BE SCHEME & SYLLABUS

Third Year
(V and VI Semester)

With effect from 2022-23

Civil Engineering

ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service & Excellence

VISION

To be a global premier Institution of professional education and research.

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular for quality professional education.
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies.
- Attract, nurture and retain the best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities (ESR) of the institution.

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E. (CSE, ECE, EEE, ME and CIV) & PG (MBA and MCA)
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS

(With effect from 2022-23)

Civil Engineering

THIRD YEAR

(V and VI Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practiced at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and two of the PG programs, namely MBA and MCA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

CONTENTS

ABOUT THE DEPARTMENT

A vibrant Department, established in 2012, aims at contributing graduate engineers equipped for careers in the public and private sectors. The Department is NBA accredited and has got a highly qualified team of faculty members having rich experience within academia and industry. Spacious and well – equipped state-of-the-art-laboratories and computing facilities are the mainstays of the Department. Frequent visits by guest faculty and professionals from academia and industry help in sharing their valuable experiences and keeping students abreast of the latest advancements. The Department also offers consultancy and testing services catering to the needs of the public in and around Mangaluru.

DEPARTMENT VISION

To impart technical education and nurture research in Civil Engineering to meet the needs of society.

DEPARTMENT MISSION

- Deliver curricula for students to meet the local, national and global demands of industry, society and research.
- Strengthening the skills of students through interaction with industry.
- Promote research and consultancy in all aspects of Civil engineering.
- Provide skilled training in emerging aspects of design and construction.
- Develop in students and staff the spirit of innovation and professional ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PE0 1: To impart to students in depth knowledge of Civil Engineering subjects to solve practical problems using modern techniques.

PE0 2: To develop in students the ability to plan, analyze, design and construct structures from the foundation to the superstructure level with cost-effective design methods.

PE0 3: To develop in students the ability for successful careers as entrepreneurs and to pursue research.

PE0 4: To enable students to identify issues related to the environment and find suitable solutions.

PE0 5: To train students to understand the ethical responsibility of Civil Engineering profession and apply relevant code for engineering practice while delivering service to the nation.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations on complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and the synthesis of information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commitment to professional ethics and responsibilities and norms of engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, making effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the Civil Engineering program are able to

PSO1: Explore domain knowledge in order to solve real-time field challenges, and to pursue research in novel areas of Civil Engineering.

PSO2: Qualify in the competitive examinations and succeed in obtaining opportunities in the public and private sectors.

V Semester (B.E. - CIVIL Engineering)													
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	HSMC	22CIV51	Construction Management & Entrepreneurship	CIV	CIV	3	-	-	03	50	50	100	3
2	IPCC	22CIV52	Design and Detailing of RC Structures	CIV	CIV	3		2	03	50	50	100	4
3	IPCC	22CIV53	Geotechnical Engineering-1 Theory & Practice	CIV	CIV	3	-	2	03	50	50	100	4
4	PCC	22CIV54	Analysis of Indeterminate Structures	CIV	CIV	2	2	-	03	50	50	100	3
5	PCCL	22CIV55L	Software Application Lab	CIV	CIV	-	-	2	03	50	50	100	1
6	PEC	22CIV56X	Professional Elective - I	CIV	CIV	3	-	-	03	50	50	100	3
7	AEC/SDC	22RMI57	Research Methodology and Intellectual Property Rights	CIV	CIV	2	-	-	03	50	50	100	2
8	AEC/SDC	22ETP58	Emerging Technologies: A Primer	COM	COM	-	-	2	03	100	-	100	1
Total						**16**	**2**	**8**	**24**	**450**	**350**	**800**	**21**

22CIV56X : Professional Elective I			
22CIV561	Railway, Harbor, Tunnel & Airport Engineering	22CIV563	Concreting Techniques & Practices
22CIV562	Advanced Environmental Engineering	22CIV564	Basics of Offshore Engineering

VI Semester (B.E. - CIVIL Engineering)													
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	IPCC	22CIV61	Designing & Detailing of Bridges	CIV	CIV	3	-	2	03	50	50	100	4
2	IPCC	22CIV62	Design of Steel Structures & Detailing	CIV	CIV	3	-	2	03	50	50	100	4
3	PCC	22CIV63	Hydrology & Irrigation Engineering	CIV	CIV	3	-	-	03	50	50	100	3
4	PEC	22CIV64X	Professional Elective -II	CIV	CIV	3	-	-	03	50	50	100	3
5	OEC	22CIV65X	Open Elective -I	CIV	CIV	3	-	-	03	50	50	100	3
6	PRJ	22CIV66	Major Project – Phase I	CIV	CIV	-	-	4	03	100	-	100	2
7	HSMC	22CIV67	Environmental Studies	CIV	CIV	1	-	-	02	50	50	100	1
8	AEC/SDC	22IIP68	Innovation and Intellectual Property	COM	COM	-	-	2	03	100	-	100	1
					Total	**15**	**2**	**10**	**23**	**500**	**300**	**800**	**21**

22CIV64X : Professional Elective II			
22CIV641	Advanced Geotechnical Engineering	22CIV643	Integrated Building Services and Design Concepts
22CIV642	Design and Construction of Highway Pavements	22CIV644	Solid Waste Management

22CIV65X : Open Elective I			
22CIV651	Geospatial Technology	22CIV653	Environmental Protection and Management
22CIV652	Water Conservation and Rainwater Harvesting	22CIV654	Finite Element Method

V Semester

Construction Management and Entrepreneurship			
Course Code	**22CIV51**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction projects.
- Inculcate Human values to grow as responsible human beings with proper personality.
- Keep up ethical conduct and discharge professional duties.

Module-1 Introduction to Construction Management (8 hours)

Management: Characteristics of management, functions of management, importance and purpose of planning process, types of plans

Construction Project Formulation: Introduction to construction management, project organization, management functions, management styles

Construction Planning and Scheduling: Introduction, types of project plans, work breakdown structure, Gantt Chart, preparation of network diagram- event and activity based and its critical path-critical path method, concept of activity on arrow and activity on node.

Applications: Basic ideas of construction management (CPM & PERT MSP)

Module-2 Construction Material Management and Equipments (8 hours)

Resource Management: Basic concepts of resource management, class of labor, Wages & statutory requirement, Labor Production rate or Productivity, Factors affecting labor output or productivity.

Construction Equipments: Classification of construction equipment, estimation of productivity for: excavator, dozer, compactors, graders and dumpers. Estimation of ownership cost, operational and maintenance cost of construction equipment. Selection of construction equipment and basic concept on equipment maintenance.

Materials: Material management functions, inventory management.

Applications: Material requirements and machinery for project management.

Module-3 Construction Quality, Safety and Human Values (8 hours)

Construction quality: process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to the concept of Total Quality Management.

HSE: Introduction to concepts of HSE as applicable to Construction. Importance of safety in construction, Safety measures to be taken during Excavation, Explosives, drilling and blasting, hot bituminous works, scaffolds / platforms /ladder, form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurance.

Ethics: Morals, values and ethics, integrity, trustworthiness, work ethics, need of engineering ethics, Professional Duties, Professional and Individual Rights, Confidential and Proprietary Information, Conflict of Interest Confidentiality, Gifts and Bribes.

Applications: quality and safety requirements for construction projects.

Module-4 Construction Finance (8 hours)

Introduction to engineering economy:

Principles of engineering economics, concepts on Micro and macro analysis, problem solving and decision making.

Interest and time value of money: concept of simple and compound interest, interest formula for: single payment, equal payment and uniform gradient series. Nominal and effective interest rates, deferred annuities, capitalized cost.

Comparison of alternatives: Present worth, annual equivalent, capitalized and rate of return methods, Minimum Cost analysis and break-even analysis.

Applications: financial requirements and comparison of different projects.

Module-5 Introduction to Entrepreneurship (8 hours)
Entrepreneurship: Evolution of the concept, functions of an entrepreneur, concepts of entrepreneurship, stages in entrepreneurial process, different sources of finance for entrepreneurs, central and state level financial institutions. **Micro, Small & Medium Enterprises (MSME):** definition, characteristics, objectives, scope, role of MSME in economic development, advantages of MSME, Introduction to different schemes: TECKSOK, KIADB, KSSIDC, DIC, Single Window Agency: SISI, NSIC, SIDBI, KSFC. **Business Planning Process:** Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture. Introduction to international entrepreneurship opportunities, entry into international business, exporting, direct foreign investment, venture capital. **Applications:** ideas and process of business establishment.

Course Outcomes: At the end of the course the student will be able to:	
22CIV51.1	Prepare a project plan based on requirements and schedule of a project by understanding the activities and their sequence.
22CIV51.2	Apply the knowledge of labor output, equipment efficiency to allocate resources required for the project to achieve desired quality and safety.
22CIV51.3	Solve a variety of issues that are encountered by every professional in discharging professional duties.
22CIV51.4	Analyze the economics of alternatives and evaluate benefits and profits of a construction activity.
22CIV51.5	Establish as an ethical entrepreneur by utilizing the provisions offered by the federal agencies.
22CIV51.6	Organize the materials, labours and machinery required for the management of the project.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Principles of Management	P C Tripathi and P N Reddy	Tata McGraw-Hill Education & Brothers	6th Edition, 2020
2	Entrepreneurship Development and Small Business Enterprise	Poornima M. Charantimath	Dorling Kindersley (India) Pvt. Ltd.,	3rd Edition, 2018
Reference Books				
1	Construction Planning and Management	P S Gahilot & B M Dhir	New age International Publishers	2nd Edition, 2018
2	Construction Project Management: Planning Scheduling and Control	Chitkara, K.K	Tata McGraw-Hill Education & Brothers	2nd Edition, 2010

Web links and Video Lectures (e-Resources):

- Principle of Construction Management: Principles of Construction Management - Course (nptel.ac.in)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV51.1	3													
22CIV51.2	3													
22CIV51.3	3					2								
22CIV51.4	3			2							2			
22CIV51.5	3					2		2		2				
22CIV51.6	3								2					

1: Low 2: Medium 3: High

Design and Detailing of RC Structures			
Course Code	**22CIV52**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Identify, formulate, and solve engineering problems of RC elements subjected to different kinds of loading.
- Follow a procedural knowledge in designing and detailing various structural RC elements.
- Impart the culture of following the codes for strength, serviceability, durability, and detailing as an ethics.
- Provide knowledge in analysis, design, and detailing of RC elements for achieving success in competitive examinations

Module-1 Concept of Limit State Design (8 hours)

Introduction: Distinction between Working stress and Limit State Methods of design, Modular Ratio and Factor of Safety. Philosophy and principles of limit state design with assumptions. Partial Safety factors, Characteristic load, and strength. Stress block parameters, the concept of balanced section, under reinforced and over reinforced section. Elastic behavior of rectangular section, Limiting deflection, short-term deflection, long-term deflection, Calculation of deflection of singly reinforced beam. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Side face reinforcement, and slenderness limits of beams for stability. Importance of bond, anchorage length, and lap length.

Module-2 Limit State Analysis of Beams (8 hours)

General aspects of ultimate strength, ultimate flexural strength of singly reinforced and doubly reinforced rectangular sections, ultimate shear strength of RC sections.

Module-3 Limit State Design of Beams (8 hours)

Design of singly and doubly reinforced rectangular beams. Design for combined bending and torsion as per IS-456, the latest version.

Module-4 Limit State Design of Slabs and Stairs (8 hours)

Introduction to one-way and two-way slabs. Design of simply supported and one-way continuous slab. Design of two-way slabs for different boundary conditions.
Design of dog-legged and open well staircases with waist slab.

Module-5 Limit State Design of Columns and Footings (8 hours)

Analysis and design of short axially loaded RC columns. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and combined axial load & uniaxial moment.

AI Applications: program in C or C++ or Python design of columns and footings, Evaluation of forces in different types of structural elements (Not to be considered for the exam*)*

PRACTICAL MODULE

Detailing of RC Structural Elements

- Beams –Reinforcement Detailing of Singly reinforced beam and Cantilever beam
- Beams- Reinforcement Detailing of Doubly reinforced and Continuous beam
- Slab – Reinforcement Detailing of One-way slab and Two-way slab
- Slab – Reinforcement Detailing of One-way continuous slab
- Staircase – Reinforcement Detailing of Dog Legged
- Staircase – Reinforcement Detailing of open well staircase
- Columns & Footings- Reinforcement Detailing of Isolated rectangular and square

footing
- Columns & Footings - Reinforcement Detailing of Combined footing

Course Outcomes: At the end of the course the student will be able to:	
22CIV52.1	Explain the design philosophies and principles of reinforced concrete structures.
22CIV52.2	Solve engineering problems of RC elements subjected to deflection, Cracking
22CIV52.3	Analysis of essential singly, doubly, and flanged beams of RC structure for flexure, shear, and torsion
22CIV52.4	Adopt the code of practice for the design and detailing of singly and doubly reinforced beams by considering safety.
22CIV52.5	Use the code of practice for the design and detailing of slabs and staircases by considering safety.
22CIV52.6	Design and detailing of columns and footings as per code of practice by considering safety.

Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Reinforced Concrete Design	Unnikrishnan Pillai and Devdas Menon	McGraw Hill	3rd Edition, 2017
2	Design of Concrete Structures	Subramaniam	Oxford University Press	Illustrated, 2013
3	Reinforced Concrete Vol. 1 (Elementary Reinforced Concrete)	H J Shah	Charotar Publishing House Pvt. Ltd.	11th edition, 2016
Reference Books				
1	Limit State design of reinforced concrete	P.C. Varghese`	PHI, New Delhi	1st Edition, 2008
2	Reinforced Concrete Design	W H Mosley, R Husle, J H Bungey	MacMillan Education, Palgrave Publishers	1st Edition, 1996
3	**Code books – IS 456-2000, SP-16, SP-34 shall be referred for designing & detailing. The same will be provided during the examination**			

Web links and Video Lectures (e-Resources):

Design of reinforced concrete structures http://nptel.ac.in/courses/105105105/

Design of reinforced concrete structures http://www.nptelvideos.in/2012/11/design-of-reinforced-concrete-structures.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV52.1	2	3		3										
22CIV52.2	2	3												
22CIV52.3	2	3												
22CIV52.4						3		3						
22CIV52.5		3				3		3						
22CIV52.6	2	3												

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1: Low 2: Medium 3: High

Geotechnical Engineering-1 (Theory and Practice)			
Course Code	**22CIV53**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives:

- Appreciate basic concepts of soil mechanics as an integral part of civil engineering.
- Comprehend basic engineering and mechanical properties of different types of soil.
- Become broadly familiar with geotechnical engineering requirements, such as flow of water through soil medium and compaction characteristics.
- Model and measure strength & settlement characteristics and bearing capacity of soils.

Module-1 Basics of Geotechnical Engineering (8 hours)

Introduction to soil mechanics: Soil types, Major soil distribution in India

Index properties and IS classification of soil

Index Properties: Phase Diagram, definitions, and their interrelationships. Determination of Index properties – sieve analysis and hydrometer analysis, Atterberg limits and indices, plasticity chart, Types of soil structures and Clay Minerals, IS soil classification of Soil, water content, specific gravity

Module-2 Soil Water-Effective Stress Analysis (8 hours)

Soil Water: Permeability, Darcy's law-assumption and validity, coefficient of permeability and its determination (only laboratory method), the permeability of stratified soils, Capillary phenomenon, Flow net characteristics, and applications

Effective Stress Analysis: Effective stress concept-total stress, effective stress and Neutral stress, quick sand condition

Module-3 Compaction and Consolidation (8 hours)

Compaction: Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control, zero air void line

Consolidation: Concept of consolidation-normally consolidated, over consolidated and under consolidated, Mass-spring analogy, Terzaghi's one-dimensional consolidation theory (No derivation). Consolidation characteristics of soil (C_c, a_v, T_v, m_v and C_v). Laboratory one-dimensional consolidation test, Pre-consolidation pressure and its determination by Casagrande's method.

Module-4 Shear strength (8 hours)

Shear Strength: Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion Total and effective shear strength parameters, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Factors affecting shear strength of soils.

Module-5 Bearing Capacity and Settlement (8 hours)

Bearing Capacity: Types of foundations, Determination of bearing capacity by Terzaghi's and IS method (IS: 6403), Modes of shear failure, Factors affecting Bearing capacity of soil. Effect of water table and load eccentricity on bearing capacity of soil, Field methods of determining bearing capacity of soil (SPT and plate load test).

Settlement: Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential and total settlements (IS 8009 Part 1).

AI Application: Using any type of software or languages like C/C++ or python, students can analyze the various geotechnical problems (Not for the exam)

PRACTICAL MODULE

A–Exercise (compulsorily to be conducted):

A1: Water content determination by oven drying method
A2: Determination of Specific gravity (Pycnometer method)
A3: Grain size analysis (Sieve analysis of soil)
A4: In-situ density tests i) Core-cutter method ii) Sand replacement method
A5: Consistency limits i) Liquid limit test (by Casagrande's and cone penetration method) & ii) Plastic limit test iii) Shrinkage Limit test
A6: Coefficient of permeability test i) Constant head test ii) Variable head test
A7: Standard compaction tests i) Light compaction ii) Heavy compaction
A8: Direct shear test
A9: Unconfined compression test
A10: Laboratory vane shear test
A11: Triaxial test (unconsolidated undrained test only)
A12: Grain size analysis (Hydrometer analysis of soil)
A13: Determination of CBR value of soil test

B–Open Ended Experiments (For demo only):

B1: Demonstration of Free Swell Index and Swell Pressure Test
B2: Demonstration of determination of relative density of sands.
B3: Demonstration for identification of gravel, sand, silt and clay soils.
B4: Demonstration of equipment such as Augers, Samplers, Rapid Moisture meter, Proctor's needle.
B5: Demonstration of Standard penetration test & Boring equipment B6: Demonstration of consolidometer

Course Outcomes: At the end of the course the student will be able to:	
22CIV53.1	Comprehend fundamentals of soil mechanics and identify and classify the soil.
22CIV53.2	Apply the knowledge to explain the role of water in soil behaviour and how soil stresses and permeability and are estimated.
22CIV53.3	Apply the knowledge to determine the compaction characteristics of the given soil
22CIV53.4	Understand the consolidation characteristics of soil
22CIV53.5	Apply the knowledge to determine the shear parameters of soil.
22CIV53.6	Apply the knowledge to compute the bearing capacity and settlement of soil.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Soil Mechanics and Foundation Engineering	Dr. Arora K. R	Standard Publishers	7th Edition, 2020
2	Basic and Applied Soil Mechanics	Gopal Ranjan and Rao	A.S.R New Age International, New Delhi	4th Edition 2022
3	Soil Mechanics and Foundation Engineering	Murthy V.N.S	CBS Publications	2009
4	Geotechnical Engineering;	Braja, M. Das,	Thomson Business Information India (P) Ltd.,	2015

Reference Books				
1	Soil Engineering-In Theory and Practice	Alam Singh	CBS Publications	4th edition 2012
2	Manual of Soil Laboratory Testing-(1986)-Vol. I, II, III,	Head K.H.,	Princeton Press, London	2006
3	Soil Mechanics in Engineering Practice	K Terzaghi, Ralph B. Peck	John Wiley & Sons Inc	3rd Edition, 1996

Web links and Video Lectures (e-Resources):

Geotechnical Engineering I : https://nptel.ac.in/courses/105101201

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV53.1	3	2									2			
22CIV53.2		2									2			
22CIV53.3		2									2			
22CIV53.4	3	2		3										
22CIV53.5				3										
22CIV53.6		2		3										

1: Low 2: Medium 3: High

ANALYSIS OF INDETERMINATE STRUCTURES			
Course Code	**22CIV54**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Analyze the rotation and displacement of continuous beams and frames using the slope deflection method.
- Analyze the continuous beams by the Moment Distribution method.
- Analyze the continuous beams by Kani's method.
- Analyze beams trusses and frames using a flexibility method.
- Analyze beams, trusses, and frames using the stiffness method.

Module-1 Slope Deflection Method (8 hours)

Introduction, sign convention, development of slope deflection equation, analysis of continuous beams including settlements, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3.

Applications: Analyzing indeterminate structure by slope deflection method.

Module-2 Moment Distribution Method (8 hours)

Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3.

Applications: Analyzing trusses by moment distribution method.

Module-3 Kani's Method (8 hours)

Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway.

Applications: Analyzing trusses by Kani's method.

Module-4 Matrix Method of Analysis (Flexibility Method) (8 hours)

Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with static indeterminacy ≤ 3.

Applications: Application of flexibility method

Module-5 Matrix Method of Analysis (Stiffness Method) (8 hours)

Introduction, Stiffness matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤ 3.

Applications: Application of Matrix method

Using C-programming to analyze the given beam structure

Course Outcomes: At the end of the course, the student will be able to:	
22CIV54.1	Analyze statically indeterminate beams and frames having a variable moment of inertia and settlement using the slope deflection method.
22CIV54.2	Illustrate the concept of carry-over moment in indeterminate structures and compute the end moments by the number of iterations using the moment distribution method.
22CIV54.3	Analyze the performance of continuous beams and frames using Kani's method.

22CIV54.4	Solve the problems of rigid jointed and pin jointed frames by finding their forces and moments using the Flexibility matrix method.
22CIV54.5	Evaluate the problems of rigid jointed and pin jointed frames by finding their forces and moments using the Stiffness matrix method
22CIV54.6	Apply the principles of structural analysis to develop a C-language program.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
	Textbooks			
1	Theory of Structures-Volume I & Volume II	Punmia B.C, Ashok Kumar Jain, Arun Kumar Jain	Laxmi Publications (P) Ltd.	13th edition, 2017
2	Basic Structural Analysis	C S Reddy	McGraw Hill Education	3rd edition, 2017
3	Structural Analysis Vol-1 &2	S S Bhavikatti	Vikas Publishing House	4th edition, 2013
4	Indeterminate Structural Analysis	M. Vijayanand Dr. K.U. Muthu, Dr. H. Narendra, Dr. Maganti Janardhana	Dreamtech Press	1st edition, 2019
	Reference Books			
1	Theory of Structures	Ramamrutham S,	Dhanpat Rai & Sons, New Delhi	11th edition, 2020
2	Structural Analysis	Hibbeler R C	Prentice Hall	18th Edition 2019
3	Intermediate structural analysis	C.K.Wang	McGraw Hill Education	1st Edition, 2017

Web links and Video Lectures (e-Resources):

- Analysis of Structures https://nptel.ac.in/courses/105/101/105101086/
- Analysis of Structures https://nptel.ac.in/courses/105/105/105105109/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV54.1	2	3												1
22CIV54.2	2	3												1
22CIV54.3	2	3												1
22CIV54.4		3			2									1
22CIV54.5		3			2									1
22CIV54.6		3												1

1: Low 2: Medium 3: High

SOFTWARE APPLICATION LABORATORY			
Course Code	**22CIV55L**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	10 Lab Slots	Credits	1

Course Learning Objectives: The objective of the course is to

- Use industry-standard software in a professional setup.
- Understand the elements of finite element modeling, specification of loads, and boundary conditions.
- Performing analysis and interpretation of results for final design.
- Develop customized automation tools.

Module-1 Use of Spread Sheets (4 hours)

Design of singly reinforced and doubly reinforced rectangular beams, design of one-way and two-way slabs, computation of earthwork, Design of horizontal curve by offset method, and Design of superelevation.

Applications: Automation of design procedures for various Civil Engineering numerical problems.

Module-2 Use of Analysis Software (12 hours)

1. Analysis of Continuous beams, Plane trusses & portal frames for Point Load, UDL & UVL.
2. Analysis of G+1 Residential Building by considering DL & IL, 3D analysis of multistoried frame structures.

Applications: Understanding the usage of Structural Analysis Software.

Module-3 Project Management (4 hours)

1. Exercise on Project planning and scheduling of a building project using any project management software:

a. Understanding basic features of Project management software

b. Constructing Project: create WBS, Activities, and Tasks and Computation Time using spreadsheet and transferring the same to Project management software.

c. Identification of Predecessor and Successor activities with constrain

d. Constructing Network diagram (AON Diagram) and analyzing for Critical path, Critical activities and Other non-critical paths, Project duration, Floats. e. Study on various View options available

f. Basic understanding of Resource Creation and allocation

g. Understanding Splitting the activity, linking multiple activities, assigning Constraints, Merging Multiple projects, and Creating Baseline Projects.

Applications: Application of different software for the data management purpose.

Course Outcomes: At the end of the course the student will be able to:

22CIV55L.1	Develop customized Validation tool for the design of RCC structural Components.
22CIV55L.2	Develop customized Validation tool for solve civil engineering problems.
22CIV55L.3	Use industry standard software for analysis of structural components in a professional setup.
22CIV55L.4	Use industry standard software for analysis of multi-story building in a professional setup.
22CIV55L.5	Use modern tools for Project Planning and Scheduling.
22CIV55L.6	Use modern tools for Project Management for creating network diagrams.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Design of Concrete Structures	N Subramanian	Oxford university Press	1st Edition, 2013
2	Highway Engineering	S K Khanna, C E G Justo, and A Veeraragavan	Nem Chand & Brothers	10th Edition, 2010
3	Surveying & levelling Vol. I ,II & III.	B. C. Punmia,	Laxmi Publications	17th Edition 2016
Reference Books				
1	● Training manuals and User manuals and Relevant course reference books ● IS 875 Parts 1, 2 and 3: 1987 ● IS 456:2000 ● IS 800:2007			

Web links and Video Lectures (e-Resources):

- https://www.qgis.org/en/site/forusers/trainingmaterial/index.html#english
- https://education.bentley.com/GetTraining

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV55L.1					3								1	
22CIV55L.2					3								1	
22CIV55L.3					3									
22CIV55L.4					3									
22CIV55L.5					3						2	1		
22CIV55L.6					3						2	1		

1: Low 2: Medium 3: High

Railways, Harbor, Tunnel & Airport Engineering			
Course Code	**22CIV561**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives:

- Understand the history and development, role of railways, railway planning and development based on essential criteria.
- Learn different types of structural components, and engineering properties of the materials, to calculate the material quantities required for construction
- Understand various aspects of geometrical elements, points and crossings, significance of maintenance of tracks.
- Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids.
- Apply design features of tunnels, harbors, docks, and necessary navigational aids; also expose them to various methods of tunneling and tunnel accessories.

