Noise Monitoring
Experiment 8	Traffic Noise Monitoring

6. References:

1. IS 5182 (Part 23): 2006
2. CPCB Guidelines Volume-I
3. IS 5182 (Part 2): 2001

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamental concepts of air pollution and noise pollution measurement techniques.	Explain	Understand
CO2	Execute sampling and measurement of PM10 and PM2.5 concentrations in ambient air using appropriate methods.	Execute	Apply
CO3	Measure the concentration of gaseous pollutants like SO ₂ , NO ₂ , CO, and hydrocarbons in ambient air.	Measure	Understand
CO4	Analyse air pollutant data to assess environmental air quality based on standard regulations.	Analyse	Analyze
CO5	Conduct noise level measurement in ambient and traffic conditions to evaluate noise pollution.	Conduct	Apply
CO6	Develop strategies for air and noise pollution control based on experimental data and regulatory standards.	Develop	Create

8. Mapping of course outcomes to module / course content

	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1	2	3	-	-	-	-
Experiment 2	2	3	-	-	-	-
Experiment 3	-	-	3	-	-	-
Experiment 4	-	-	3	-	-	-
Experiment 5	-	-	3	-	-	-
Experiment 6	-	-	-	3	-	-
Experiment 7	-	-	-	-	3	-
Experiment 8	-	-	-	-	3	3

9. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	1	-	3	2	-	1
CO2	3	3	1	3	-	1	-	3	2	-	1

CO3	3	3	1	3	2	1	-	3	2	-	1
CO4	3	3	1	3	-	1	-	3	2	-	1
CO5	3	3	1	3	2	1	-	3	2	-	1
CO6	3	3	2	3	2	1	-	3	2	-	1

10. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	1	-
CO3	3	1	-
CO4	3	1	-
CO5	3	1	-
CO6	3	1	-