

Third Year BE SCHEME & SYLLABUS

Autonomous Scheme 2021-22

Civil Engineering



ST JOSEPH ENGINEERING COLLEGE
AN AUTONOMOUS INSTITUTION
Vamanjoor, Mangaluru - 575028

MOTTO

Service and 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) & MBA
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS (With effect from 2021-22)

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 had 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 practised 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 MBA 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 practising 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.

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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 keep students abreast with 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 the society.

DEPARTMENT MISSION

- Deliver curricula for students to meet the local, national and global demands of industry, society and research.
- Strengthen 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 in students the ability 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 the 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 the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and 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)

Sl. No.	Course and Course Code		Course Title	Teaching Department	Paper Setting Board	Teaching Hours/Week			Examination				Credits
						Theory Lecture	Tutorial	Practical/Drawing	Duration in hours	CIE Marks	SEE Marks	Total	
						L	T	P					
1	HSMC	21CIV501	Construction Management and Entrepreneurship	CIV	CIV	3	-	-	03	50	50	100	3
2	PCC	21CIV502	Water and Municipal Wastewater Engineering (Integrated Course)	CIV	CIV	3	-	2	03	50	50	100	4
3	PCC	21CIV503	Geotechnical Engineering	CIV	CIV	3	-	-	03	50	50	100	3
4	PCC	21CIV504	Analysis of Determinate Structures	CIV	CIV	2	2	-	03	50	50	100	3
5	PCC	21CIV505	Hydrology and Irrigation Engineering	CIV	CIV	3	-	-	03	50	50	100	3
6	PCC	21CVL506	Geotechnical Engineering Laboratory	CIV	CIV	-	-	2	03	50	50	100	1
7	HSMC	21RMI507	Research Methodology and Intellectual Property Rights	COM	COM	3	-	-	03	50	50	100	3
8	INT	21INT508	Summer Internship - II	COM	COM	-	-	-	03	100	-	100	2
9	MNCC	21ETP509	Emerging Technologies: A Primer	COM	COM	-	-	2	02	50	-	50	-
						17	2	6	26	500	350	850	22

Note: BSC: Basic Science Courses; ESC: Engineering Science Courses; HSMC: Humanity, Social Science and Management Courses; MNCC = Mandatory Non-Credit Course. INT: Internship, PCC: Professional Core Course; PEC = Professional Elective Course; OEC = Open Elective Course; UHV: Universal Human Values SDC: Ability Enhancement (Skill Development) Course.

One-hour Lecture (L) per week per semester = 1 Credit; Two-hour Tutorial (T) per week per semester = 1 Credit; Two-hour Practical/Laboratory/Drawing (P) per week per semester = 1 Credit.

VI Semester (B.E. - Civil Engineering)													
Sl. No.	Course and Course Code		Course Title	Teaching Department	Paper Setting Board	Teaching Hours/Week			Examination				Credits
						Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total	
						L	T	P					
1	PCC	21CIV601	Design of RC Structural Elements (Integrated Course)	CIV	CIV	3	-	2	03	50	50	100	4
2	PCC	21CIV602	Design of Steel Structural Elements	CIV	CIV	2	2	-	03	50	50	100	3
3	PEC	21CIV603X	Professional Elective - 1	CIV	CIV	3	-	-	03	50	50	100	3
4	OEC	21CIV604X	Open Elective - 1	CIV	CIV	3	-	-	03	50	50	100	3
5	HSMC	21CIV605	Environmental Studies	CIV	CIV	1	-	-	02	50	50	100	1
6	PCC	21CVL606	Software Application Laboratory	CIV	CIV	-	-	2	03	50	50	100	1
7	PCC	21CIV607	Analysis of Indeterminate Structures	CIV	CIV	2	2	-	03	50	50	100	3
8	SDC	21CIV608	Extensive Survey Project	CIV	CIV	1	-	2	03	100	-	100	2
9	MNCC	21IIP609	Innovation and Intellectual Property	COM	COM	-	-	2	02	50	-	50	-
10	INT	Summer Internship III: Research Internship / Industrial Internship: 24 weeks during the VI to VIII semesters On successful completion, 10 credits will be added in the VIII Semester marks card.											
						15	04	08	25	500	350	850	20

Professional Elective - I: Students can select any one of the professional electives offered by the Department.

Professional Elective – I (21XXX603X)					
21CIV6031	Solid Waste Management	21CIV6033	Design of Offshore Structures	21CIV6035	Advanced Reinforced Concrete Structures
21CIV6032	Ground Improvement Techniques	21CIV6034	Design Concepts of Building Services	-	

Open Elective I (21XXX604X)							
Course Code	CSE	AIM	CBS	ECE	EEE	MEC	CIV
21XXX6041	Introduction to Database Management System	Neural Networks	Neural Networks	Basics of Analog Circuits	Renewable Energy Sources	Automobile Engineering	Remote Sensing and Geographical Information System
21XXX6042	Introduction to Programming in Java	Introduction to AI and ML	Introduction to AI and ML	Fundamentals of Digital System Design	PLC & SCADA	3D modelling	Numerical Methods and Applications
21XXX6043	Dot Net Programming	Computer Vision	Computer Vision	Microcontroller	Control Systems	Entrepreneurship Development	Sustainability Concepts in Engineering
21XXX6044	Introduction to Python	Predictive Analytics	Predictive Analytics	Programming & Interfacing with Arduino	Electrical Safety Practices	Statistical Quality Control	Occupational Health and Safety
21XXX6045	-	Introduction to Data Science	Introduction to Data Science	Communication Theory	Energy Conservation and Audit	Non-Destructive Testing	-

Note: Open Elective – I: Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives). Selection of an open elective shall not be allowed if, (i) the candidate has studied the same course during the previous semesters of the program. (ii) the syllabus content of open elective is similar to that of the Departmental core courses or professional electives. (iii) a similar course, under any category, is prescribed in the higher semesters of the program. Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Research/Industrial Internship - All the students admitted shall have to undergo a mandatory internship of minimum 24 weeks during the VI to VIII semesters. Viva-Voce examination shall be conducted during VIII semester and the prescribed credit shall be included. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.

Research Internship Students have to take up research internships at Centers of Excellence (CoE) / Study Centers established in the same institute and /or out of the institute at reputed research organizations / Institutes. A research internship is intended to give students the flavour of current research going on a particular topic/s. The internships serve this purpose. They help students to get familiarized with the field, the skill needed, the amount and kind of effort required for carrying out research in that field.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B. Plan day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

V Semester

Construction Management and Entrepreneurship			
Course Code	21CIV501	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
<p>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.</p> <ul style="list-style-type: none"> • 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)			
<p>Management: Characteristics of management, functions of management, importance and purpose of planning process, types of plans</p> <p>Construction Project Formulation: Introduction to construction management, project organization, management functions, management styles</p> <p>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.</p> <p>Applications: basic ideas of construction management (CPM & PERT MSP)</p>			
Module-2 Construction Material Management and Equipments (8 hours)			
<p>Resource Management: Basic concepts of resource management, class of labor, Wages & statutory requirement, Labor Production rate or Productivity, Factors affecting labor output or productivity.</p> <p>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</p> <p>Materials: material management functions, inventory management.</p> <p>Applications: material requirement and machineries for project management</p>			
Module-3 Construction Quality, safety and Human Values (8 hours)			
<p>Construction quality: process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management</p> <p>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.</p> <p>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</p> <p>Applications: quality and safety requirements for construction projects</p>			
Module-4 Construction Finance (8 hours)			
<p>Introduction to engineering economy: Principles of engineering economics, concept on Micro and macro analysis, problem solving and decision making.</p> <p>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.</p> <p>Comparison of alternatives: Present worth, annual equivalent, capitalized and rate of return methods, Minimum Cost analysis and break even analysis</p> <p>Applications: financial requirements and comparison of different projects</p>			

Module-5 Introduction to Business Management (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:

21CIV501.1	Prepare a project plan based on requirements and schedule of a project by understanding the activities and their sequence
21CIV501.2	Apply the knowledge of labour output, equipment efficiency to allocate resources required for the project to achieve desired quality and safety
21CIV501.3	Solve a variety of issues that are encountered by every professional in discharging professional duties.
21CIV501.4	Analyze the economics of alternatives and evaluate benefits and profits of a construction activity
21CIV501.5	Establish as an ethical entrepreneur by utilizing the provisions offered by the federal agencies
21CIV501.6	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	6 th Edition, 2020
2	Construction Project Management: Planning Scheduling and Control	Chitkara, K.K	Tata McGraw-Hill Education & Brothers	2 nd Edition, 2010
3.	Entrepreneurship Development and Small Business Enterprise	Poornima M. Charantimath	Dorling Kindersley (India) Pvt. Ltd.,	3 rd Edition, 2018
4.	Construction Planning and Management	Dr. U.K. Shrivastava	Galgotia Publications Pvt. Ltd. New Delhi.	1 st Edition, 2000
Reference Books				
1	Construction Planning and Management	P S Gahilot & B M Dhir	New age International Publishers	2 nd Edition, 2018
2	Modern Construction Management	Frank Harris, Ronald McCaffer with Francis Edum-Fotwe	Wiley-Blackwell	8 th Edition, 2020

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=pwv1Nu3TO4A&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs
- https://www.youtube.com/watch?v=4yzPzVCgRH4&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=2
- <https://www.youtube.com/watch?v=2B7DhQvL8kw&list=PLwdnzlV3ogoVGSUhjx4VzW-dGz7DqQFoj>
- <https://www.youtube.com/watch?v=Tm2HhqMu5Jg>