Module-1 Introduction to Railway (8 Hours)

Significance of Road, Rail, Air, and Water transports – Coordination of all modes to achieve sustainability, Track Stress, coning of wheels, creep in rails, defects in rails, Route alignment surveys, conventional and modern methods, Soil suitability analysis, Geometric design of railways, gradient, super elevation, widening of gauge on curves – Points and Crossings (Explanation & Sketches of Right- and Left-hand turnouts only) – New transportation modes such as Metros, hyperloops, etc.

Module-2 Railway Construction and Maintenance (8 hours)

Introduction to performance grading and super pave, Construction of bituminous pavements, Types and causes of failures in flexible and rigid pavements, Highway drainage.
Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construct ion & maintenance. Design of sleepers using BIM. Calculating the quantities of materials (rails, sleepers, ballast, etc.) required for laying a railway track based on input parameters like track length, gauge, and specifications.

Module-3 Harbor and Tunnel Engineering (8 hours)

Principles – Harbor Layout and Terminal Facilities, Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works.
Tunnelling methods in soils, transfer of RL from ground level to underground, tunnel lining, tunnel drainage and ventilation.

Module-4 Airport Planning: & Design (8 hours)

Layout characteristics, and socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking, and circulation area.
Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length.

Module- 5 Geometric Design of Airport Runways (8 hours)

Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.
AI application (Only as demo): Use C, C++, or Python: Develop programs for calculating the quantities of materials (rails, sleepers, ballast, etc.) required for laying a railway track based on input parameters like track length, gauge, and specifications. To calculate runway lengths, taxiway dimensions, and other geometric design elements based on aircraft specifications, wind rose diagrams, and design criteria.

Course Outcomes: At the end of the course the student will be able to:	
22CIV561.1	Understand the history and development, role of railways, railway planning and development based on essential criteria.
22CIV561.2	Track material estimate. Locomotive hauling. Components, properties. Construction quantities. Geometry, crossings, maintenance.
22CIV561.3	Apply design features of tunnels, harbors, dock and necessary navigational aids.
22CIV561.4	Expose them to various methods of tunnelling and tunnel accessories.
22CIV561.5	Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids.
22CIV561.6	Airport Maintenance, Signage and marking in airport.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	A Text book of Railway Engineering	Saxena Subhash C and Satyapal Arora	Dhanpat Rai and Sons, Delhi.	7th Edition 2008
2	Railway Engineering	Satish Chandra and Agarwal M. M	Oxford University Press, New Delhi.	2nd Edition 2015
3	Airport Planning and Design	Khanna S K, Arora M G and Jain S S	N Chandra and Brothers, Roorkee.	6th Edition 2005
4	A Course in Docks and Harbour Engineering	Bindra S P	Dhanpat Rai and Sons, Delhi.	January 2017
Reference Books				
1	Harbor, Dock, and Tunnel Engineering	Srinivasan R	Lewis Publication.	26th Edition 2013
2	Transportation Engineering, Volume II: Railways, Airports, Docks and Harbors, Bridges and Tunnels	C Venkat Ramaiah	Universities Press	January 2016

Web links and Video Lectures (e-Resources):
NPTEL Transportation Engineering II**:** https://nptel.ac.in/courses/105107123

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV561.1	2	2												
22CIV561.2				2										
22CIV561.3	2													
22CIV561.4				2										
22CIV561.5			2											
22CIV561.6	2	2												

1: Low 2: Medium 3: High

Advanced Environmental Engineering			
Course Code	**22CIV562**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Apply the principles of alkalinity and coagulation in water treatment, including calculating coagulant dosages and performing water softening estimations.
- Apply the Streeter-Phelps equation and oxygen sag analysis to evaluate and manage the impact of effluent disposal on natural water bodies.
- Understand the principles of designing treatment units for effective wastewater management.
- Apply knowledge of biological treatment processes to practical wastewater treatment problems.
- Identify and address problems associated with sewage pumping systems.

Module-1 Coagulation (8 Hours)

Alkalinity- Coagulation Relationships, commonly used Coagulants, Classification of surface waters based on coagulation. Coagulant dosage as a function of turbidity. Water softening- Estimation of quantity of lime and soda. (Numerical)

Module 2 Disposal of effluents (8 hours)

Self-purification of natural streams. Oxygen sag analysis (Deoxygenation and reoxygenation curves). Streeter – Phelp's equation. (Derivation and numerical).

Applications: Determine various dilution and disposal techniques.

Module 3 Design of treatment units (8 hours)

Bar screen, Grit chamber (rectangular cross-section, Parabolic cross-section), Detritus tank. Design of sedimentation tank (Primary rectangular, Circular settling tank).

Applications: Determination of wastewater treatment units, application of wastewater treatment units.

Module 4 Biological treatment (II) design (8 hours)

Loading, Efficiency, and Performance of Conventional Trickling Filters (NRC formula). Design of High-rate trickling filter. Food-microorganism ratio (F/M ratio) Sludge volume index, and Sludge density index. Aeration tank design. Imhoff tank, advantages and disadvantages, design.

Applications: Determination of various biological treatment processes.

Module- 5 Sewage pumping (8 hours)

Problems associated with the pumping, Types of pumps, Power for pumps. House drainage-Principles, pipes and traps, Classification of traps, Systems of plumbing. House drainage plans.

Applications: Preparation of house drainage plans.

Course Outcomes: At the end of the course the student will be able to:	
22CIV562.1	Apply the principles of alkalinity and coagulation in water treatment, including calculating coagulant dosages and performing water softening estimations.
22CIV562.2	Utilize the Streeter-Phelps equation and oxygen sag analysis to assess and manage the impact of effluent disposal on natural water bodies.
22CIV562.3	Design key wastewater treatment units such as bar screens, grit chambers, and sedimentation tanks, applying theoretical knowledge to practical scenarios.

22CIV562.4	Evaluate and design biological treatment processes, including trickling filters and aeration tanks, and understand their operational efficiencies and applications.
22CIV562.5	Identify and solve problems related to sewage pumping, understand the principles of house drainage, and prepare detailed house drainage plans.
22CIV562.6	Integrate knowledge from various modules to develop comprehensive solutions for water and wastewater treatment, ensuring effective environmental management and sustainability.

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Water Supply Engineering	S.K. Garg	Khanna Publishers	35th Edition 2016
2	Wastewater treatment	S. K. Garg	Khanna Publishers	41st Edition 2016
Reference Books				
1	Water Technology	Hammer and Hammer	Tata McGraw-Hill	17th Edition 2016
2	Wastewater Engineering: Treatment and Resource Recovery	Metcalf & Eddy Inc., George Tchobanoglous, H. David Stensel, RyujiroTsuchihashi , Franklin L. Burton	McGraw-Hill Education	5th Edition, 2013
3	Environmental Engineering	Howard Peavey, Donald Rowe, George Tchobanoglous	McGraw Hill Education	1st Edition, 2017

Web links and Video Lectures (e-Resources):

1. NPTEL :: Civil Engineering - Water and Waste Water Engineering

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV562.1	2	3												
22CIV562.2						3	3							
22CIV562.3	3					3		3						
22CIV562.4	3						3							
22CIV562.5			3		3									
22CIV562.6	3					3	3							

1: Low 2: Medium 3: High

CONCRETING TECHNIQUES & PRACTICES			
Course Code	**22CIV563**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- To acquire knowledge on the materials used in Concrete and their testing as per relevant Indian standard codes and practical aspects on concreting activities at projects.
- To comprehend the techniques on Blending of aggregates
- To learn a complete mix design as per the project requirement.
- To understand the challenges in placement of concrete and site related issues

Module-1 Repair and Maintenance of Concrete Structures (8 hours)

Common defects in concrete: Cracks, spalling and honeycombing. Repair techniques: Surface repair, injection grouting, retrofitting. Maintenance practices: Regular inspections, preventive measures.

Module-2 Mix Design of Special Concrete (8 hours)

Concrete mix design of SCC, Alkali activated concrete and FRC.

AI Application: Using AI model for predicting compressive strength using dataset containing various mix proportions and corresponding compressive strength of concrete. A popular dataset is the Concrete Compressive Strength dataset available on the UCI Machine Learning Repository.

Module-3 - Special Concreting Techniques and Quality Control (8 hours)

Ready –Mix Concrete: Production, transport and benefits.

Precast concrete: Types of elements and production process, Prestressed Concrete: Principles, method (Pre-tensioning and post -tensioning),

Self-compacting concrete: Properties, mix design and placement, High performance and lightweight concrete: Characteristics and applications

Module-4 Quality control and Testing (8 hours)

Importance of quality control in concrete construction, Quality control measures in concrete production, Factors affecting concrete quality.

Statistical Quality Control in Concrete Production: Sampling techniques, Control charts for concrete properties, Acceptance criteria and lot acceptance

Field Quality Control: On-site testing procedures, Curing control and monitoring, Managing non-conformances.

Testing: Non-destructive testing methods: Rebound hammer, Ultrasonic pulse velocity.

Quality control in batching and mixing, Testing methods for admixture efficiency.

Module-5 Durability tests and Sustainable Practices (8 hours)

Techniques to predict life of concrete: Chloride penetration in concrete. Tests for chloride penetration. **Introduction to Life365 Software.**

Sustainable Practices in Concrete: Green concrete: Use of recycled materials, low carbon footprint concretes. Waste management: Reuse and recycling of concrete waste

Course Outcomes: At the end of the course the student will be able to:	
22CIV563.1	Describe fundamentals of concrete.
22CIV563.2	Design concrete mix for different grades of concrete.
22CIV563.3	Comprehend the process involved in production and placement of concrete
22CIV563.4	Interpret special concreting techniques and practices for quality control
22CIV563.5	Identify factors affecting durability and measures to retrofit the concrete structures

22CIV563.6	Develop eco-friendly concrete to reduce carbon footprint.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Concrete Technology	M S Shetty	S Chand	2006
2	Concrete Technology and Good construction practices	Y P Guptha	New age International Pvt Ltd.,	2013
Reference Books				
1	Concrete Materials and Technology-A Practical Guide	Kambiz Janamian, José Aguiar	CRC Press	2023
2	Advanced Concrete Technology	Zongjin Li	John Wiley&Sons,inc	2011

Web links and Video Lectures (e-Resources):

- Concreting Techniques and Practices- https://Intedutech.com/concreting-techniques-and-practices/
- Concreting Techniques and Practices - https://archive.nptel.ac.in/courses/105/102/105102012/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV563.1	2													
22CIV563.2	2	3					2	3						
22CIV563.3		3		3			2							
22CIV563.4		3					2							
22CIV563.5	2						2							
22CIV563.6	2						2	2						

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1: Low 2: Medium 3: High

Basics of Offshore Engineering			
Course Code	**22CIV564**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the basic concepts and principles of offshore structures, including their types, design considerations, and environmental loads.
- Analyze the structural behavior of offshore platforms under different environmental conditions, including waves, wind, currents, and earthquakes.
- Gain knowledge of numerical methods for modelling, simulation, and optimising offshore structures.
- Understand the methods for installation of various offshore structures

Module-1 Introduction to Offshore Structures (8 hours)
Overview of offshore structures and their importance, Design Considerations for offshore structures Types of offshore structures (fixed, floating, subsea), Regulatory requirements for offshore structures, Introduction to relevant codes and standards
Module-2 Environmental Loading on Offshore Structures (8 hours)
Waves, currents, and wind forces on offshore structures, Response of offshore structures to environmental loading, Methods for calculating environmental loads, Site-specific environmental conditions
Module-3 Structural Analysis of Offshore Structures (8 hours)
Introduction to structural analysis and design, Analysis of fixed offshore platforms and subsea structures, Finite element methods for offshore structures, Design of structural members (tubulars, beams, etc.), Buckling and fatigue analysis of offshore structures
Module-4 Design of Offshore Foundations (8 hours)
Soil-structure interaction in offshore environments, Types of offshore foundations (piles, gravity-based suction anchors), Design of foundations for different offshore structures, Geotechnical site investigation techniques for offshore foundations
Module-5 Offshore Installation and Maintenance (8 hours)
Installation methods for offshore structures, Maintenance and inspection of offshore structures Decommissioning of offshore structures, Health and safety considerations for offshore operations