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV501.1	3										2			
21CIV501.2	3										2			
21CIV501.3	3										2			
21CIV501.4		2									2			
21CIV501.5	3									2				
21CIV501.6	3										2			

1: Low 2: Medium 3: High

Water and Municipal Wastewater Engineering			
Course Code	21CIV502	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Define the characteristics of water and examine different approaches to population forecasting • Illustrate the details of water treatment units • Determine the goals of collecting wastewater and evaluate the attributes of wastewater. • Depict details regarding wastewater treatment units. • Discuss different approaches to the water distribution system and clarify the process of laying, testing, and sewer appurtenances. 			
Module-1 Quantity and Quality of Water (8 Hours)			
<p>Environmental pollution due to human activities, Types of water demands, Per capita consumption and factors for per capita demand, Population forecasting, Fire demand, design periods & factors governing the design period. Physical, chemical, and biological examinations using instrumental and analytical techniques.</p> <p>Applications: Analysis of water quality, determination of water quantity.</p>			
Module-2 Treatment of Water (8 hours)			
<p>Flow diagram of municipal water treatment plant. Preliminary treatment. Primary treatment: sedimentation tanks, types, operations. Filtration: Mechanism, types of filters. Disinfection- methods of disinfection, Hardness removal: lime soda process and zeolite process, fluoridation and defluoridation. Design of rising main</p> <p>Applications: Determination of water treatment units, application of treatment units.</p>			
Module-3 Measure and Examination of Sewage (8 hours)			
<p>Introduction: Necessity for sanitation, methods of domestic wastewater disposal, types of sewerage systems and their suitability.</p> <p>Quantity of sewage: Dry weather flow (DWF) and wet weather flow (WWF), factors affecting DWF and WWF, estimation of storm flow, time of concentration. Self-cleansing and non-scouring velocities. Physical, chemical, and biological characteristics, BOD and COD.</p> <p>Disposal of effluents — natural and artificial methods.</p> <p>Applications: Determine various treatment techniques, determine types and characteristics of wastewater.</p>			
Module-4 Treatment of Wastewater (8 hours)			
<p>Flow diagram of municipal water and wastewater treatment plant, Preliminary treatment- Screening, grit chambers, skimming tanks, Primary treatment, Secondary treatment: Attached growth process- trickling filter, suspended growth process — Activated sludge process, SBR, MBBR, Aerated Lagoons, Oxidation Ditches.</p> <p>Applications: Determination of wastewater treatment units, application of wastewater treatment units.</p>			
Module- 5 Collection systems and Testing of Sewers (8 hours)			
<p>Collection and conveyance of water from surface and subsurface sources, intake structures. Methods of distribution systems- System of supply and Methods of layout distribution. Laying, testing, ventilation of sewers. Sewer appurtenances: manholes, oil and grease traps, drainage traps.</p> <p>Applications: Determination of various collection system of water, testing of sewers</p>			

PRACTICAL MODULE

A–Demonstration (offline/virtual):

- A1. Air quality monitoring of the area
- A2. Quantitative estimation of aluminum by precipitation method
- A4. Determination of chloride content in the given water sample by Argentometric method

B–Exercise (compulsorily to be conducted):

- B1. Determination of Alkalinity, Acidity, and pH.
- B2. Determination of Chlorides.
- B3. Determination of Calcium, Magnesium and Total Hardness.
- B4. Determination of solids: Total solids, suspended solids, dissolved solids, and settleable solids.
- B5. Determination of Optimum dosage of Alum by Jar test.

C–Structured Enquiry (compulsorily any 4 to be conducted):

- C1. Determination of BOD.
- C2. Determination of COD.
- C3. Determination of Available Chlorine in bleaching powder.
- C4. Determination of Chlorine Demand and Residual Chlorine.
- C5. Determination of Iron.
- C6. Determination of Sulphate and Nitrates.

D–Open Ended Experiments (any one):

- D1. Gravimetric estimation of Fluorides in water
- D2. E-coli in the given wastewater sample

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

21CIV502.1	Identify the sources and characteristics of water.
21CIV502.2	Estimate the quantity of drinking water and design the various treatment units.
21CIV502.3	Identify the source and estimate quantity of wastewater generated.
21CIV502.4	Analyze characteristics of wastewater, explain the importance of disposal of sewage and design the various treatment units.
21CIV502.5	Understand the process of conveyance and distribution of water involving transportation of water and its distribution to users.
21CIV502.6	Evaluate the process of laying and testing of sewers involving the laying of pipes and testing for leakage.

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	35 th Edition 2016
2	Wastewater treatment	S. K. Garg	Khanna Publishers	41 st 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, Ryujiro Tsuchihashi, Franklin L. Burton	McGraw-Hill Education	5 th Edition, 2013

3	Environmental Engineering	Howard Peavey, Donald Rowe, George Tchobanoglous	McGraw Hill Education	1 st Edition, 2017
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Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/105/105/105105201/>
- <https://nptel.ac.in/courses/105/105/105105048/>
- <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ce26/>

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV502.1	2	1				2	2						2	3
21CIV502.2	2	2				2	2						2	3
21CIV502.3	1	2				2	3						1	3
21CIV502.4	1	1				2	3						1	3
21CIV502.5	1	2				2	3						1	3
21CIV502.6	2	1				2	2						2	3

1: Low 2: Medium 3: High

Geotechnical Engineering			
Course Code	21CIV503	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
<p>Course Learning Objectives: This course will enable students:</p> <ul style="list-style-type: none"> • To analyze basic concepts of soil mechanics as an integral part in the knowledge of civil engineering. • To understand basic engineering and mechanical properties of different types of soil. • To become familiar with geotechnical engineering problems such as, flow of water through soil medium and terminologies associated with geotechnical engineering. • To assess the improvement in mechanical behavior by densification of soil deposits using compaction. • To model and measure strength-deformation characteristics of soils. 			
Module-1 Introduction (08 Hours)			
<p>Introduction: Origin and formation of soil, Regional soil deposits in India, Phase Diagram, phase relationships, definitions and their interrelationships. Determination of Index properties: Specific gravity, water content, in-situ density, relative density, particle size analysis(sieve and Hydrometer analysis). Atterberg's Limits, consistency indices. Activity of clay, Field identification tests, Plasticity chart, BIS soil classification (IS: 1498 -1970).</p>			
Module-2 Soil Structure (08 Hours)			
<p>Soil Structure and Clay Mineralogy Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite and their application in Engineering</p> <p>Compaction of Soils: Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control-compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, Compacting equipment and their suitability.</p>			
Module-3 Flow through Soil (08 Hours)			
<p>Flow through Soils: Darcy's law-assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity, superficial velocity and coefficient of percolation, Capillary Phenomena.</p> <p>Effective Stress Analysis: Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress and impact of the effective stress in construction of structures, quick sand phenomena.</p>			
Module-4 Shear Strength of Soil (08 Hours)			
<p>Shear Strength of Soil: Concept of shear strength, Mohr-Coulomb Failure Criterion, Modified Mohr-Coulomb Criterion Total and effective shear strength parameters, factors affecting shear strength of soils. Thixotropy and sensitivity, Measurement of shear strength parameters</p> <p>- Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Test under different drainage conditions.</p>			
Module-5 Consolidation of Soil (08 Hours)			
<p>Consolidation of Soil: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumptions and limitations, Governing differential Equation and solution (No derivation). Laboratory one dimensional consolidation test, characteristics of e-log (σ') curve, Pre-consolidation pressure and its determination by Casagrande's method. Over consolidation ratio, normally consolidated, under consolidated and over consolidated soils. Determination of consolidation</p>			

characteristics of soils- compression index and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method). Primary and secondary consolidation.

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

21CIV503.1	To know the different types of soil & the index properties
21CIV503.2	To understand the behavior of soil structure & clay mineralogy
21CIV503.3	To determine compaction characteristics of given soil
21CIV503.4	To explain role of water in soil behavior and how soil stresses and permeability and are estimated
21CIV503.5	To determine shear parameter and stress changes in soil due to foundation loads
21CIV503.6	To estimate the magnitude and time rate of settlement due to consolidation

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Text Books				
1	Soil Mechanics and Foundation Engineering	Punmia B C	Laxmi Publications co., New Delhi.	16th Edition, 2017
2	Basic and Applied Soil Mechanics	Gopal Ranjan and Rao	A.S.R New Age International, New Delhi	2022
Reference Books				
1	Soil Engineering-In Theory and Practice	Alam Singh	CBS Pub	4th edition, 2012
2	Soil Mechanics and Foundation Engineering	Murthy V.N.S	CBS Pub	2009
Relevant BIS Codes of Practice: IS: 1498 -1970, IS-2720 series				
Weblink: https://nptel.ac.in/courses/105101201				

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV503.1				3					2	2				2
21CIV503.2				3					2	2				2
21CIV503.3		3		3					2	2				2
21CIV503.4		3												2
21CIV503.5		3												2
21CIV503.6		3												2

1: Low 2: Medium 3: High

Analysis of Determinate Structures			
Course Code	21CIV504	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 Theory	Credits	03
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Illustrate different forms of structures and evaluate their indeterminacy and analyze determinate truss. • Analyze the deflection of simple beams by different methods. • Associate the concepts of Energy Principles and Energy Theorems • Analyze parabolic and circular arches and determine the length of the cables under various load cases. • Relate influence lines for long spans structures and describe the behavior of structural components subjected to rolling loads. 			
Module-1 Introduction and Analysis of Plane Trusses (8 hours)			
Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and non-linear analysis, Static and kinematic indeterminacies of structural systems, Types of trusses, Assumptions in analysis, Analysis of determinate trusses by method of joints and method of sections.			
Applications: Classification of the structures, Analysis of trusses			
Module-2 Deflection of Beams (8 hours)			
Definition of slope, Deflection and curvature, Sign conventions, Derivation of the moment-curvature equation. Conjugate beam method- Introduction, support conditions for the conjugate beams Numerical on cantilever beams, simply supported beams. Moment area method - Introduction, equation for slope and deflection, Numerical on the cantilever, simply supported beams.			
Applications: Calculation of deflection and slope for the determinate beams, problems using software			
Module-3 Energy Principles and Energy Theorems (8 hours)			
Principle of virtual displacements, Principle of virtual forces, Strain energy and complementary energy, Strain energy due to axial force, bending, shear and torsion, Deflection of determinate beams and trusses using total strain energy			
Deflection at the point of application of single load, Castigliano's theorems and its application to estimate the deflections of trusses, bent frames, Special applications - Dummy unit load method			
Applications: Calculation of deflection for the determinate beams, bent frames and trusses			
Module-4 Arches and Cable Structures (8 hours)			
Three hinged parabolic arches with supports at same and different levels. Determination of normal thrust, radial shear, and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening structures for suspension.			
Applications: Determination of forces developed in the arches and cables			
Module-5 Influence Line Diagram and Rolling Loads (8 hours)			
Introduction to influence line diagram (ILD), applications, difference between ILD and BMD, construction of ILD for support reactions, shear force, and bending moments in determinate beams-ILD for axial forces in determinate trusses. Reactions, BM, and SF in determinate beams using rolling loads concepts.			
Applications: Determination of the stresses developed by moving loads using ILD			
Course Outcomes: At the end of the course, the student will be able to:			
21CIV504.1	Apply the method of joints and sections to evaluate the reactions and forces in trusses		

21CIV504.2	Apply the concept of moment area and conjugate beam method to determine deflection and slope at required points in a determinate structure
21CIV504.3	Develop strain energy expressions and calculate the deflection at points for determinate beams and trusses using the concept of strain energy
21CIV504.4	Calculate the deflections of beams and bent frames using the unit load and Castigliano's theorems
21CIV504.5	Compute the stress resultants in three hinged arches and cables
21CIV504.6	Make use of the concept of influence lines to construct the influence line diagram for analyzing the rolling loads

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Theory of Structures	GS Pandit, SP Gupta, R Gupta	Tata McGraw Hill, New Delhi.	2013
2	Basic structural analysis	CS Reddy	Tata McGraw Hill, New Delhi.	Second Edition, 2012
3	Theory of Structures	Punmia B. C., Ashok Kumar Jain, Arun Kumar Jain	Volume I & Volume II, Laxmi Publications (P) Ltd	Twelfth Edition, 2013
4	Structural Analysis – I	SS Bhavikatti	Vikas Publishing House Pvt. Ltd, New Delhi	Fourth Edition, 2013
Reference Books				
1	Structural Analysis	Hibbeler R C	Prentice Hall	Eighth Edition 2019
2	Structural Analysis	Devados Menon	Narosa Publishing House, New Delhi	Second Edition, 2018
3	Theory of Structures	Ramamrutham S, Narayan R	Dhanpat Rai & Sons, New Delhi	Ninth Edition, 2014
4	Structural Analysis	Thandavamoorthy T S	Oxford university press	Sixth Edition, 2015
Web links/Video Lectures/MOOCs				
1. Structural analysis – I, IITB https://nptel.ac.in/courses/105101085/				
2. Structural analysis – I, IITKH https://nptel.ac.in/courses/105105166/				
3. Structural analysis – II, IITKH https://nptel.ac.in/courses/105105109/				

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV504.1	2	3												1
21CIV504.2	2	3			2									1
21CIV504.3	2	3												1
21CIV504.4	2	3												1
21CIV504.5		3												1
21CIV504.6	2	3												1

1: Low 2: Medium 3: High

Hydrology and Irrigation Engineering			
Course Code	21CIV505	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
<p>Course Learning Objectives: This course will enable students to</p> <ul style="list-style-type: none"> ● 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)			
<p>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.</p> <p>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.</p> <p>Applications: Water resource management, flood forecasting, Agriculture</p>			
Module-2 Evaporations and Infiltration (8 hours)			
<p>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.</p> <p>Evapo-transpiration: Introduction, Consumptive use, AET, PET, Factors affecting, Measurement, Estimation by Blaney-Criddle equation.</p> <p>Infiltration: Introduction, factors affecting infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices.</p> <p>Applications: Stormwater management.</p>			
Module-3 Runoff and Hydrographs (8 hours)			
<p>Runoff: Definition, concept of catchment, factors affecting runoff, rainfall – runoff relationship using regression analysis.</p> <p>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</p> <p>Applications: Preparations of hydrological modeling, Watershed management, water supply management</p>			
Module-4 Irrigation Engineering (8 hours)			
<p>Irrigation: Definition. Benefits and ill effects of irrigation. System of irrigation: surface and ground water, flow irrigation, lift irrigation, Bandhara irrigation.</p> <p>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.</p> <p>Applications: Water supply management, Agricultural irrigation, water conservation</p>			

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:

21CIV505.1	Apply the concept of hydrology and components of hydrologic cycle such as Forms and types of precipitation, measurement of rainfall using Symon's and Syphon type of rain gauges
21CIV505.2	Analyze the water cycle and its components such as precipitation, evapotranspiration, surface runoff, and groundwater flow.
21CIV505.3	Evaluate the impact of land use changes and climate variability on runoff and development of storm and unit hydrograph.
21CIV505.4	Analyze and Design the irrigation systems to ensure efficient use of water for agriculture and other uses.
21CIV505.5	Identify classification of soil and to correlate soil –water-crop relationship
21CIV505.6	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	4 th Edition 2017
2	Irrigation and Water Power Engineering	Punmia and Lal Pandey	Lakshmi Publications, New Delhi	16 th Edition, 2018
Reference Books				
1	Hydrology	H.M. Raghunath	Wiley Eastern Publication New Delhi	4 th Edition, 2021
2	Irrigation Engineering and Hydraulic Structures	SK Garg	Khanna publications	5 th Edition, 2005
3	Water Resources and Water Power Engineering	Modi P N	Standard Book House	5 th 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
21CIV505.1	3						2							
21CIV505.2	3	2					2							
21CIV505.3	3	2					2							
21CIV505.4	3						2		2	2				
21CIV505.5	3	2					2		2	2				
21CIV505.6	3	2					2		2	2				

1: Low 2: Medium 3: High

Geotechnical Engineering Laboratory			
Course Code	21CVL506	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:			
<ul style="list-style-type: none"> ● To carry out laboratory tests and to identify soil as per IS codal procedures ● To perform laboratory tests to determine index properties of soil ● To perform tests to determine shear strength and consolidation characteristics of soils 			
Module 1 Physical and index properties of soil			
1. Field identification of soil, Specific gravity test (pycnometer and density bottle method). Water content determination by oven drying and Pycnometer method. 2. Grain size analysis i. Sieve analysis ii. Hydrometer analysis 3. Consistency limits i. Liquid limit test (by Casagrande's method) ii. Plastic limit test iii. Shrinkage limit test			
Module 2 Field identification of soil			
1. In-situ density tests i. Core-cutter method ii. Sand replacement method 2. Standard compaction test (light and heavy compaction) 3. Coefficient of permeability test i. Constant head test ii. Variable head test			
Module 3 Shear strength and consolidation parameters			
1. Shear strength tests i. Unconfined compression test ii. Direct shear test iii. Triaxial test (unconsolidated undrained test only) 2. Consolidation test : To determine pre consolidation pressure only (half an hour per loading-test) 3. Laboratory vane shear test 4. Demonstration of Standard penetration test and boring equipment.			
Course Outcomes: At the end of the course the student will be able to:			
21CVL506.1	Determine Physical and index properties of the soil.		
21CVL506.2	Classify soil based on index properties and field identification.		
21CVL506.3	Estimate the in-situ density of the soil.		
21CVL506.4	Determine OMC and MDD, plan and assess field compaction program.		
21CVL506.5	Evaluate Shear strength and consolidation parameters to assess strength and deformation characteristics.		
21CVL506.6	Describe In-situ shear strength characteristics (SPT-Demonstration)		

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books				
1	Soil Mechanics and Foundation Engineering	Punmia B C	Laxmi Publications co., New Delhi.	16th Edition, (2017)
2	Soil Testing for Engineers	Lambe T.W	Wiley Eastern Ltd., New Delhi	1996
3	Manual of Soil Laboratory Testing	Head K.H	Vol. I, II, III, Princeton Press	2006
4	Engineering Properties of Soil and Their Measurements	Bowles J.E	McGraw Hill Book Co. New York	2001
5	Relevant BIS Codes of Practice: IS-2720 series			

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVL506.1	2	-	-	3	-	-	-	-	2	-	-	2	2	-
21CVL506.2	2	-	-	3	-	-	-	-	2	-	-	2	2	-
21CVL506.3	2	-	-	3	-	-	-	-	2	-	-	2	2	-
21CVL506.4	2	-	-	3	-	-	-	-	2	-	-	2	2	-
21CVL506.5	2	-	-	3	-	-	-	-	2	-	-	2	2	-
21CVL506.6	2	-	-	3	-	-	-	-	2	-	-	2	2	-