Course Outcomes: At the end of the course the student will be able to:	
22CIV564.1	Analyze the response of offshore structures to environmental loading and apply methods for calculating site-specific environmental conditions.
22CIV564.2	Evaluate different types of offshore foundations, and design foundations for various offshore structures based on geotechnical site investigation techniques.
22CIV564.3	Derive the design and analysis of structural members and systems for offshore structures.
22CIV564.4	Apply safety and reliability standards in offshore structure design
22CIV564.5	Incorporate environmental protection regulations in offshore structure design
22CIV564.6	Analyze the installation, maintenance, and decommissioning of offshore structures

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Essentials of Offshore Structures	D. V. Reddy and A. S. J. Swamidas	CRC Press	1st Edition 2013
2	Construction of Marine and Offshore Structures	B.C Gerwick, Jr	CRC Press, Florida	3rd Edition 2007
3	Planning, Designing and Constructing Fixed Offshore Platforms	API RP 2 A., API	API RP 2 A., API	21st Edition 2014
Reference Books				
1	Offshore Structural Engineering: Reliability and Risk Assessment	Srinivasan Chandrasekaran	CRC-Press	1st Edition 2016
2	Ocean Structures Construction, Materials, and Operations	Srinivasan Chandrasekaran, Arvind Jain	CRC Press	1st Edition 2017

Web links and Video Lectures (e-Resources):

- Ocean Engineering Design of Offshore Structures
  https://archive.nptel.ac.in/courses/114/106/114106011/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV564.1	2		3											
22CIV564.2		3												
22CIV564.3	3		3											
22CIV564.4						3	3							
22CIV564.5						2	3	3						
22CIV564.6	2													

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	**22RMI57**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:0:0	SEE	3 Hours
Total Hours	25 hours	Credits	02

Course Learning Objectives: The objective of the course is

- To understand the basic concepts related to research
- To learn the concept of literature survey, review and technical writing
- To discuss the basics of intellectual property
- To explain the patents, copyrights, trademarks, industrial designs and geographical indications

Module-1 Research Methodology and Literature Survey (5 hours)

Research Methodology: Meaning, Objectives, Types of research, Method versus methodology, Research process, Criteria of good research.

Literature Survey, Literature Review: Introduction, process, databases and management tools. Identifying gap areas from literature review. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Chapter 1 , Textbook 2: Ch 7-9, 14-17.

Module-2 Technical Writing and Presentations (5 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, Illustrations.

Thesis Writing: Synopsis, Introduction, Literature review, Aim and Objectives, Methodology, Time frame, Results and discussions, Conclusions. Illustrations.

Research Proposal Writing: Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Chapter 20-22, 26-28, 35.

Module-3 Introduction to IPR and Patents (5 hours)

Introduction to Intellectual Property: Types of IP, Role of IP in the economic and cultural development of the society, IP governance, IP as a global indicator of innovation, National IPR Policy in India. Textbook 3: Chapter 1,

Patents: Conditions for patent, Non-patentable matters, Inventions Eligible for Patenting**,** Salient features of the Indian Patent 1970**,** Process of patenting**,** Types of patent applications**,** Patent infringements**.** Case examples. Textbook 3: Chapter 2: 2.1.

Module-4 Copyright and Trademarks (5 hours)

Copyright: Classes of copyrights, Salient features of the Indian Copyright Act 1957, Criteria for copyright, Copyrights of the author, Copyright Infringements, Non-Copyright Work, Process of copyright registration. Copyright cases.

Trademark: Eligibility Criteria, Classification, Trade Mark Rules 2017, Advantages of registration, Types of trademark registered in India, Process for Trademarks Registration, Case examples.

Textbook 3: Chapter 2: 2.2 and 2.3.

Module-5 Industrial Designs and Geographical Indications (5 hours)

Industrial Designs: Introduction, Eligibility criteria, Famous industrial designs, Features of Design Act 2000, Non-Protectable industrial designs in India, Procedure for Registration of Industrial Designs, Case examples.

Geographical Indications (GIs): Introduction, Rights granted to holders, Popular GIs registered in India, salient features of Geographical Indications of Goods (Registration & Protection) Act, 1999, Non-Registerable GI, Procedure for GI Registration**,** Case examples.

Textbook 3: Chapter 2: 2.4 and 2.5.

Course Outcomes: At the end of the course the student will be able:

22RMI57.1	To conduct literature survey, review and define a research problem.

22RMI57.2	To follow research ethics and develop the art of writing technical papers and reports.
22RMI57.3	To discuss the role of Intellectual Property and Patents in India.
22RMI57.4	To explain the various aspects of Copyright and Trademark in Indian context.
22RMI57.5	To explain legal aspects of Industrial Designs and Geographical Indications in India.
22RMI57.6	To discuss the case studies related to the different Intellectual Property.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Research Methodology: Methods and Techniques	C R Kothari and Gaurav Garg	New Age International Publishers	4th edition, 2019
2	Academic Writing	Ajay Semalty	B S Publications	2021
3	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
Reference Books				
1	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications India Pvt Ld New Delhi	4th edition, 2014
2	Intellectual Property Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018

Additional Resources: Web links/NPTEL Courses

https://ipindia.gov.in/ (Official website of Intellectual Property India)
https://dpiit.gov.in/policies-rules-and-acts/policies/national-ipr-policy
https://www.icsi.edu/media/webmodules/FINAL_IPR&LP_BOOK_10022020.pdf
https://corpbiz.io/learning/design-infringement-in-india/
https://nptel.ac.in/courses/121106007 (Introduction to Research (Research Methodology))
https://nptel.ac.in/courses/109105112 (Introduction on Intellectual Property to Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22RMI57.1	-	2	-	-	1	-	-	-	-	-	-	2	-	-
22RMI57.2	-	-	-	-	1	-	-	3	-	2	-	-	-	-
22RMI57.3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.4	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.5	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.6	-	-	-	-	-	2	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	22ETP58	CIE Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	1	Exam Hours	03

Course Learning Objectives:

1. To develop a strong awareness of the ethical and societal implications associated with emerging technologies.
2. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity.
3. To enable experiences of working on a team project, allowing students to apply their knowledge and skills to a real-world problem and present their findings effectively.

Module-1: AI and Web 3.0 (06 Hours)

Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.

Artificial Intelligence (AI): Definition and history of AI, Machine learning and deep learning, Applications of AI in various industries, In-Class Assignment: AI in Everyday Life, Homework Assignment: Building a Simple Chatbot.

Web 3.0: Blockchain and Metaverse - Introduction to Blockchain technology, Metaverse and its potential, In-Class Assignment: Creating a Simple Smart Contract, Homework Assignment: Exploring a Metaverse Platform.

Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)

Smart Manufacturing and Digital Twins: The concept of Smart Manufacturing, Role of IoT and sensors, Digital Twins and their applications, In-Class Assignment: Explore the designs of Digital Twins, Homework Assignment: Analysing a Smart Manufacturing Case Study.

Robotic Process Automation: Understanding Robotic Process Automation (RPA), Types of robots and their applications, Human-robot collaboration, In-Class Assignment: Automating a Task with RPA, Homework Assignment: Researching Advances in Robotics.

Module-3: Cybersecurity and Quantum Computing (06 Hours)

Cybersecurity: Importance of cybersecurity in the digital age, Threats and vulnerabilities, Security best practices, In-Class Assignment: Ethical Hacking Simulation, Homework Assignment: Creating a Cybersecurity Plan.

Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.

Module-4: Project Work (06 Hours)

Team Formation, Synopsis submission, Mid-Term Progress Review, Final Project Presentation.

Course Outcomes: At the end of the course the student will be able to:

22ETP58.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.
22ETP58.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.
22ETP58.3	Apply RPA principles and tools to automate common tasks to boost productivity.
22ETP58.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.
22ETP58.5	Explain the fundamentals of quantum computing and its real-world applications.
22ETP58.6	Develop a solution using emerging technologies for a real-world problem in teams.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	Pearson	Fourth Edition, 2020
2	Blockchain Technology	Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan	Universities Press (India) Pvt. Ltd.	First Edition 2020
3	Metaverse and Web 3: A Beginner's Guide: A Beginner's Guide: A Digital Space Powered with Decentralized Technology	Utpal Chakraborty	BPB Publications	First Edition, 2022
4	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath	Alok Mani Tripathi	Packt Publishing	First Edition 2018
5	Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity	Dr. Erdal Ozkaya	Packt Publishing Limited	First Edition 2019
6	Quantum Computing: A Gentle Introduction	Eleanor G. Rieffel, Wolfgang H. Polak.	MIT Press	First Edition 2014
Reference Books				
1	Smart Manufacturing Technologies for Industry 4.0: Integration, Benefits, and Operational Activities	Edited By: Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena	CRC Press	First Edition 2022
2	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems	Tom Taulli	Apress Berkeley, CA	2020
3	The Cyber Security Handbook: Prepare for, respond to and recover from cyber-attacks with the IT Governance Cyber Resilience Framework (CRF)	Alan Calder	IT Governance Publishing	First Edition 2020

Web links/Video Lectures:

Introduction to Emerging Technologies:

1. https://aiethics.princeton.edu/case-studies/case-study-pdfs/
2. https://research.aimultiple.com/ai-ethics/
3. https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/
4. https://www.sciencedirect.com/science/article/pii/S0268401223000816
5. https://www.youtube.com/watch?v=G2fqAlgmoPo
6. https://www.youtube.com/watch?v=zizonToFXDs

Web 3.0: Blockchain and Metaverse

1. What is Ethereum? | ethereum.org

2. Navigating Remix — Remix - Ethereum IDE 1 documentation (remix-ide.readthedocs.io)
3. Solidity — Solidity 0.6.8 documentation (soliditylang.org)
4. https://www.youtube.com/watch?v=nalMdCI_pv8&t=765s
5. The Decentralized Autonomous Organization and Governance Issues by Usman W. Chohan :: SSRN
6. Ethereum Smart Contract Best Practices (consensys.github.io)
7. https://hackernoon.com/hack-solidity-reentrancy-attack

Smart Manufacturing and Digital Twins:

1. https://www.youtube.com/watch?v=nwFed03fS_s
2. https://www.youtube.com/watch?v=ScmK-bKJ4MI

RPA and Robotics:

1. https://www.youtube.com/watch?v=9URSbTOE4YI
2. https://www.youtube.com/watch?v=UEbw7dIOg0g
3. https://www.uipath.com/resources/automation-case-studies
4. https://www.ibm.com/products/robotic-process-automation/case-studies

Cybersecurity:

1. https://www.getastra.com/blog/security-audit/what-is-vapt/
2. https://owasp.org/www-project-top-ten/
3. https://owasp.org/www-project-mutillidae-ii/
4. https://www.youtube.com/watch?v=JAtwZoW76-I
5. Threat modelling (STRIDE framework): https://learn.microsoft.com/en- us/azure/security/develop/threat-modeling-tool-threats
6. Cyber Kill Chain:https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill- chain.html

Quantum Computing:

1. https://www.youtube.com/watch?v=e3fz3dqhN44
2. https://quantumai.google/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22ETP58.1	-	-	-	-		3	-	2	-	--	-	-
22ETP58.2	-	2	-	-	3	-	-	-		-	-	1
22ETP58.3	-	-	-	3	2	-	-	-	--	-	-	-
22ETP58.4	-	-	-	-	3	-		-	-	-	-	1
22ETP58.5	2	-	-	-	3	-	-	-	-	-	-	-
22ETP58.6	-	-	2	-	3	-	--	-	2	-	-	1

1: Low 2: Medium 3: High

VI Semester

Designing and Detailing of Bridges			
Course Code	**22CIV61**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours + 10 lab slots	Credits	04

Course Learning Objectives:

- Introduce students to various aspects of Bridge structures and their components.
- Infer the hydraulic design concepts of Bridges and various IRC loading standards.
- Design small span bridges like culverts, slab decks, T-beam decks, and post-tensioned slabs.
- Infer various types of bearings, and analysis of substructures, and foundations.
- Infer superstructure construction methods and practices.

Module-1 Introduction and Conceptual Design of Bridges (8 hours)

Introduction, components of a bridge and their functions, Site investigations before bridge construction, classification of bridges, IRC loading standards, IRC A, B, AA, and 70R. Hydraulic design of bridges, natural and artificial waterways, afflux, Economic span, problems.

Module-2 Design of pipe culverts and Box culverts (8 hours)

Pipe culverts. Hydraulic design and structural design, IRC loading standards. Design problems. Design of Box culverts, the general procedure of design for all the conditions of the culvert, reinforcement details, Design example (students should design the culvert for both IRC A and B loading conditions)

Module-3 Design of Deck slab (Limit state method) (8 hours)

Introduction, Design of deck slab. Effective dispersion of wheel load along the span and effective width concept, Arrangement of wheel loads of IRC A for obtaining maximum bending moment and shear force, Design example. Arrangement of IRC class AA obtaining maximum bending moment and shear force, Design example. Arrangement of IRC 70R loading for obtaining maximum bending moment and shear force. Design examples.