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	21RMI507	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:			
<ol style="list-style-type: none"> 1. To understand the basic concepts related to research 2. To learn the concept of literature survey, review and technical writing 3. To discuss the basics of intellectual property 4. To explain the patents, copyrights, trademarks, industrial designs and geographical indications. 			
Module-1 Research Methodology and Literature Survey (8 hours)			
<p>Research Methodology: Meaning, objectives, types, significance of research. Research approaches, method versus methodology, research process, Criteria of good research. Defining the research problem: conditions, components, selection, necessity, techniques and illustrations.</p> <p>Literature Survey, Literature Review: Introduction, process, databases (Google Scholar, Web of Science, Scopus, Science Direct etc) and management tools. Author Metrics and Journal Metrics, Identifying gap areas from literature review. Ethics in research and publications. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.</p> <p>Textbook 1: Ch 1 and 2, Textbook 2: Ch 7-17.</p>			
Module-2 Technical Writing and Presentations (8 hours)			
<p>Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, referencing and citations, submission and post-submission. Illustrations.</p> <p>Thesis Writing: Synopsis, Introduction, Literature review, Aim and objectives, Methodology, Time frame, Results and discussions, Conclusions.</p> <p>Research Proposal Writing: Types of research projects, Major funding agencies in India, Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.</p> <p>Textbook 2: Ch 20-28, 35.</p>			
Module-3 Introduction to IPR and Patents (8 hours)			
<p>Introduction to Intellectual Property: Meaning, relevance, Types of IP, Role of International Institutions: The Patent Cooperation Treaty (PCT), TRIPS Agreement, WIPO, IP system in India and National IPR Policy in India.</p> <p>Patents: Concept, Patents Act 1970 and its amendments, Patentable Subject Matter and Patentability Criteria, Non- Patentable Subject Matter, Procedure for Filing of Patent Application and types of Applications, Patent Search and Databases, Patent Granting Procedure, Rights of Patentee, Patent Infringement, Recent Developments: Patenting of Softwares, Inventions in Biotechnology. Illustrations.</p> <p>Textbook 3: Lesson 1-10.</p>			
Module-4 Copyright and Trademarks (8 hours)			
<p>Copyright: Introduction, meaning, nature of copyright protection, Indian copyright law: Classes of work, copyright pertaining to software, Authorship and ownership and rights, Terms of copyright, Assignment, transmission and licensing, Infringement of copyrights: Exceptions and remedies, Copyright societies, Office, board, Registration of copyrights and appeals, Illustrations.</p> <p>Trademark: Introduction, The Trade Marks Act 1999, Important Definitions, Trade Mark Rules 2017, Procedure of registration of trade mark in India. Duration and renewal, Opposition to registration, Grounds for refusal to registration, Rights conferred by registration, Infringement of registered Trade Mark and Remedies. Illustrations.</p> <p>Textbook 3: Lesson 11 and 12.</p>			

Module-5 Industrial Designs and Geographical Indications (8 hours)
<p>Industrial Designs: Introduction, Need for protection of industrial designs, Registrable and non-registrable designs, Registration of designs, Infringement of Industrial Designs–and Remedies, Illustrations.</p> <p>Geographical Indications (GIs): Introduction, Geographical Indications of Goods (Registration & Protection) Act, 1999, Procedure for registration of geographical indications, Infringement of GIs.</p> <p>Layout – Designs of Integrated Circuits: Introduction, Procedure for Registration of Layout design under the Semi-Conductor Integrated Circuits Layout-Design Act, 2000, Conditions and Procedures for registration. Infringement and Penalty.</p> <p>Miscellaneous Topics: The Protection of Plant Varieties and Farmers' Rights, Protection of Traditional Knowledge and Bio-diversity Act.</p> <p>Textbook 3: Lesson 13-16, Textbook 4: Ch 70.</p>

Course Outcomes: At the end of the course the student will be able :	
21RMI507.1	To conduct literature survey, review and define a research problem.
21RMI507.2	To follow research ethics and develop the art of writing technical papers and reports.
21RMI507.3	To discuss the importance of Intellectual Property Rights in India.
21RMI507.4	To explain the various forms of Intellectual Property and its relevance in Indian context.
21RMI507.5	To explain the legal aspects of patents, copyrights and trademarks in India.
21RMI507.6	To explain the legal aspects of industrial designs, geographical indications and semi-conductor integrated circuits layout-designs in India.

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	4 th Edition 2019
2	Academic Writing	Ajay Semalty	B S Publications	2021
3	Intellectual Property Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018
4	Law Relating to Intellectual Property Rights	V K Ahuja	LexisNexis, India	3 rd Edition 2017
Reference Books				
1	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications India Pvt Ld New Delhi	4 th Edition 2014
2	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
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 and Technologists)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21RMI507.1	-	2	-	-	1	-	-	-	-	-	-	2	-	-
21RMI507.2	-	-	-	-	1	-	-	3	-	2	-	-	-	-
21RMI507.3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
21RMI507.4	-	-	-	-	-	2	-	-	-	2	-	-	-	-
21RMI507.5	-	-	-	-	-	2	-	-	-	2	-	-	-	-
21RMI507.6	-	-	-	-	-	2	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	21ETP509	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	0	Exam Hours	02
Course Learning Objectives:			
<ol style="list-style-type: none"> To develop a strong awareness of the ethical and societal implications associated with emerging technologies. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity. 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)			
<p>Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.</p> <p>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.</p> <p>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.</p>			
Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)			
<p>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.</p> <p>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.</p>			
Module-3: Cybersecurity and Quantum Computing (06 Hours)			
<p>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.</p> <p>Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.</p>			
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:			
21ETP509.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.		
21ETP509.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.		
21ETP509.3	Apply RPA principles and tools to automate common tasks to boost productivity.		
21ETP509.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.		
21ETP509.5	Explain the fundamentals of quantum computing and its real-world applications.		
21ETP509.6	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=naIMdCI_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=JAAtwZoW76-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
21ETP509.1	-	-	-	-		3	-	2	-	1	-	-
21ETP509.2	-	2	-	-	3	-	-	-		-	-	1
21ETP509.3	-	-	-	3	2	-	-	-	1	-	-	-
21ETP509.4	-	-	-	-	3	-		-	-	-	-	1
21ETP509.5	2	-	-	-	3	-	-	-	-	-	-	-
21ETP509.6	-	-	2	-	3	-	-	-	2	-	-	1

1: Low 2: Medium 3: High

VI Semester

Design of RC Structural Elements			
Course Code	21CIV601	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Identify, formulate and solve engineering problems of RC elements subjected to different kinds of loading. • Follow a procedural knowledge in designing and detailing of 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 the achieving success in competitive examinations 			
Module-1 Concept of Limit State Design (8 hours)			
<p>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, concept of balanced section, under reinforced and over reinforced section. Elastic behaviour 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, slenderness limits of beams for stability. Importance of bond, anchorage length and lap length.</p> <p>Applications: Evaluation of maximum shear and flexural strength, evaluation of load carrying capacity and serviceability criteria of any RC structural elements.</p>			
Module-2 Limit State Analysis of Beams (8 hours)			
<p>General aspects of ultimate strength, ultimate flexural strength of singly reinforced and doubly reinforced rectangular sections, ultimate flexural strength of flanged sections, ultimate shear strength of RC sections.</p> <p>Applications: Evaluation of flexural and shear capacity of any rectangular and flanged sections</p>			
Module-3 Limit State Design of Beams (8 hours)			
<p>Design of singly and doubly reinforced (rectangular and flanged) beams. Design for combined bending and torsion as per IS-456, latest version.</p> <p>Applications: Construction, Design and detailing of beams in any multistoried structures.</p>			
Module-4 Limit State Design of Slabs and Stairs (8 hours)			
<p>Introduction to one way and two way slabs and cantilever 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.</p> <p>Applications: Construction of one way, two way and cantilever slabs, Construction of dog-legged and open well staircase.</p>			
Module-5 Limit State Design of Columns and Footings (8 hours)			
<p>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.</p> <p>Applications: Construction of column and footings , Evaluation of forces in different types of foundations</p>			

PRACTICAL MODULE

A–Detailing of RC Structural Elements

- Beams – Singly reinforced, Doubly reinforced, Continuous and Cantilever

- Slab – One way, Two way and One-way continuous
- Staircase – Dog Legged
- Columns & Footings-Isolated rectangular and square footing, Combined footing

B– Detailing of Steel Structures

- Connections – Beam to beam, Beam to Column by Bolted and Welded Connections.
- Built-up Columns with lacings and battens
- Column bases and Gusseted bases with bolted and welded connections.
- Roof Truss – Welded and Bolted

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

21CIV601.1	Explain the design philosophies and principles of reinforced concrete structures.
21CIV601.2	Solve engineering problems of RC elements subjected to deflection, Cracking
21CIV601.3	Analysis of essential singly, doubly and flanged beams of RC structure for flexure, shear and torsion
21CIV601.4	Adopt the code of practice for the design and detailing of singly and doubly reinforced beams by considering safety.
21CIV601.5	Use the code of practice for the design and detailing of slabs and staircases by considering safety.
21CIV601.6	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.	Twelfth Edition, 2021
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	Reinforced and Pre-Stressed Concrete	Kong and Evans	Springer Publications.	3rd Edition, 1987
4	Reinforced Concrete Structures	Robert Park and Thomas Paulay	John Wiley & Sons, Inc	2nd Edition, 1989
5	Code books – IS 456-2000, SP-16, SP-34 shall be referred for designing & detailing. The same will be provided during examination			

Web links and Video Lectures (e-Resources):

- <http://nptel.ac.in/courses/105105105/>
- <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
21CIV601.1	2													1
21CIV601.2			2											1
21CIV601.3			2											1
21CIV601.4			2			2							1	1
21CIV601.5						2							1	
21CIV601.6			2			2								

1: Low 2: Medium 3: High

Design of Steel Structural Elements			
Course Code	21CIV602	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 Theory	Credits	03
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> ● Understand advantages and disadvantages of steel structures, steel code provisions, and plastic behaviour of structural steel. ● 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 & Plastic Behaviour of Structural Steel (8 hours)			
<p>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.</p> <p>Plastic Behavior of Structural Steel: Introduction, Plastic theory, Plastic Hinge Concept, Plastic collapse load, load factor, Shape factor.</p> <p>Applications: Knowledge of different methods of Analysis of steel structures.</p>			
Module-2 Bolted Connections & Welded Connection. (8 hours)			
<p>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.</p> <p>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.</p> <p>Applications: To find the strength of Bolted & Welded Connection.</p>			
Module-3 Design of Compression Members (8 hours)			
<p>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 and Battered Systems.</p> <p>Applications: Design of compression members for various applied loads.</p>			
Module-4 Design of Tension Members (8 hours)			
<p>Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension members, Design of Tension members and Lug angles, Splices, Gussets.</p> <p>Design of Column Bases: Design of Simple Slab Base and Gusseted Base.</p> <p>Applications: Design of tension members for various applied loads.</p>			
Module-5 Design of Beams (8 hours)			
<p>Introduction, Beam types, Lateral Stability of beams, factors affecting lateral stability, Web buckling and crippling, Behavior of Beams in Bending, Design strength of laterally supported beams in Bending, Design of Laterally Unsupported Beams [No Numerical Problems], Shear Strength of Steel Beams. Beam to Beam Connections, Beam to Column Connection and Column Splices [No Numerical Problems].</p> <p>Applications: Designing various steel beams for various loading & Boundary connections.</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV602.1	Explain the knowledge of Steel Structures as per code provisions and plastic

	behavior of structural steel
21CIV602.2	Design Bolted and Welded connections as per IS code provisions
21CIV602.3	Design Welded connections as per IS code provisions
21CIV602.4	Design of compression members, built-up columns and columns splices as per IS code provisions
21CIV602.5	Design of tension members, simple slab base and gusseted base as per the requirements of IS code
21CIV602.6	Design laterally supported and un-supported steel beams 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	1 st Edition, 2020
2	Design of Steel Structures	Kazim S M A and Jindal R S	Prentice Hall of India, New Delhi.	7 th Edition, 2009
3	IS 800-2007: General Construction in Steel Code Practice , Bureau of Indian Standards, New Delhi.			
4	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):

<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
21CIV602.1	2	-	-	-	-	-	-	-	-	-	-	-	-	2
21CIV602.2	-	-	3	-	-	-	-	-	-	-	-	1	-	2
21CIV602.3	-	-	3	-	-	-	-	-	-	-	-	1	-	2
21CIV602.4	-	-	3	-	-	-	-	-	-	-	-	1	-	2
21CIV602.5	-	-	3	-	-	-	-	-	-	-	-	1	-	2
21CIV602.6	-	-	3	-	-	-	-	-	-	-	-	1	-	2

1: Low 2: Medium 3: High

Solid Waste Management			
Course Code	21CIV6031	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Study the present methods of solid waste management system and to analyze their drawbacks comparing with statutory rules. • Understand different elements of solid waste management from generation of solid waste to disposal. • Analyze different processing technologies and to study 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)			
<p>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.</p> <p>Storage and Collection: Storage, segregation, Collection of solid waste- services and systems, equipment.</p> <p>Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with 2016 amendments.</p> <p>Applications: Developing and implementing municipal or city-level solid waste management plans</p>			
Module-2 Processing of Solid Waste (6 hours)			
<p>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).</p> <p>Applications: Selecting appropriate techniques, designing facilities, training professionals, and implementing policies</p>			
Module-3 Composting and Landfilling (6 hours)			
<p>Composting: Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems.</p> <p>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.</p> <p>Applications: Determine various treatment techniques, determine types and characteristics of solid waste and its disposal.</p>			
Module-4 Risk Assessment (6 hours)			
<p>Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies, biomedical waste, e-waste</p> <p>Applications: Comparing the risks associated with different waste treatment or disposal options</p>			
Module- 5 Thermal Treatment and Energy Recovery (6 hours)			
<p>Incineration - 3Ts factor affecting incineration, types of incinerations, Pyrolysis, Energy recovery technique from solid waste management, construction and demolition waste.</p> <p>Applications: Recovering energy from solid waste using waste-to-energy facilities.</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV6031.1	Explain the components, sources, hierarchy, types, and composition of solid waste management.
21CIV6031.2	Apply appropriate techniques for selecting, designing, training professionals, and implementing policies for solid waste management

21CIV6031.3	Apply various treatment techniques and determine types and characteristics of solid waste and its disposal.
21CIV6031.4	Compare the risks associated with different waste treatment or disposal options.
21CIV6031.5	Evaluate disposal sites and Analyze the 3Ts factor affecting incineration, and energy recovery techniques from solid waste management.
21CIV6031.6	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 Education	2nd Edition, 1993
2	Environmental Engineering	Howard S Peavy, Donald R Rowe and George Tchobanoglous	Tata Mcgraw Hill Publishing Co ltd.	1 st 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	2 nd Edition, 2002

Web links and Video Lectures (e-Resources):
<ul style="list-style-type: none"> • https://onlinecourses.nptel.ac.in/noc20_ce56 • https://onlinecourses.nptel.ac.in/noc20_ce43

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV6031.1	2		1											3
21CIV6031.2	2		2											3
21CIV6031.3	1		2				3							3
21CIV6031.4	1						3							3
21CIV6031.5	1						3							3
21CIV6031.6	2		1				2							3

1: Low 2: Medium 3: High

Ground Improvement Techniques			
Course Code	21CIV6032	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
<p>Course Learning Objectives: This course will enable students</p> <ul style="list-style-type: none"> • Understand the fundamental concepts of ground improvement techniques • Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification of ground required for construction of civil engineering structures. • Understand the concepts of chemical compaction, grouting and other miscellaneous methods. • Impart the knowledge of geo synthetics, vibration, grouting and Injection 			
Module-1 Introduction(08 Hours)			
<p>Formation and Development of Ground: Introduction, Formation of Rock, soil and soil profile, Soil distribution in India, Alterations of ground after formation, Reclaimed soils, Natural offshore deposits; Ground Improvement Potential – Hazardous ground conditions, poor ground conditions, favourable ground conditions, Alternative Approaches, Geotechnical processes.</p> <p>Compaction: Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control, Shallow surface compaction-Rollers – operational aspects. Deep Compaction – Explosion- heavy tamping- vibro-compaction and vibro replacement. Properties of compacted soil, Compaction control tests.</p>			
Module-2 Drainage and Dewatering (08 Hours)			
<p>Drainage Methods: Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems- open sumps and ditches, Well point systems, deep well drainage, Vacuum dewatering, Electro osmosis. Design of dewatering for excavations, Design of dewatering system including pipe line effects of dewatering, Drains, different types of drains.</p> <p>Pre-compression and Vertical Drains: Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading.</p>			
Module-3 Stabilization of Soil (08 Hours)			
<p>Chemical Modification-I: Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement stabilization. Stabilization using Flyash.</p> <p>Chemical Modification-II: Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization</p>			
Module-4 Vibration (08 Hours)			
<p>Vibration Methods: Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping Grouting and Injection: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting.</p>			
Module-5 Soil Reinforcement (08 Hours)			
<p>Soil improvement using reinforcing elements: introduction to geosynthetics, concept of reinforced earth, load transfer mechanism and strength development soil anchors, reinforced earth retaining walls, Geotextiles – polymer type geotextiles, woven and non-woven geotextiles, geogrids-physical and strength properties, behavior of soils on reinforcing with geotextiles - effect on strength, bearing capacity, compaction and permeability - design aspects.</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV6032.1	Apply solutions to mitigate problems associated with soil formations exhibiting inadequate strength.
21CIV6032.2	Analyze and apply compaction techniques, quality control in soil engineering.
21CIV6032.3	Evaluate drainage, seepage and dewatering methods adopted for ground improvement.
21CIV6032.4	Assess chemical modification techniques in soil stabilization for geotechnical applications.
21CIV6032.5	Apply vibration and grouting techniques in geotechnical engineering for soil improvement.
21CIV6032.6	Implement geosynthetics for soil reinforcement and analyze their influence on soil properties.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Ground Improvement Techniques	Purushothama Raj P	Laxmi Publications, NewDelhi.	2007
2	Ground Improvement Techniques	Bikash Chandra Chattopadhyay Joyanta	PHI learning, Eastern Economy Edition	2017
Reference Books				
1	Ground and soil improvement	C.A.Raison	Thomas Telford Publishing, London	2004
2	Ground control and improvement	Petros P. Xanthakos Lee W. Abramson Donald A. Bruce	Wiley-Interscience Publication John Wiley & Sons, Inc.	1994
3	Ground Improvement — Case Histories	Buddhima Indraratna Jian Chu John A. Hudson	Elsevier Geo-Engineering Book Series	2005
4	Ground Improvement by Deep Vibratory Methods	Klaus Kirsch Fabian Kirsch	Taylor & Francis	2010
5	Ground Improvement	Klaus Kirsch Alan Bell	CRC Press Taylor & Francis Group	2013
6	Ground Improvement	M.P. Moseley K. Kirsch	Spon Press Taylor & Francis Group	2004
7	The Deep Mixing Method	Masaki Kitazume Masaaki Terashi	CRC Press Taylor & Francis Group	2013
MOOC/NPTEL Resources:				
https://nptel.ac.in/courses/105108075/				

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV6032.1	2	2	-	-	-	2	-	-	-	-	-	-	-	-
21CIV6032.2	2	-	-	-	-	2	-	-	-	-	-	-	-	-
21CIV6032.3	2	-	2	-	-	-	-	-	-	-	-	-	-	-
21CIV6032.4	2	-	-	-	-	2	-	-	-	-	-	-	-	-
21CIV6032.5	2	-	-	-	-	-	-	-	2	2	-	-	-	-
21CIV6032.6	2	-	-	-	-	-	-	-	2	2	-	-	-	-

1: Low 2: Medium 3: High

Design of Offshore Structures			
Course Code	21CIV6033	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • 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:	
21CIV6033.1	Analyze the response of offshore structures to environmental loading, such as waves, currents, and wind forces, and apply methods for calculating site-specific environmental conditions.
21CIV6033.2	Evaluate different types of offshore foundations, including piles, gravity-based structures, and suction anchors, and design foundations for various offshore structures based on geotechnical site investigation techniques.
21CIV6033.3	Derive the design and analysis of structural members and systems for offshore structures using finite element methods, and apply principles of buckling and fatigue analysis.
21CIV6033.4	Apply regulatory requirements and relevant codes and standards governing offshore structures, including those related to safety, reliability, and environmental protection, in the design of offshore structures.