Module-4 Introduction to T-beam bridges (8 hours)

Code provisions, typical arrangement of longitudinal and cross girders, Pigeaud's method, design of interior panel (for IRC class AA and 70R), methods for finding load distribution among longitudinal girders (Courbon's, method), general steps of design (only design concepts).

Module-5 Bridge substructures, abutments and Piers (8 hours)

Types of abutments and piers, stability analysis of piers and abutments, base pressure distribution. Bridge bearings, types and their suitability. bridge foundations and its types.

PRACTICAL MODULE

Detailing of Bridges

- Detailing of pipe culverts

Design specification, Plan, Profile View (Longitudinal Section), Cross-Sectional View

- Detailing Box culverts

Design specification, Plan, Profile View (Longitudinal Section), Cross-Sectional View

- Detailing of Deck slab

Design specification, Plan, Profile View (Longitudinal Section), Cross-Sectional View.

Course Outcomes: At the end of the course the student will be able to:	
22CIV61.1	Selection of bridge type based on the site investigation, inputs and be able to compute design discharge, linear waterway, economic span, and depth of scour.
22CIV61.2	Design pipe culverts and Box culverts.

22CIV61.3	Design deck slabs for critical loads.
22CIV61.4	Analyze the stability of bridge piers and abutments.
22CIV61.5	Recommend suitable bearings for the given type of bridge and support condition.
22CIV61.6	Abutments and piers, stability analysis of piers and abutments, base pressure distribution.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Essentials of Bridge Engineering	Johnson – victor	Oxford IBH Publications, New Delhi	6th edition 2019
2	Design of Bridge Structures,	T.R. Jagadeesh and M A Jayaram,	PHI, New Delhi	3rd edition, 2020
3	Design of Bridges,	Krishna Raju N	Oxford-IBH Publishing	5th edition, 2020
4	Bridge Super Structures	Rajagopalan	Narosa Publishing House	2013
Reference Books				
1	IRC : 112- 2020:	Code of Practice for Concrete Bridges	New Delhi	2020

Web links and Video Lectures (e-Resources):
(Basics of Bridge Design) - NPTEL: Civil Engineering - NOC:Bridge Engineering

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV61.1	2			2										
22CIV61.2			2											
22CIV61.3			3											
22CIV61.4	2	2												
22CIV61.5						2								
22CIV61.6			2											

1: Low 2: Medium 3: High

DESIGN OF STEEL STRUCTURES & DETAILING			
Course Code	**22CIV62**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Understand advantages and disadvantages of steel structures and Codal provisions.
- Learn Bolted connections and Welded connections.
- Design of compression members, built-up columns and columns splices.
- Design of tension members, simple slab base and gusseted base.
- Design of laterally supported and un-supported steel beams.

Module-1 Introduction to Structural Steel (8 hours)

Introduction: Advantages and Disadvantages of Steel Structures, Limit state method Limit State of Strength, Structural Stability, Serviceability Limit states, Failure Criteria of steel, Design Consideration, Loading and load combinations, IS code provisions, Specification and Section classification, fire resistance and ductility of steel.
Applications: Knowledge of different methods of Analysis of steel structures.

Module-2 Bolted Connections. (8 hours)

Bolted Connections: Introduction, Types of Bolts, Behavior of bolted joints, Transfer of forces in bolted connections, Failure of bolted connections (bolt value). Design of High Strength friction Grip (HSFG) bolts, Design of Simple bolted Connections (Lap and Butt joints) and bracket connections.
Applications: Introduction to design tools for Bolted Connection by taking various loading conditions.

Module-3 Welded Connections. (8 hours)

Welded Connections: Introduction, Types and properties of welds, Effective areas of welds, Weld Defects, Simple welded joints for truss member and bracket connections, Advantages and Disadvantages of Bolted and Welded Connections.
Applications: Design of Welded Connection for various loading conditions.

Module-4 Design of Compression Members & Tension Members (8 hours)

Design of Compression Members: Introduction, Failure modes, Behavior of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built-up Compression members, Design of Laced System, Design of Battened Systems [No Numerical Problems].
Design of Tension Members: Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension members, Design of Tension members and Lug angles.
Applications: Design of compression & tension members for various applied loads.

Module-5 Design of Beams & Column Bases (8 hours)

Design of Beams: Introduction, Beam types, Lateral Stability of beams, factors affecting lateral stability, Web buckling and crippling, Behavior of Beams in Bending, Design of laterally supported beams in Bending, Shear Strength of Steel Beams. Beam to Beam Connections, Beam to Column Connection and Column Splices [No Numerical Problems].
Design of Column Bases: Design of Simple Slab Base and Gusseted Base.
Applications: Designing steel beams & Column Bases for various loading conditions.

PRACTICAL MODULE

Detailing of Steel Structural using 2D Drafting Software.

- Beam to Beam Connections: Beam to Beam Bolted Connection, Beam to Beam Welded Connection.

- Beams & Column Connection: Beam to Column Bolted Connection, Beam to Column Welded Connection.
- Built-up Columns: Lacing connection, Batten Connection.
- Column Bases: Slab Base, Gusseted Base.
- Truss Detailing: Bolded Connection, Welded connection.

Course Outcomes: At the end of the course the student will be able to:	
22CIV62.1	Explain the knowledge of Steel Structures as per code provisions and plastic the behavior of structural steel
22CIV62.2	Design of Bolted connections as per IS code provisions
22CIV62.3	Design of Welded connections as per IS code provisions
22CIV62.4	Design of compression members, built-up columns and column splices as per IS code provisions
22CIV62.5	Design of tension members as per the requirements of IS code
22CIV62.6	Design laterally supported and un-supported steel beams & simple slab base and gusseted base as per the requirements of IS code

Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Design of Steel Structures	N Subramanian	Oxford University Press, New Delhi.	Third Edition 2019
2	Limit State Method of Design of Steel Structures	Duggal S K	Tata McGraw-Hill Publishing Company New Delhi	2010
Reference Books				
1	Design of Steel Structures	Dayarathnam P	Scientific International Pvt. Ltd	1st Edition, 2020
2	Design of Steel Structures	Kazim S M A and Jindal R S	Prentice Hall of India, New Delhi.	7th Edition, 2009
3	**Code books – IS 800, SP (6), IS808 – Steel Tables, shall be referred for designing. The same will be provided during examination**			

Web links and Video Lectures (e-Resources):
Design of steel structures https://nptel.ac.in/courses/105105162

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV62.1	2													2
22CIV62.2			3									1		2
22CIV62.3			3									1		2
22CIV62.4						3		3						2
22CIV62.5						3		3						2
22CIV62.6						2		3						2

1: Low 2: Medium 3: High

Hydrology and Irrigation Engineering			
Course Code	**22CIV63**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: This course will enable students to

- Analyze and interpret hydrological data: Develop skills in analyzing and interpreting hydrological data, enabling understanding of water resource dynamics.
- Assess water availability and demand: Gain the ability to assess water availability and demand for different sectors, considering factors such as population growth and climate change.
- Design and evaluate irrigation systems: Acquire knowledge of principles and techniques for designing efficient irrigation systems, ensuring optimal water use for agriculture and other purposes.
- Promote sustainable water management practices: Understand the importance of sustainable water management and develop strategies to conserve water, recycle, and integrate environmental considerations into water management.

Module-1 Introduction to Hydrology (8 hours)

Hydrology: Introduction, Importance of hydrology, Global distribution of water and Indian water availability, Practical application of hydrology, Hydrologic cycle (Horton's) qualitative and engineering representation.

Precipitation: Definition, Forms and types of precipitation, measurement of rain fall using Symon's and Syphon type of rain gauges, optimum number of rain gauge stations, consistency of rainfall data (double mass curve method), computation of mean rainfall, estimation of missing data, presentation of precipitation data, moving average curve, mass curve, rainfall hyetographs.

Applications: Water resource management, flood forecasting, Agriculture

Module-2 Evaporations and Infiltration (8 hours)

Losses: Evaporation: Introduction, Process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae (Meyer's and Rohwer's equations) Reservoir evaporation and control.

Evapo-transpiration: Introduction, Consumptive use, AET, PET, Factors affecting, Measurement, Estimation by Blaney-Criddle equation.

Infiltration: Introduction, factors affecting infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices.

Applications: Stormwater management.

Module-3 Runoff and Hydrographs (8 hours)

Runoff: Definition, concept of catchment, factors affecting runoff, rainfall – runoff relationship using regression analysis.

Hydrographs: Definition, components of hydrograph, base flow separation, unit hydrograph, assumption, application and limitations, derivation from simple storm hydrographs, S curve and its computations, Conversion of UH of different durations. Flow in rivers

Applications: Preparations of hydrological modeling, Watershed management, water supply management

Module-4 Irrigation Engineering (8 hours)

Irrigation: Definition. Benefits and ill effects of irrigation. System of irrigation: surface and ground water, flow irrigation, lift irrigation, Bandhara irrigation.

Water Requirements of Crops: Duty, delta and base period, relationship between them, factors affecting duty of water crops and crop seasons in India, irrigation efficiency, frequency of irrigation.

Applications: Water supply management, Agricultural irrigation, water conservation.

Module-5 Irrigation structures (8 hours)
Canals & Aqueducts: Types of canals. Alignment of canals. Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor. Unlined and lined canals. Standard sections. Design of canals by Lacey's and Kennedy's method. **Reservoirs:** Definition, investigation for reservoir site, storage zones determination of storage capacity using mass curves, economical height of dam. **Applications: Water supply, Flood control, Wastewater management**

Course Outcomes: At the end of the course the student will be able to:	
22CIV63.1	Apply the concept of hydrology and components of the hydrologic cycle such as Forms and types of precipitation, measurement of rainfall using Symon's and Syphon type of rain gauges
22CIV63.2	Analyze the water cycle and its components such as precipitation, evapotranspiration, surface runoff, and groundwater flow.
22CIV63.3	Evaluate the impact of land use changes and climate variability on runoff and development of storm and unit hydrograph.
22CIV63.4	Analyze and Design the irrigation systems to ensure efficient use of water for agriculture and other uses.
22CIV63.5	Identify the classification of soil and correlate soil –the water-crop relationship
22CIV63.6	Design canal systems and compute the reservoir capacity

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Engineering Hydrology	K. Subramanya	Tata McGraw Hill, New Delhi	4th Edition 2017
2	Irrigation and Water Power Engineering	Punmia and Lal Pandey	Lakshmi Publications, New Delhi	16th Edition, 2018
Reference Books				
1	Hydrology	H.M. Raghunath	Wiley Eastern Publication New Delhi	4th Edition, 2021
2	Irrigation Engineering and Hydraulic Structures	SK Garg	Khanna Publications	5th Edition, 2005
3	Water Resources and Water Power Engineering	Modi P N	Standard Book House	5th Edition, 2018

Web links and Video Lectures (e-Resources):

1. Introduction to Hydrology" by Professor Jeff McDonnell from the University of Saskatchewan: https://www.youtube.com/watch?v=5o_wPpsvBhM
2. "Surface Water Hydrology" by Professor Richard Palmer from the University of Massachusetts Amherst: https://www.youtube.com/watch?v=9NmdD8-6xN0
3. Groundwater Hydrology" by Professor David Tarboton from Utah State University: https://www.youtube.com/watch?v=y0dJ-PF8f_0
4. Irrigation Engineering" by Professor Prabir Basu from the Indian Institute of Technology Kharagpur: https://www.youtube.com/watch?v=sOnhSBtQ2rM
5. Hydrological Software Packages" by Professor Neil McIntyre from the University of Canterbury: https://www.youtube.com/watch?v=TwQsF4A4g4M

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV63.1	3						2							
22CIV63.2	3	2					2							
22CIV63.3	3	2					2							
22CIV63.4	3						2		2	2				
22CIV63.5	3	2					2		2	2				
22CIV63.6	3	2					2		2	2				

1: Low 2: Medium 3: High

Advanced Geotechnical Engineering			
Course Code	**22CIV641**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives:

- Understand basic concepts of soil mechanics applied in the design of foundations
- Learn concepts of Geotechnical investigations required for civil engineering projects emphasizing in situ investigations
- Identify the type of soil, and its properties in designing the foundations
- Study assessing slope stability and earth pressure on rigid retaining structures.
- Identify the soil suitable for reinforced earth and the type of reinforcing material suitable for the project and designing the reinforced earth

Module -1 Site investigation and soil sampling (8 hours)

Site investigation and soil exploration: objectives - planning - reconnaissance - Guidelines for choosing spacing and depth of borings [I.S. guidelines only]- Methods of subsurface exploration - test pits - Auger borings – Wash Boring - Rotary drilling - Standard Penetration Test – procedure and correlations - Corrections for SPT value – Numerical Problems
Soil Sampling: disturbed samples, undisturbed samples and chunk samples - types of samplers - Sampler parameters - Boring log – Soil profile- Location of Water table - Geophysical methods: Seismic Refraction method and Electrical Resistivity method (in brief).