21CIV6033.5	Analyze the installation, maintenance, and decommissioning of offshore structures, and develop health and safety considerations for offshore operations based on real-world challenges.
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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	2013
2	Construction of Marine and Offshore Structures	B.C Gerwick, Jr	CRC Press, Florida	2007
3	Planning, Designing and Constructing Fixed Offshore Platforms	API RP 2 A., API	API RP 2 A., API	2000
Reference Books				
1	Offshore Structural Engineering: Reliability and Risk Assessment	Srinivasan Chandrasekaran	CRC-Press	2016
2	Ocean Structures Construction, Materials, and Operations	Srinivasan Chandrasekaran, Arvind Jain	CRC Press	2017

Web links and Video Lectures (e-Resources):
<ul style="list-style-type: none"> • 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
21CIV6033.1	2		2											
21CIV6033.2		2												
21CIV6033.3	3		2											
21CIV6033.4	3													
21CIV6033.5	2													

1: Low 2: Medium 3: High

Design Concepts of Building Services			
Course Code	21CIV6034	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> ● 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)			
<p>Water Supply and its Services. 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. Material, types of fixtures and fitting for a contemporary bathroom– taps –quarter turn, half turn, ceramic, foam flow etc, hot water mixer, hand shower Rainwater harvesting to include roof top harvesting, type of spouts, sizes of rainwater pipes and typical detail of a water harvesting pit.</p> <p>Applications: knowledge about water treatment and supply for different types of buildings.</p>			
Module-2 Heat Ventilation and Air Conditioning (HVAC) (8 hours)			
<p>Heat Ventilation and Air Conditioning (HVAC): 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.</p> <p>Ventilation: Definition and necessity, system of ventilation.</p> <p>Air Conditioning: Principles of air conditioning, Air cooling, Different systems of ducting and distribution, Essentials of air-conditioning system.</p> <p>Applications: principles of heat propagation and air conditioning</p>			
Module-3 Electrical and Fire Fighting Services (8 hours)			
<p>Electrical Services: 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.</p> <p>Fire Fighting Services: Classification of buildings based on occupancy in fire fighting services, causes of fire and spread of fire, fire standards/classification, fire fighting, 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 detector, smoke detectors, fire dampers, fire doors, etc. Provisions of NBC.</p> <p>Applications: Knowledge about prevention from fire hazards/ fire fighting</p>			
Module-4 Plumbing and Fire Fighting Layout of Simple Buildings (8 hours)			
<p>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.</p> <p>Applications: building layout plan of plumbing and firefighting</p>			
Module-5 Engineering Services and Building Maintenance (8 hours)			
<p>Engineering Services: (Introduction to BIMs?)</p> <p>Engineering services in a building as a system, Lifts, escalators, cold and hot water systems, waste water 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 – Classification and types of lifts, lift</p>			

codes, rules structural provision: escalators, their uses, types and sizes, safety norms to be adopted – Social features required for physically handicapped and elderly, 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.

Applications: services and maintenance of the building

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

21CIV6034.1	Describe the basics of house plumbing and waste water collection and disposal.
21CIV6034.2	Discuss the safety and guidelines with respect to fire safety.
21CIV6034.3	Describe the issues with respect to quantity of water, rain water harvesting and roof top harvesting.
21CIV6034.4	Draw building layout plan of plumbing and firefighting
21CIV6034.5	Analyse and implement the requirements of thermal comfort in buildings.
21CIV6034.6	Apply the knowledge of Preventive and protective maintenance for the service requirements of the buildings

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Water Supply Engineering	B C Punmia	Laxmi publications	2 nd edition, 2016
2	Fire Safety in Building	V. K. Jain,	New Age International Publishers	3 rd edition, 2020
Reference Books				
1	Environmental Engineering	N N Basak	McGraw Hill Publishing Co. Ltd.	7 th edition, 2017
2	Plumbing, Heating and Ventilation	International Correspondence School	Forgotten Books Publishers.	1 st edition, 2018
3	Practical Handbook on Building Construction	M K Guptha	A Nabhi publication	1 st edition, 2021
4	National Building Code.	NBC, New Delhi.	NBC, New Delhi.	2016

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/@VTUeShikshanaProgramme>
- <https://swayam.gov.in/explorer?searchText=design+concept+of+building+services>

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV6034.1	3												2	
21CIV6034.2	3												2	
21CIV6034.3	3												2	
21CIV6034.4	3												2	
21CIV6034.5	3												2	
21CIV6034.6									2	2				

1: Low 2: Medium 3: High

Advanced Reinforced Concrete Structures			
Course Code	21CIV6035	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Make students to learn principle of structural design • Design different types of structures • Detail the structures. • Evaluate the performance of structures • Develop analytical skills in solving structural problems. 			
Module-1 Limit Analysis of R.C. Structures (8 hours)			
<p>Yield line analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis for square, rectangular and circular slabs with various end conditions.</p> <p>Applications: Design of slabs with different end conditions..</p>			
Module-2 Analysis and Design of Flat slabs (8 hours)			
<p>Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears – Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip.</p> <p>Applications: Design of floors.</p>			
Module-3 Fire and Seismic Resistance of Concrete Structures (8 hours)			
<p>Design of Reinforced Concrete Members for Fire Resistance: Introduction, ISO 834 standard heating conditions, Grading or classifications, Effect of high temperature on steel and concrete, Effect of high temperatures on different types of structural members, Analytical determination of the ultimate bending moment, Capacity of reinforced concrete beams under fire.</p> <p>Ductile Detailing of Frames for Seismic Resistance: Introduction, General principles, Factors that increase ductility, Specifications of materials for ductility, ductile detailing of beams – Requirements, Ductile detailing of columns and frame members with axial load (P) and moment (M) – Requirements.</p> <p>Applications: Design of structures for lateral loads.</p>			
Module-4 Design of Reinforced Concrete Deep Beams, Corbels and Beams curved in plan (8 hours)			
<p>Steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams, Analysis of Forces in a Corbels, Design Procedure of Corbels.</p> <p>Design of beams curved in plan.</p> <p>Applications: Design examples.</p>			
Module-5 Analysis and design of Bunkers, Silos and Chimney (8 hours)			
<p>BUNKERS AND SILOS: Introduction, Design of rectangular bunkers, circular bunkers and silos. Rankine’s and Airy’s theory.</p> <p>Applications: Design of Industrial Structures</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV6035.1	Perform yield line analysis of slabs and Interpret the results
21CIV6035.2	Analyze and design a flat slab system
21CIV6035.3	Design for wind and seismic resistance of concrete structures.
21CIV6035.4	Design of Deep beams and Corbels

21CIV6035.5	Analyze and design beams curved in plan.
21CIV6035.6	Analyze and design bunkers and silos.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Reinforced Concrete Design II Ed	Varghese P.C.	Prentice-Hall of India, New Delhi	2nd Edition, 2005
2	Reinforced Concrete Design	Unnikrishnan Pillai and Devdas Menon	McGraw Hill	3rd Edition, 2017
Reference Books				
1	Reinforced Concrete Structures	Robert Park and Thomas Paulay	John Wiley & Sons, Inc	2nd Edition, 1989
2	Design of Concrete Structures	Subramaniam	Oxford university Press	Illustrated, 2013
3	Reinforced Concrete Design	W H Mosley, R Husle, J H Bungey	MacMillan Education, Palgrave Publishers	1st Edition, 1996
4	Code books – IS 456-Latest version., SP-16, shall be referred for designing. The same will be provided during examination			

Web links and Video Lectures (e-Resources):

- <https://www.studocu.com/row/document/national-university-of-science-andtechnology/structure-analysis/lecture-notes/chapter-1-9-yield-line-analysis-ofslabs/5916250/view>
- <https://nptel.ac.in/courses/105/105/105105105/>

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV6035.1	2													1
21CIV6035.2			2											1
21CIV6035.3			2											1
21CIV6035.4			2			2							1	1
21CIV6035.5						2							1	
21CIV6035.6						2							1	