Module-2 Stability of slopes and earth pressure (8 hours)

Stability of Slopes: Assumptions, infinite and finite slopes, factor of safety, Swedish slip circle method for c and c-ϕ (Method of slices) soils, use of Taylor's stability charts. Causes for slope instability, Methods of stabilization of slopes
Lateral Earth Pressure: Active, Passive and earth pressure at rest, Rankine's theory for cohesionless and cohesive soils, Factors influencing lateral earth pressure, Geotechnical design of gravity and cantilever retaining wall (procedure only)

Module 3 Reinforced earth structure (8 hours)

Reinforced soil structure: Introduction to reinforced soil structures, comparison with reinforced cement concrete structures.
Reinforced Earth: Principles, concepts, and Mechanisms of reinforced earth, materials used – geotextile, geogrids, geomembranes, geocomposites, metallic strips etc., Design of reinforced earth in Pavements and embankments
Case studies of reinforced soil structures and discussion on current literature

Module-4 Foundations on problematic soils (8 hours)

Special Topics of Foundation Engineering Foundations on Collapsible Soils: Origin and occurrence, Identification, Sampling and Testing, Preventive and Remedial Measures. **Foundations on Expansive Soils:** The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and Preventive design & construction measures.

Module-5 Case histories (8 hours)

Case histories- typical cases of performance failure representative of soil engineering projects namely shallow and deep foundations, slope stability, earth dams, retaining structures

AI Application: Preparation of Bore log database of the site investigation and soil sampling (Not for exam, only for self-study)

Course Outcomes: At the end of the course the student will be able to:	
22CIV641.1	Ability to plan and execute geotechnical site investigation programs for different civil engineering projects
22CIV641.2	Ability to estimate a factor of safety against failure of slopes
22CIV641.3	Ability to compute lateral pressure distribution behind earth-retaining structures
22CIV641.4	Ability to design and incorporate the reinforced earth for the sites at weak soil sites to enhance the engineering properties of the soils
22CIV641.5	Analyze and adapt design skills of foundation in problematic soils
22CIV641.6	To develop new approaches for the design of stable structures by understanding the case histories for failure of foundation structures and arrive at classical geotechnical behavior to contract the failures

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Principles of Geotechnical Engineering	Braja M. Das	Cengage Learning	10th edition, 2020
2	Soil Mechanics and Foundation Engineering	Dr. Arora K. R	Standard Publishers	7th Edition, 2020
Reference Books				
1	Soil Mechanics and Foundation Engineering	S K Garg	Khanna Publications	1st, Edition 2003
2	Soil Mechanics and Foundations	Muniram Budhu	John Wiley & Sons, Inc.	2011
3	Geotechnical Engineering	Dr. Arora K. R.	Standard Publishers	2019

Web links and Video Lectures (e-Resources):

Soil Exploration-boring: https://nptel.ac.in/courses/105/105/105105176/

Lateral earth pressure: https://nptel.ac.in/courses/105/101/105101083/

Stability of Slopes: https://nptel.ac.in/courses/105/107/105107120

Course outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV641.1	3	2		3										
22CIV641.2	3	2		1										
22CIV641.3	3		3	1										
22CIV641.4		2		3	3									
22CIV641.5	3				3									
22CIV641.6	3				3	2	2							

1: Low 2: Medium 3: High

Design and Construction of Highway Pavements			
Course Code	**22CIV642**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Gain knowledge about the process of collecting data required for design, factors affecting pavement design, and maintenance of pavement.
- Excel in the path of analysis of stress, strain and deflection in pavement.
- Understand design concepts of flexible pavement by various methods (CBR, IRC 37-2001, Mcleods, Kansas) and also the same of rigid pavement by IRC 58-2002
- Understand the various causes leading to failure of pavement and remedies for the same.
- Develop skills to perform functional and structural evaluation of pavement by suitable methods.

Module-1 Introduction to Pavement (8 hours)

Introduction: Desirable characteristics of pavement, Types and components, Difference between Highway pavement and Air field pavement, Design strategies of variables, Functions of sub grade, sub base, Base course, surface course, comparison between Rigid and flexible pavement. Fundamentals of Design of Pavements: Stresses and deflections, Principle, Assumptions and Limitations of Boussinesq's theory, Burmister theory and problems on Stress and deflection

Module-2 Design of Flexible Pavement (8 hours)

Design Factors: Design wheel load, contact pressure, Design life, Traffic factors, climatic factors, Road geometry, Subgrade strength and drainage, ESWL concept Determination of ESWL by equivalent deflection criteria, Stress criteria, ESWL concept, and problems on above. **Flexible pavement Design:** Assumptions, Mcleod Method, Kansas method, CBR method, IRC Method (old), CSA method using IRC-37-2001, problems on above

Module-3 Design of Rigid Pavement (8 hours)

Stresses in Rigid Pavement: Types of stress, Analysis of Stresses, Westergaard's Analysis, Modified Westergaard equations, Critical stresses, Wheel load stresses, Warping stress, Frictional stress, combined stresses (using chart / equations), problems on above. Design of Rigid Pavement: Design of CC pavement by IRC: 58-2002 for dual and Tandem axle load, Reinforcement in slabs, Design of Dowel bars, Design of Tie bars, Design factors for Runway pavements, Design methods for airfield pavements, problems of the above

Module-4 Construction of Pavement (8 hours)

Construction of Subgrade and Subbase: Specifications and steps for construction of subgrade, subbase, quality control tests Construction of granular layers: Specifications and steps of construction , WBM, WMM, CRM, quality control tests

Construction of Bituminous Layers: Different types of bituminous layers, specifications and construction of bituminous layers, quality control tests

Construction of Cement Concrete Pavements: Specifications and steps for construction of DLC, Paving Quality Concrete pavements, quality control test

Module-5 Flexible & Rigid Pavement Failures (8 hours)

Flexible & Rigid Pavement Failures, Maintenance and Evaluation:

Maintenance and Evaluation, Types of failures, Causes, Remedial/Maintenance measures in flexible pavements and rigid pavements, Structural evaluation by Benkleman beam deflection method, Falling weight deflectometer

Course Outcomes: At the end of the course the student will be able to:	
22CIV642.1	Apply the knowledge of components of pavement for the design requirements of pavement.
22CIV642.2	Compute stresses and deflections in the pavement using Boussinesq's theory and Burmister theory for the design of pavement
22CIV642.3	Design the flexible pavement by using Mcleod Method, Kansas method, CBR method and IRC-37-2001
22CIV642.4	Design the rigid pavement by analyzing the stresses using Westergaard's and Modified Westergaard equations
22CIV642.5	Acquire skillful knowledge of pavement construction practices, plant and machinery selection and quality control
22CIV642.6	Analyze flexible & rigid pavement failures using Visual inspection and unevenness measurements

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Highway Engineering	S K Khanna, C E G Justo, and A Veeraragavan	Nem Chand& Brothers	10th edition, 2010
2	Principles and Practices of Highway Engineering	L.R.Kadiyali and Dr.N.B.Lal	Khanna publishers	7th edition, 2009
Reference Books				
1	Pavement Analysis and Design	Yang H. Huang	University of Kentucky	2nd edition, 2008
2	IRC-37-2001 & IRC: 58-2002	Indian Road Congress	Indian Road Congress	2001&2002

Web links and Video Lectures (e-Resources):

- Pavement Materials- Pavement Materials (Under Pavement Engineering) - Course (nptel.ac.in)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV642.1	3													
22CIV642.2		2												
22CIV642.3			2											
22CIV642.4			2											
22CIV642.5			2					3	3	3				
22CIV642.6			2											

1: Low 2: Medium 3: High

INTEGRATED BUILDING SERVICES AND DESIGN CONCEPTS			
Course Code	**22CIV643**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

This course will enable students to:

- Learn the importance of sanitation, domestic water supply, and plumbing and fire services.
- Understand the concepts of heat, ventilation and air conditioning.
- Develop technical and practical knowledge in Building Services.

Module-1- Water Supply and its Services (8 Hours)

Water requirements for different types of buildings, simple method of removal of impurities, water saving practices and their potential Service connection from mains, sump and storage tank, types and sizes of pipes, special installation in multistoried buildings. Rainwater harvesting includes roof top harvesting, type of spouts, sizes of rainwater pipes and typical detail of a water harvesting pit.

Module-2- Heat Ventilation and Air Conditioning (HVAC) (8 Hours)

Behavior of heat propagation, thermal insulating materials and their co-efficient of thermal conductivity. General methods of thermal insulation: Thermal insulation of roofs, exposed walls. Ventilation: Definition and necessity, system of ventilation. Principles of air conditioning, Air cooling, Different systems of ducting and distribution, Essentials of air-conditioning system.

Self-Learning Exercise: Different types of modern air conditioning systems

Module-3- Electrical and Fire Fighting Services (8 Hours)

Electrical systems, Basics of electricity, single/Three phase supply, protective devices in electrical installation, Earthing for safety, Types of earthing, ISI Specifications. Electrical installations in buildings, Types of wires, Wiring systems and their choice, planning electrical wiring for building, Main and distribution boards, Principles of illumination.

Classification of buildings based on occupancy, causes of fire and spread of fire, Standard fire, Firefighting, protection and fire resistance, Firefighting equipment and different methods of fighting fire., means of escape, alarms, etc., Combustibility of materials, Structural elements and fire resistance, Fire escape routes and elements, planning and design. Wet risers, dry risers, sprinklers, heat detectors, smoke detectors, fire dampers, fire doors, etc. Provisions of NBC.

Self-Learning Exercise: Planning electrical wiring for Residential building; Fire escape route plans for residential building

Module-4-Plumbing and Fire Fighting Layout of Simple Buildings (8 Hours)

Plumbing and Fire Fighting Layout of Simple Buildings: Application of above studies in preparing layout and details - Plumbing layout of residential and public buildings, Fire fighting layout, Reflected ceiling plan of smoke detectors / sprinklers, etc.

Self Learning Exercise: Reflected ceiling plan of smoke detectors /sprinklers for school building/Hostel buildings

Module-5- Engineering Services and Building Maintenance (8 Hours)

Engineering Services: engineering services in a building as a system, Lifts, escalators, cold and hot water systems, wastewater systems and electrical systems. Pumps and Machineries: Reciprocating, Centrifugal, Deep well, Submersible, Automatic pumps, Sewerage pumps, Compressors, Vacuum pump – their selection, installation and maintenance – Hot water boilers –, DC/AC motors, Generators.

Building Maintenance: Preventive and protective maintenance, Scheduled and contingency maintenance planning, M.I.S. for building maintenance. Maintenance standards. Economic maintenance decisions.

Self Learning Exercise: Classification and types of lifts, lift codes, rules structural provision: escalators, their uses, types and sizes, safety norms to be adopted – Social features required for physically handicapped and elderly.	
Course Outcomes: At the end of the course the student will be able to:	
22CIV643.1	Interpret different types of water supply systems and its applications.
22CIV643.2	Design Rainwater harvesting systems in various buildings.
22CIV643.3	Apply the knowledge of heat ventilation and principles of air-conditioning in designing services.
22CIV643.4	Develop the plans for electrical services and understand the requirements of NBC for fighting services.
22CIV643.5	Develop plumbing plans and fire escape route plan for various types of buildings.
22CIV643.6	Analyse the requirements of different types of engineering services in a building and understand different types of maintenance standard required for building.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Fire Safety in Buildings	V. K. Jain	New Age International Publishers	3rd Edition, 2020
2	Heat Pumps and Electric Heating	E. R. Ambrose	John and Wiley and Sons Inc, New York	2016
Reference Books				
1	National Building Code of India 2016 (NBC 2016)	Bureau of Indian Standards		2016
2	Handbook for Building Engineers in Metric systems	National Building Organisation		1966

Web links/Video Lectures/MOOCs

1. **INTEGRATED BUIDING SERVICES AND DESIGN CONCEPTS**
   https://www.youtube.com/watch?v=VN9IX4m-t8U&list=PLq46p_ppqQem38VzrRTe8gtCUdfGjEKzA

Course Articulation Matrix

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV643.1	2					2								
22CIV643.2	2													
22CIV643.3		2								2				
22CIV643.4		2								2				
22CIV643.5			2							2				
22CIV643.6	2									2				

1: Low 2: Medium 3: High

Solid Waste Management			
Course Code	**22CIV644**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Study the present methods of solid waste management systems and analyze their drawbacks compared with statutory rules.
- Understand different elements of solid waste management from generation of solid waste to disposal.
- Analyze different processing technologies and to study the conversion of municipal solid waste to compost or biogas.
- Evaluate landfill sites and to study the sanitary landfill reactions.

Module-1 Preliminary steps for Solid Waste Management (6 Hours)

Sources: Need for solid waste management, Components and role of solid waste management, Sources of Solid waste, Hierarchy of waste management options, Types of solid waste, Waste Generation, Physical and Chemical composition of municipal solid waste., Numerical Problems.

Storage and Collection: Storage, segregation, Collection of solid waste- services and systems, equipment.

Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid Waste Management 2000 rules with 2016 amendments.

Applications: Developing and implementing municipal or city-level solid waste management plans

Module-2 Processing of Solid Waste (6 hours)

Processing techniques: Purpose of processing, Volume reduction by incineration, Process description, Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).

Applications: Selecting appropriate techniques, designing facilities, training professionals, and implementing policies

Module-3 Composting and Landfilling (6 hours)

Composting: Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems.

Sanitary land filling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill - Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems. Groundwater contamination and remediation.

Applications: Determine various treatment techniques, determine types and characteristics of solid waste and its disposal.

Module-4 Risk Assessment (6 hours)

Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies, biomedical waste, e-waste

Applications: Comparing the risks associated with different waste treatment or disposal options

Module- 5 Thermal Treatment and Energy Recovery (6 hours)

Incineration - 3Ts factor affecting incineration, types of incinerations, Pyrolysis, Energy recovery technique from solid waste management, construction and demolition waste.

Applications: Recovering energy from solid waste using waste-to-energy facilities.

Course Outcomes: At the end of the course the student will be able to:	
22CIV644.1	Explain the components, sources, hierarchy, types, and composition of solid waste management.
22CIV644.2	Apply appropriate techniques for selecting, designing, training professionals, and implementing policies for solid waste management
22CIV644.3	Apply various treatment techniques and determine types and characteristics of solid waste and its disposal.
22CIV644.4	Compare the risks associated with different waste treatment or disposal options.
22CIV644.5	Evaluate disposal sites and Analyze the 3Ts factor affecting incineration, and energy recovery techniques from solid waste management.
22CIV644.6	Evaluate the applications of recovering energy from solid waste using waste-to- energy facilities.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Integrated Solid Waste Management: Engineering principles and management issues	George Tchobanoglous, Hilary Theisen, Samuel A Vigil	Mc Graw Hill	2nd Edition, 1993
2	Environmental Engineering	Howard S Peavy, Donald R Rowe and George Tchobanoglous	Tata Mcgraw Hill Publishing Co ltd.	1st Edition, 2017
Reference Books				
1	Municipal Solid Wastes (Management and Handling) Rules	Ministry of Environment and Forests Notification	Amendment – 1357(E)	Edition 2016
2	Municipal Solid waste management manual, Part II	Published under Swachh Bharat Mission	Central Public Health and Environmental Engineering Organization	Edition 2016
3	Handbook of Solid waste management	George Tchobanoglous, Frank Kreith	Mc Graw Hill Education	2nd Edition, 2002

Web links and Video Lectures (e-Resources):

Introduction to waste management - https://onlinecourses.nptel.ac.in/noc20_ce56

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV644.1	2		1											3
22CIV644.2	2		2											3
22CIV644.3	1		2				3							3
22CIV644.4	1						3							3
22CIV644.5	1						3							3
22CIV644.6	2		1				2							3
1: Low 2: Medium 3: High														

GEOSPATIAL TECHNOLOGY			
Course Code	**22CIV651**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	Exam Hours	03 hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

- Introduce the concept of various geospatial technologies used in the industry
- Help to acquire basic idea about the processing and mapping with modern surveying equipment.
- Elaborate proven concepts, business practices and applications of geospatial technology.
- Explain learners understand how geospatial concepts are leveraged in handling real world business challenges of engineering and construction industry.
- Develop skills in utilizing GIS software for data conversion, spatial analysis, and geospatial data visualization.
- Understand the principles and applications of remote sensing technologies, including 3D scanning, photogrammetry, LiDAR, RADAR, and SONAR, in various engineering contexts.

Module-1 Need of Geospatial Technology in Industry (8 hrs)

Geospatial in Day to Day Life, Spatial thinking, Evolution of location technology and importance of geography and maps. Need for spatial information, Terminologies, logic, language and formats of spatial technology. Location perspective of construction industry, Overview of Geospatial technology in tenders, Design and execution and Construction lifecycle management. Fundamentals and components of Geospatial Engineering, Surveying and Conventional survey equipment Vs Modern surveying equipment Components. Digital Land Surveying Needs.

Module-2 Total Station and Global Navigation Satellite System (GNSS) (8 hrs)

Basics of Surveying, Introduction to Survey and Mapping, Geospatial Surveying Equipment, Demo of Total Station Equipment, Setting out and mapping, Advanced geospatial solutions, GNSS Overview of components, working and signal structure of Global navigation System.

Module-3 Geospatial Engineering and Technology (8 hrs)

Remote Sensing Technologies, Types of remote sensing, Sensors and its types, Application of sensors & platforms, Image Acquisition, Applications of Remote Sensing. 3D scanning, Principles and the science behind photogrammetry, LiDAR, RADAR and SONAR. Introduction to Platforms and working.

Module-4 Geographical Information System (8 hrs)

Basics of GIS, Vector & Raster data models, Types and components of a Map. Hardware for GIS, DEM and TIN Data products, Attribute Data Types. Basic GIS data conversions, conversions from non-spatial formats to spatial formats. Demo of Conversion of Excel to GIS, Demo of Conversion of CAD TO GIS, Demo of Downloading and Geo-referencing Topo sheets and Raster files.

Module-5 Applications and Future trends of Geospatial Technologies: (8 hrs)

Application of GIS - Spatial Analysis, Catchment Area delineation, Overlay Analysis, Cluster Analysis, Hotspot Analysis and View shed Analysis. Future Trends of Geospatial Technologies. Case Study 1 -Benefit Realization - Case Study 2 Advancements in Modern Survey & Mapping Technologies, Advancements in Spatial Analytics – Geo Intelligence, Future Trends, Geospatial Technology - Way Forward.

Course Outcomes: At the end of the course the student will be able to:	
22CIV651.1	Comprehend different geospatial techniques in the Construction Industry.
22CIV651.2	Understand the application of geospatial equipment like Total Station, GNSS, LIDAR, UAV (Drones), etc.,

22CIV651.3	Evaluate the various spatial analysis operations by using GIS Environment
22CIV651.4	Create a map layout with all essential cartographic elements in GIS Environment.
22CIV651.5	Illustrate the various geospatial emerging trends of GIS in Industry
22CIV651.6	Implement advanced geospatial solutions and analyze their effectiveness in improving construction lifecycle management and project outcomes.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Surveying and Levelling, Parts 1 & 2	T. P. Kanetkar and S. V. Kulkarn	Pune Vidyarthi Griha Prakashan, Pune	2nd edition, 2000
2	Surveying, Theory and Practice	James M. Anderson and Edward M. Mikhai	McGraw Hil	3rd edition, 1993
Reference Books				
1	Advanced Surveying, Total Station GPS and Remote Sensing	Satheesh Gopi, R. Sathikumar, N. Madhu	Pearson education	2nd edition, 2017

Web links/Video Lectures/MOOCs/papers

NPTEL :: Civil Engineering - NOC:Digital Land Surveying And Mapping(DLS&M)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV651.1	3				3	2								
22CIV651.2					3				3					
22CIV651.3							3				3			
22CIV651.4					3									
22CIV651.5											3	3		
22CIV651.6					3	2	2				3			

1: Low 2: Medium 3: High

Water Conservation and Rainwater Harvesting			
Course Code	**22CIV652**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

- Judge surface and ground water resources.
- Address the issues of water resources management.
- Learn the principles of integrated water resources management.
- Understand the legal framework of water policy.
- Know the different methods of water harvesting

Module-1 Surface and Ground water Resources: (8 Hours)

Hydrologic Cycle, Global and Indian Water resources, Surface Water Resources, Water Balance, Available Renewable Water Resources, and Water Scarcity. Impact of human interference on the Water Balance, Groundwater Resources, Types of Aquifers, and the use of Groundwater as a Storage Medium. Water balance equation.

Module-2 Water Resources Planning and Management (8 hours)

Necessity of water resources planning and management. System components, planning scales, approaches, and various aspects of planning and management. Analysis, models for impact prediction and evaluation, Adaptive Integrated Policies, and post-planning management issues.

Module-3 Integrated Water Resources Management (8 hours)

Integrated Water Resources Management (IWRM), its principles, and implementation strategies. Legislative and organizational framework, and the types and forms of private sector involvement.

Module-4 Water Governance and Water Policy (8 hours)

Legal framework of water, National Water Laws, and other key issues. National Water Policy, National-Level Commissions, Irrigation Management, Transfer Policies and Activities, Legal Registration of Water User Associations (WUAs), Legal Changes in Water Allocation, the Role of Local Institutions, Community-Based Organizations, and Water Policy Reforms in India. Water laws & case studies.

Module- 5 Rainwater Harvesting in Rural and Urban Areas (8 hours)

Rural areas: Traditional Methods of Rainwater Harvesting, Construction and Maintenance of Farm Ponds, Design and Implementation of Check Dams, Watershed Management, Soil Conservation Techniques, Recharge Pits and Trenches, Percolation Tanks.

Urban areas: Rooftop Rainwater Harvesting Systems, Design of Rain Barrels and Cisterns, Rain Gardens and Bioswales, Permeable Pavements, Stormwater Management, Greywater Recycling, Legal and Safety Aspects of Urban Rainwater Harvesting, Integration of Rainwater Harvesting with Urban Infrastructure.

Course Outcomes: At the end of the course the student will be able to:	
22CIV652.1	Assess the potential of groundwater and surface water resources.
22CIV652.2	Address the issues related to planning and management of water resources.
22CIV652.3	Understand how to implement Integrated Water Resources Management (IWRM) in different regions.
22CIV652.4	Comprehend the legal issues of water policy.
22CIV652.5	Analyze the key elements of rainwater harvesting.
22CIV652.6	Select the appropriate method for water harvesting based on the area.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Engineering Hydrology	K. Subramanya	Tata McGraw Hill Publishers, New Delhi.	4th Edition 2017
2	Ground Water	H.M. Raghunath	Wiley Eastern Publication, New Delhi.	3rd Edition 2007
Reference Books				
1	Integrated Watershed Management in the Global Ecosystem.	Lal, Ruttan	CRC Press, New York.	Edition 2018
2	Integrated Watershed Management: Principles and Practice.	Heathcote, I. W.	John Wiley and Sons, Inc., New York.	2nd Edition 2009
3	Water Resources Systems: Planning and Management	Daniel P. Loucks and Eelco van Beek	UNESCO Publication	1st Edition 2017

Web links and Video Lectures (e-Resources):
Water resources engineering: https://archive.nptel.ac.in/courses/105/105/105105110/
Water resources system planning & management:
https://archive.nptel.ac.in/courses/105/108/105108081/
Water Resources and Watershed Management: https://onlinecourses.swayam2.ac.in/cec21_ge14/preview
Rural Water Resources Management: https://onlinecourses.nptel.ac.in/noc22_ce45/preview

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV652.1	3	2												
22CIV652.2			2				2							
22CIV652.3						2	2							
22CIV652.4	2							3						
22CIV652.5				3			2							
22CIV652.6	2				2									

1: Low 2: Medium 3: High

ENVIRONMENTAL PROTECTION AND MANAGEMENT			
Course Code	**22CIV653**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	Exam Hours	03 hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

- Understand environmental problems and systems approach to corporate environmental management.
- Classify environmental impact reduction efforts and comprehend the Business Charter for sustainable production.
- Analyze national policies on environmental protection, pollution abatement, and resource conservation.
- Evaluate environmental quality objectives and standards, including pollution control versus pollution prevention.
- Implement and manage Environmental Management Systems (EMS) like ISO 14001.
- Conduct environmental audits and develop waste minimization plans in various industries.

Module 1 Environmental Management Standards (8 Hours)

Unique Characteristics of Environmental Problems -Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts - Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers - Evolution of Environmental Stewardship. Environmental Management Principles - National policies on the environment, reduction of pollution, and conservation of resources - Charter on Corporate Responsibility for Environmental Protection.

Module 2 Environmental Standards (8 Hours)

Environmental quality objectives – Rationale of Environmental standards: Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking. Pollution Control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies.

Module 3 EMAS: ISO 14000 - EMS as per ISO 14001(8 Hours)

Benefits and barriers of EMS – Concept of continual improvement and pollution prevention – environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.

Module 4 Environmental Audit (8 Hours)

Environmental management system audits as per ISO 19011- – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non - conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement (form V) - Due diligence audit.

Module 5 Applications of EMS Audit (8 Hours)

Waste Audits and Pollution Prevention opportunities in Textile , Sugar, Pulp & Paper, Electroplating, , Tanning industry, Dairy, Cement, Chemical industries, etc. Transboundary movement, disposal, and procedures, of hazardous wastes.

Course Outcomes: At the end of the course, the student will be able to:	
22CIV653 .1	Evaluate national policies on environmental protection, pollution abatement, and resource conservation to recommend improvements in existing frameworks.