1: Low 2: Medium 3: High

Remote Sensing and Geographical Information System			
Course Code	21CIV6041	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
<p>Course Learning Objectives: This course will enable students to</p> <ul style="list-style-type: none"> ● understand the basic concepts of remote sensing. ● analyze satellite imagery and extract the required units. ● extract the GIS data and prepare the thematic maps. ● use the thematic maps for various applications. 			
Module-1 Introduction to Remote Sensing (8 hours)			
<p>Remote Sensing: Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False color composite, elements of visual interpretation techniques.</p> <p>Application: Environmental monitoring, land resource management, infrastructure development, disaster management, and geospatial analysis.</p>			
Module-2 Sensor Characteristics and Digital Image Processing (8 hours)			
<p>Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data.</p> <p>Data Formats: Introduction, platforms IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal).</p> <p>Basics of digital image processing: Introduction to digital data, systematic errors (Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity, Earth Rotation) and non-systematic [random] errors (Altitude, Attitude), Image enhancements (Gray Level Thresholding, level slicing, contrast stretching), Image filtering.</p> <p>Application: Land surveying, infrastructure planning, monitoring and assessment, image processing and analysis.</p>			
Module-3 Introduction to GIS (8 hours)			
<p>Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data.</p> <p>GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum.</p> <p>Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.</p> <p>Application: To analyze and visualize geospatial data for applications such as urban planning, infrastructure design, environmental modeling, and transportation network analysis.</p>			
Module-4 GIS Data Models (8 hours)			
<p>Data Models:-Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database.</p> <p>Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, and Data conversion.</p> <p>Application: For analyzing continuous data, to perform spatial analysis, map generation, and infrastructure planning.</p>			
Module-5 Integrated Applications of RS & GIS (8 hours)			
<p>Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services and Its Applications.</p> <p>Application: Engineering projects and decision-making process</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV6041.1	Collect data and delineate various elements from the satellite imagery using their spectral signature.
21CIV6041.2	Analyze different features of ground information to create raster or vector data.
21CIV6041.3	Perform digital classification and create different thematic maps for solving specific problems
21CIV6041.4	Make decision based on the GIS analysis on thematic maps.
21CIV6041.5	Use the Remotely sensed and GIS integrated data in various fields of application.
21CIV6041.6	Know about the various satellite parameters to obtain a specific image for an application.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Remote Sensing and Image Interpretation	Lilles and Kiefer, Chipman	Wiley	6 th Edition 2017
2	Geographical Information Science	Panigrahi Narayan	University Press	2013
3	Introduction to Geographic Information Systems	Chang Kang-Tsung	McGraw Hill, New Delhi	2016
Reference Books				
1	Remote Sensing of the Environment	Jensen John R	Pearson Education Pvt. Ltd.	2017
2	Textbook of Remote Sensing and Geographical Information Systems	Reddy M Anji	BSP BS Publications	2013
Web links and Video Lectures (e-Resources):				
1. NPTEL: Remote Sensing and GIS - https://nptel.ac.in/courses/105103193/				
2. Remote Sensing Image Acquisition, Analysis and Applications - https://www.coursera.org/learn/remote-sensing				

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV6041.1	1											2		
21CIV6041.2		1											1	
21CIV6041.3	3		2										1	
21CIV6041.4		2												
21CIV6041.5		2			2							2	3	
21CIV6041.6	1	1										3	3	

1: Low 2: Medium 3: High

Numerical Methods and Applications			
Course Code	21CIV6042	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Articulate the importance of numerical techniques in Civil Engineering and utilize iterative techniques to solve simultaneous equations • Analyze Civil engineering problems applying Interpolation techniques and Newton's difference formulae. • Apply the knowledge of Numerical Techniques to solve first order differential equations. • Develop the knowledge of Finite Difference Techniques to solve one dimensional and two dimensional equations. 			
Module-1 Solution Of Equations And Eigenvalue Problems(8 hours)			
<p>Solution of algebraic and transcendental equations — Fixed point iteration method — Newton Raphson method — Solution of linear system of equations — Gauss elimination method — Pivoting — Gauss Jordan method — Iterative methods of Gauss Jacobi and Gauss Seidel — Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.</p> <p>Applications: Problems involving Supply and Demand of material for construction</p>			
Module-2 Interpolation And Approximation (8 hours)			
<p>Interpolation with unequal intervals — Lagrange's interpolation — Newton's divided difference interpolation — Cubic Splines — Difference operators and relations — Interpolation with equal intervals — Newton's forward and backward difference formulae.</p> <p>Applications: Problems needing investigations/research such as in finding variation of temperature with the depth of water.</p>			
Module-3 Numerical Differentiation And Integration(8 hours)			
<p>Approximation of derivatives using interpolation polynomials — Numerical integration using Trapezoidal, Simpson's 1/3 rule — Romberg's Method — Two point and three-point Gaussian quadrature formulae — Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.</p> <p>Applications: In the calculation of volume of earthwork and other application in Surveying</p>			
Module-4 Initial Value Problems For Ordinary Differential Equations (8 hours)			
<p>Single step methods — Taylor's series method — Euler's method — Modified Euler's method — Fourth order Runge — Kutta method for solving first order equations — Multi step methods — Milne's and Adams — Bash forth predictor corrector methods for solving first order equations.</p> <p>Applications: These methods are useful in writing codes using programming languages and simplifying complex problems</p>			
Module-5 Boundary Value Problems In Ordinary And Partial Differential Equations (8 hours)			
<p>Finite difference methods for solving second order two — point linear boundary value problems — Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain — One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods — One dimensional wave equation by explicit method.</p> <p>Applications: In Finite Element Method of Analysis of structures.</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV6042.1	Apply the knowledge of basic mathematics to solve Civil Engineering problems using different iterative methods.

21CIV6042.2	Apply the concept of numerical interpolation and approximation to Civil Engineering Problems
21CIV6042.3	Solve ordinary differential equations arising in Civil Engineering problems using single step numerical methods
21CIV6042.4	Solve ordinary differential equations arising in Civil Engineering problems using multi step numerical methods.
21CIV6042.5	Analyze boundary value problems in Civil Engineering using finite difference methods
21CIV6042.6	Analyze One dimensional partial differential equations arising out of Civil Engineering problems using finite difference methods

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Numerical methods in Engineering and Science	Grewal. B.S., and Grewal. J.S	Khanna Publishers, New Delhi	9th Edition -2014
2	Applied Numerical Analysis	Gerald. C. F., and Wheatley. P. O	Pearson Education, Asia, New Delhi	7th Edition -2022
Reference Books				
1	Numerical Methods for Engineers	Chapra. S.C., and Canale.R.P	Tata McGraw-Hill, New Delhi	7th Edition-2016
2	A friendly introduction to Numerical analysis	Brian Bradie	Pearson Education, Asia, New Delhi	2006
3	Numerical methods for Scientists and Engineers	Sankara Rao. K	Prentice Hall of India Private, New Delhi	4th Edition -2018

Web links and Video Lectures (e-Resources):

- Introduction to Numerical Methods Finite Difference Approach
https://youtu.be/w4_b0X8teTk?list=PLq-Gm0yRYwTizWtb_xwk0KEMzcoelbOZq
- Numerical methods for Engineers: https://onlinecourses.nptel.ac.in/noc22_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
21CIV6042.1	1	2							2					
21CIV6042.2	1	2						2	2					
21CIV6042.3	1	2						2	2					
21CIV6042.4	1	2						2	2					
21CIV6042.5	1	2						2	2					
21CIV6042.6	1	2						2	2					

1: Low 2: Medium 3: High

Sustainability Concepts in Engineering			
Course Code	21CIV6043	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
<p>Course Learning Objectives: This course will enable students to</p> <ul style="list-style-type: none"> ● Learn about the principles, indicators and general concept of sustainability. ● Apprehend the local, regional and global impacts of unsustainable designs, products and processes. ● Student shall be able to apply the sustainability concepts in engineering ● Know built environment framework and their use ● Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability. 			
Module-1 Introduction (10 Hours)			
<p>Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development goals, balance between development and Sustainability, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM). Introduction to environmental legislations in India.</p> <p>Applications: Understand/ Study current environmental issues</p>			
Module-2 Global Environmental Issues (8 Hours)			
<p>Global Environmental/Societal Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon footprint Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking. Over exploitation of natural resources</p> <p>Applications: Analyzing global Environmental/ Societal Issues to relate it with that of our country.</p>			
Module-3 Sustainable Design Concepts(8 Hours)			
<p>Sustainable Design: Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification - GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.</p> <p>Applications: Implementation of sustainable designs along with conventional designs</p>			
Module-4 Clean Technology and Energy (8 Hours)			
<p>Clean Technology and Energy: Energy sources: Basic Concepts-Conventional and non-Conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio -fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.</p> <p>Applications: Understanding various scopes of sustainable designs</p>			
Module-5 Green Engineering (10 Hrs)			
<p>Green Engineering: Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.</p> <p>Applications: Understanding green Engineering Concepts in implementing sustainable designs</p>			
Course Outcomes: At the end of the course the student will be able to:			
21CIV6043.1	Learn the sustainability concepts; understand the role and responsibility of engineers in sustainable development.		

21CIV6043.2	Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits.
21CIV6043.3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines.
21CIV6043.4	Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society.
21CIV6043.5	Study Social and technological changes and its impacts
21CIV6043.6	Applying green engineering concepts and becoming a lifelong advocate of sustainability in society.