22CIV653 .2	Analyze the unique characteristics of environmental problems and apply a systems approach to develop effective corporate environmental management strategies.
22CIV653 .3	Classify and assess various environmental impact reduction efforts and the principles of the Business Charter for sustainable production and consumption.
22CIV653 .4	Implement Environmental Management Systems (EMS) such as ISO 14001, focusing on continual improvement, pollution prevention, and compliance with legal requirements.
22CIV653 .5	Develop and utilize environmental performance indicators and benchmarks to monitor and improve environmental quality and standards.
22CIV653 .6	Conduct comprehensive environmental audits and waste audits, and devise waste minimization plans tailored to various industries.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Installing Environmental management Systems – a step by step guide	Christopher Sheldon and Mark Yoxon	Earthscan Publications Ltd, London	3rd Edition 1999
2	ISO 14001/14004: Environmental Management Systems – Requirements and Guidelines	International Organization for Standardization		3rd Edition 2015
Reference Books				
1	Environmental Management Systems A Step-by-Step Guide to Implementation and Maintenance	Christopher Sheldon and Mark Yoxon	Earthscan Publications Ltd, London	3rd Edition 1999

Web links/Video Lectures/MOOCs/papers

NPTEL :: Multidisciplinary - NOC:Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV653 .1	3						2							
22CIV653 .2							2							
22CIV653 .3						3	2							
22CIV653 .4						2	3	3						
22CIV653 .5							3							
22CIV653 .6	3								2			2		

1: Low 2: Medium 3: High

FINITE ELEMENT METHOD			
Course Code	**22CIV654**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the basic principles of the finite element method, including the discretization process, interpolation, and numerical integration techniques.
- Understand how to formulate a mathematical model for a given engineering problem and apply the finite element method.
- Develop problem-solving skills using finite element software and understand its capabilities and limitations.
- Understand the principles of FEM for one- and two-dimensional problems.
- Develop the algorithm of the computer program for Finite Element Analysis

Module-1 Introduction (8 hours)

Theory of elasticity concepts, Energy principles, Rayleigh-Ritz Method, Galerkin and finite element method, steps in finite element analysis, displacement approach, stiffness matrix, and boundary conditions.

Module-2 One-dimensional problems (8 hours)

Discretization: finite representation of infinite bodies and discretization of very large bodies. Natural Coordinates, Shape functions; polynomial, LaGrange, and Serendipity; one-dimensional formulations; beam and truss with numerical examples.

Module-3 Two-dimensional problems (8 hours)

2D formulations; Constant Strain Triangle, Linear Strain Triangle, 4 and 8 noded quadrilateral elements, Numerical Evaluation of Element Stiffness - Computation of Stresses, Static Condensation of nodes, degradation technique, Axisymmetric Element.

Module-4 Isoperimetric formulations (8 hours)

Isoperimetric concepts are opera metric, sub-parametric and super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Isoperimetric Elements, and Numerical integration by Gaussian quadrature rule for one and two-dimensional problems.

Module-5 Introduction to software (8 hours)

Structure of computer program for FEM analysis, description of different modules using any programming language / FEM software.

Soft skills (This part of the syllabus is not there for external exams)

Overview of AI techniques and their potential applications in FEM simulations

Course Outcomes: At the end of the course, the student will be able to:	
22CIV654.1	Summarize the basics of finite element formulation
22CIV654.2	Apply finite element formulations to solve one-dimensional Problems
22CIV654.3	Develop shape functions for different elements
22CIV654.4	Apply finite element formulations to solve two-dimensional scalar Problems.
22CIV654.5	Apply finite element method to solve problems on isoparametric element
22CIV654.6	Develop the algorithm of the computer program for Finite Element Analysis

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Finite Element analysis	Krishnamoorthy C.S	Tata McGraw Hill	2nd Edition, 2008
2	Introduction to Finite Elements in Engineering	Tirupathi R. Chandrupatla, Ashok D. Belegundu	Pearson Publishers	3rd Edition, 2008
Reference Books				
1	Finite Element Analysis	S.S. Bhavikatti	New Age International (P) Limited, Publishers	3rd Edition, 2015
2	Finite Element Procedures in Engineering Analysis	Bathe K J	Prentice Hall	1996
3	Concepts and applications of Finite Element analysis	Cook RD, Malkan DS, Plesta ME	John Wiley	4th Edition, 2012

Web links and Video Lectures (e-Resources):
Basics of finite element analysis, IITKP - https://nptel.ac.in/courses/112104193
Introduction to finite element method, IITM - https://nptel.ac.in/courses/112106135
Finite element method, IITKH - https://archive.nptel.ac.in/courses/112/105/112105308/
Finite element method, IITKP - https://nptel.ac.in/courses/112104116

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV654.1	3	3												
22CIV654.2	3	3												
22CIV654.3	3	3												
22CIV654.4	3	3												
22CIV654.5	3	3												
22CIV654.6	3	3			1									

1: Low 2: Medium 3: High

Major Project Phase I			
Course Code	**22CIV66**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:4)	SEE	-
Total Hours	48 hours	Credits	02

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- **Feasibility**: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

5. Report Submission

- **Report**: The project report should include an abstract, introduction, literature review, methodology, completed portion of the project work with the available results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work,

findings, and contributions.

- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the project report, presentation, and the ability to answer questions.

8. Plagiarism Check

- **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources.
- **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).

9. Mentorship and Feedback

- **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.
- **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 100 marks)**
1. Project Synopsis Evaluation	Beginning of the 6th Semester	20 marks
2. Project Progress Evaluation	Middle of the 6th Semester	30 marks
3. Project Report Evaluation (Phase I)	End of the 6th Semester	50 marks
Marks given for the Project Report shall be the same for all project team members, However, marks may differ for presentations and viva-voce depending upon the individual student performance.		
Semester End Examinations (SEE)		
There is No SEE component for Major Project Phase I.		

Course Outcomes: At the end of the course the student will be able to :	
22CIV66.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
22CIV66.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
22CIV66.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
22CIV66.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
22CIV66.5	Demonstrate awareness of professional ethics, societal impact, and sustainability

	in the design and implementation of engineering solutions.
22CIV66.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV66.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
22CIV66.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
22CIV66.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
22CIV66.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
22CIV66.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
22CIV66.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	**22CIV67**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:0:0	SEE	2 Hours
Total Hours	15 hours Theory	Credits	01

Course Learning Objectives: This course will enable

- To create environmental awareness among the students.
- To gain knowledge on different types of pollution in the environment.

Module-1 Introduction to Ecology (3 hours)

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic, and Lake. Biodiversity: Types, Value; Hot spots; Threats and Conservation of Biodiversity, Forest Wealth, and Deforestation.

Module-2 Energy Systems and Natural Resources (3 hours)

Advances in Energy Systems (Merits, Demerits, Global Status, and Applications): Hydrogen, Solar, OTEC, Tidal, and Wind.

Natural Resource Management (Concept and case studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Module-3 Environmental Pollution and Public Health (3 hours)

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution, and Air Pollution.

Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4 Environmental Concerns (3 hours)

Global Environmental Concerns (Concept, policies, and case studies): Groundwater depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problems in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5 Environmental Management (3 hours)

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Fieldwork: A visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; thought to be Followed by an understanding of the process and its brief documentation (Optional).

Course Outcomes: At the end of the course the student will be able to:	
22CIV67.1	Identify the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
22CIV67.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
22CIV67.3	Demonstrate ecology knowledge of a complex relationship between a biotic and abiotic component.
22CIV67.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
22CIV67.5	Address problems related to waste management and public health aspects
22CIV67.6	List the Standards and latest tools to mitigate pollution.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Environmental studies	Benny Joseph	Tata McGraw-Hill	3rd Edition, 2018
2	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford Uni-Press	3rd Edition, 2020
Reference Books				
1	A Basic Course in Environmental Studies	Surinder Deswal, Anupama Deswal	Dhanpat Rai Publishing Co. (P) Ltd	1st Edition, 2017
2	Text book of Environmental Studies for Undergraduate Courses	Bharucha Erach	Universities Press	Edition 2, 2017
3	Environmental Studies	Ranjit R. J Daniels, Jagdish Krishnaswamy	John Wiley & Sons Inc.	2010
4	Perspective in Environmental Studies	Anubha Kaushik, C P Kaushik	New Age International Pvt. Ltd	Edition 3, 2009

Web links and Video Lectures (e-Resources):

1. **Coursera Course: Introduction to Environmental Science Specialization - https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc**
2. **NPTEL: Environmental Studies - https://onlinecourses.swayam2.ac.in/cec22_ge22/preview**

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV67.1	-	-	-	-	-	1	3	-	-	-	-	-	-	-
22CIV67.2	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.3	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.4	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.5	-	-	-	-	-	2	3	1	-	-	-	-	-	-
22CIV67.6	-	-	-	-	1	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	**22IIP68**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	Exam Hours	3 Hours
Total Hours	20 Hrs	Credits	01

Course Learning Objectives:

1. Learn how to use online databases and search tools for conducting patent searches.
2. Develop skills in analyzing patent documents and identifying relevant prior art.
3. Gain proficiency in evaluating the patentability criteria for engineering inventions.
4. Understand the principles of technology gap analysis and patentability search.
5. Understand the patent drafting and patent prosecution.

Module-1 Basics of Intellectual Property Rights (4 Hours)

Creativity, Invention, and Innovation – Introduction to Intellectual Property Rights-types and Importance – Overview of Patent Law – Intellectual Property Management and Commercialization – Emerging Issues in Intellectual Property – Case Studies and Practical Examples – Ethical and Social Considerations.

Activity: Trademark Design Challenge – IP Case Study Analysis

Module-2 Patent Landscape Analysis – Technology Gap Analysis (4 Hours)

Overview of Patent Databases and Search Tools – Keyword Searching, Classification Searching, and Citation Searching – Methods for Analyzing Patent Data: Patent Counts, Citation Analysis, and Patent Mapping – Technology Gap Analysis – Patent Portfolios – Portfolio Strength Assessment – Identification of Key Players – Competitive Intelligence and Market Analysis.

Activity: Conduct Patent Landscape Analysis for the Proposed Capstone Project.

Module-3 Patentability Assessment (6 Hours)

Significance of Patentability Assessment – Patentability Criteria: Novelty, Non-obviousness (Inventive Step), and Industrial Applicability/Utility – Prior Art Searching and Analysis (Keyword Searching, Classification Searching, and Citation Searching) – Non-Patent Literature Search and Other sources of Prior Art – Patentability Reports and Assessments – Case Studies and Practical Examples.

Activity: Conduct a Patentability Search for the Proposed Capstone Project.

Module-4 Patent Drafting and Prosecution (6 Hours)

Significance of Patent Drafting and Prosecution – Structure and Components of a Patent Application – Drafting of Patent Specifications, Claims, and Drawings – Overview of Patent Prosecution Process

Activity: Prepare a Patent Draft for the Proposed Capstone Project.

Course Outcomes: At the end of the course, the student will be able to:	
22IIP68.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
22IIP68.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
22IIP68.3	Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility.
22IIP68.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
22IIP68.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
22IIP68.6	Apply the acquired knowledge and skills in conducting practical activities, such as conducting patent landscape analysis, patentability searches, and drafting patent

	applications, to solve real-world problems and challenges in the field of intellectual property rights.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books/Sources				
1	Intellectual Property-A Primer for Academia (For Module 1)	Rupinder Tewari Mamtha Bhardway	Publication Bureau, Panjab University Chandigarh India	2021
2	Patent Landscape Reports (For Module 2)	WIPO - World Intellectual Property Organization https://www.wipo.int/patentscope/en/programs/patent_landscapes		
3	Guidelines for Preparing Patent Landscape Reports (For Module 2)	Anthony Trippe, Patinformatics, LLC	World Intellectual Property Organization (WIPO)	2015
4	Patent Searching - Tools and Techniques (For Module 3)	David Hunt	John Wiley & Sons Inc	First edition 2007
5	The Complete Patent Book_ Everything You Need to Obtain Your Patent (For Module 4)	James L. Rogers	Sphinx Publishing	First Edition 2003

Additional Resources:

1. WIPO Patent Drafting Manual - Second Edition 2023, https://www.wipo.int/edocs/pubdocs/en/wipo-pub-867-23-en-wipo-patent-drafting-manual.pdf
2. Patent Drafting for Beginners - https://elearn.nptel.ac.in/shop/nptel/patent-drafting-for-beginners/?v=c86ee0d9d7ed
3. The Office of the Controller General of Patents, Designs and Trade Marks, Government of India - https://www.ipindia.gov.in/
4. Copyright Office, Government of India - https://copyright.gov.in/
5. United States Patent and Trademark Office - https://www.uspto.gov/
6. Espacenet – patent search - https://worldwide.espacenet.com/
7. The Lens - Free & Open Patent and Scholarly Search - https://www.lens.org/
8. WIPO PATENTSCOPE - https://patentscope.wipo.int/search/en/search.jsf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22IIP68.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
22IIP68.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
22IIP68.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
22IIP68.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
22IIP68.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
22IIP68.6	-	-	-	-	2	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

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Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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