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Sustainability Engineering: Concepts, Design and Case Studies	Allen, D.T. and Shonnard, D. R	Prentice Hall	2011
2	Engineering applications in sustainable design and development	Bradley. A.S; Adebayo, A. O., Maria, P	Cengage learning	2016
Reference Books				
1	Basic Concepts in Environmental Management	Mackenthun, K. M	Lewis Publication	2018
2	ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications- Rating System, TERI Publications - GRIHA Rating System			
3	Systems Analysis for Sustainable Engineering: Theory and Applications	Ni bin Chang	McGraw-Hill Professional	2010
4	Renewable Energy Resources	Twidell, J. W. and Weir, A. D	English Language Book Society (ELBS)	4th Edition 2021

MOOC/NPTEL Resources:

Sustainable materials and Green building-<https://nptel.ac.in/courses/105/102/105102195/>

Course Articulation Matrix:

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV6043.1	3	-	-	-	-	2	2	-	-	-	-	1	-	-
21CIV6043.2	3	-	-	-	-	2	2	-	-	-	-	1	-	-
21CIV6043.3	3	-	-	-	-	2	2	-	-	-	-	1	-	-
21CIV6043.4	3	-	-	-	-	2	2	-	-	-	-	1	-	-
21CIV6043.5	3	-	-	-	-	2	2	-	-	-	-	1	-	-
21CIV6043.6	3	-	-	-	-	2	2	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

Occupational Health and Safety			
Course Code	21CIV6044	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • Gain historical, economical, and organizational perspective of occupational safety & health • Investigate current occupational safety and health problems and solutions. • Identify the forces that influence occupational safety and health. • Demonstrate the knowledge and skills needed to identify work place problems and safe work practices 			
Module-1 Occupational Hazard and Control Principles (8 Hours)			
<p>Safety, History, and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation. (Limits to exposure to hazardous wastes)</p> <p>Applications: Promote workplace safety, investigate accidents, and hold employers responsible for informing and protecting their employees.</p>			
Module-2 Ergonomics at Work Place (8 hours)			
<p>Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis Fault Tree Analysis Emergency Response - Decision for action purpose and considerations.</p> <p>Applications: Help to create safe and comfortable workspaces, prevent ergonomic hazards, analyze hazards and human errors, and make informed decisions for emergency response.</p>			
Module-3 Fire and Electrical Safety (8 hours)			
<p>Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers.</p> <p>Electrical Safety, Product Safety: Technical Requirements of Product safety.</p> <p>Applications: Fire protection engineering is the application of science and engineering principles to protect people and their environment from destructive fire.</p>			
Module-4 Health Considerations at Work Place (8 hours)			
<p>Types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) types and advantages, effects of exposure and treatment for engineering industries, Hazardous/Industrial waste, Environment management plans (EMP) for safety and sustainability</p> <p>Applications: PPEs can prevent unnecessary injury in the workplace, protect employees from excessive chemical exposure, prevent the spread of germs and infectious diseases.</p>			
Module- 5 Occupational Health and Safety Considerations (8 hours)			
<p>Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers, and supervisors.</p> <p>Applications: The physical, chemical, biological, and radioactive pollutants are removed that are present in the wastewater</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CIV6044.1	Identify hazards in the work place that pose a danger or threat to their safety or health, or that of others.

21CIV6044.2	Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
21CIV6044.3	Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.
21CIV6044.4	Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
21CIV6044.5	Identify the decisions required to maintain protection of the environment, workplace and personal health.
21CIV6044.6	Evaluating the effectiveness of the decisions made to maintain safety by monitoring their implementation and outcomes.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Occupational Safety and Health for Technologists, Engineers, and Managers	Goetsch D. L.	Prentice Hall	8th Edition 2014
2	Industrial Accident Prevention-A Scientific Approach	Heinrich H. W	McGraw-Hill Book Company	Edition 2007
Reference Books				
1	Industrial Safety Management and Technology	Colling D.A.	Prentice Hall, New Delhi.	Edition 1990
2	Safety and Environmental Management	Della D.E., and Giustina	Van Nostrand Reinhold International Thomson Publishing Inc	Edition 1996

Web links and Video Lectures (e-Resources):

<https://nptel.ac.in/courses/110105094/>

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
21CIV6044.1	3					2			2				1		
21CIV6044.2	3					2			2				1		
21CIV6044.3	3					2			2				1		
21CIV6044.4	3					2			2				1		
21CIV6044.5	3					2			2				1		
21CIV6044.6	3					2			2				1		

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	21CIV605	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 Hours	02
Total Hours	15 hours Theory	Credits	01
Course Learning Objectives: This course will enable <ul style="list-style-type: none"> 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): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem 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. Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.			

Course Outcomes: At the end of the course the student will be able to:	
21CIV605.1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale
21CIV605.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
21CIV605.3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic component.
21CIV605.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
21CIV605.5	Address problems related to waste management and public health aspects
21CIV605.6	Understand about 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	Edition 3, 2018
2	Environmental Studies –From Crisis to Cure	R Rajagopalan	Oxford Uni-Press	Edition 3, 2020
Reference Books				
1	A Basic Course in Environmental Studies	Surinder Deswal, Anupama Deswal	DhanpatRai Publishing Co. (P) Ltd	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):

- Coursera Course: Introduction to Environmental Science Specialization - <https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc>
- NPTEL: Environmental Studies - https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
- Directory of Open Access Books (DOAB) -Environmental Leadership Capacity Building in Higher Education: Experience and Lessons from Asian Program for Incubation of Environmental Leaders : <http://link.springer.com/openurl?genre=book&isbn=978-4-431-54339-8>
- Lec 31: Environmental Management Systems (EMS) - <https://youtu.be/BYqLRGawoH0>
- ISO 14001:2015 Training - Environmental Management - <https://youtu.be/2f4pBIvXkBs>

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV605.1	0	0	0	0	0	1	3	0	0	0	0	0	0	0
21CIV605.2	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.3	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.4	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.5	0	0	0	0	0	2	3	1	0	0	0	0	0	0
21CIV605.6	0	0	0	0	1	0	0	2	0	0	0	0	0	0

1: Low 2: Medium 3: High

Software Application Laboratory			
Course Code	21CVL606	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Laboratory	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
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> ● Use industry standard software in a professional set up. ● Understand the elements of finite element modelling, 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 (8 hours)			
<p>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, Design of super elevation.</p> <p>Applications: Automation of design procedure for various Civil Engineering numerical problems.</p>			
Module-2 Use of Analysis Software (8 hours)			
<p>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.</p> <p>Applications: Understanding the usage of Structural Analysis Software.</p>			
Module-3 Project Management & GIS Applications (8 hours)			
<p>1. Exercise on Project planning and scheduling of a building project using any project management software:</p> <ol style="list-style-type: none"> a. Understanding basic features of Project management software b. Constructing Project: create WBS, Activities, and tasks and Computation Time using spread sheet 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 about Resource Creation and allocation g. Understanding about Splitting the activity, linking multiple activity, assigning Constraints, Merging Multiple projects, Creating Baseline Project. <p>2. GIS applications using Software:</p> <ol style="list-style-type: none"> a. To create shape files for point, line and polygon features with a map as reference. b. To create decision maps for specific purposes. <p>Applications: Application of different softwares for the data management purpose & Map preparation.</p>			

Course Outcomes: At the end of the course the student will be able to:	
21CVL606.1	Use industry standard software for analysis of structural components in a professional setup.
21CVL606.2	Use industry standard software for analysis of multi storey building in a professional setup.
21CVL606.3	Use modern tools for Project Management for creating network diagrams.
21CVL606.4	Develop shape files and to develop Map using modern techniques.
21CVL606.5	Develop customized Validation tool for the design of RCC structural Components.
21CVL606.6	Develop customized Validation tool for solve civil engineering problems.

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	1 st edition, 2013
2	Highway Engineering	S K Khanna, C E G Justo, and A Veeraragavan	Nem Chand & Brothers	10 th edition, 2010
3	Surveying & levelling Vol. I,II & III.	B. C. Punmia,	Laxmi Publications;	17 th Edition 2016
Reference Books				
1	<ul style="list-style-type: none"> • 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
21CVL606.1	-	-	-	-	3	-	-	-	-	-	-	-	1	-
21CVL606.2	-	-	-	-	3	-	-	-	-	-	-	-	1	-
21CVL606.3	-	-	-	-	3	-	-	-	-	-	2	-	-	-
21CVL606.4	-	-	-	-	3	-	-	-	-	-	-	-	-	-
21CVL606.5	-	-	-	-	3	-	-	-	-	-	-	1	-	-
21CVL606.6	-	-	-	-	3	-	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

ANALYSIS OF INDETERMINATE STRUCTURES			
Course Code	21CIV607	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 Theory	Credits	03
<p>Course Learning Objectives: The objective of the course is to</p> <ul style="list-style-type: none"> • This course will enable students to: • Analyze the rotation and displacement of continuous beams and frames using slope deflection method. • Analyze the continuous beams by Moment Distribution method. • Analyze the continuous beams by Kani's method. • Analyze beams and trusses and frames using flexibility method. • Analyze beams, trusses and frames using 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:	
21CIV607.1	Analyze statically indeterminate beams and frames having a variable moment of inertia and settlement using the slope deflection method.
21CIV607.2	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.
21CIV607.3	Analyze the performance of continuous beams and frames using Kani's method.

21CIV607.4	Solve the problems of rigid jointed and pin jointed frames by finding their forces and moments using the Flexibility matrix method.
21CIV607.5	Evaluate the problems of rigid jointed and pin jointed frames by finding their forces and moments using the Stiffness matrix method.
21CIV607.6	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.	Thirteenth edition, 2017
2	Basic Structural Analysis	C S Reddy	McGraw Hill Education	3 rd edition, 2017
3	Structural Analysis Vol-1 & 2	S S Bhavikatti	Vikas Publishing House	Fourth edition (1 January 2013)
4	Indeterminate Structural Analysis	M. Vijayanand Dr. K.U. Muthu, Dr. H. Narendra, Dr. Maganti Janardhana	Dreamtech Press	1 st edition, 2019
Reference Books				
1	Theory of Structures	Ramamrutham S,	Dhanpat Rai & Sons, New Delhi	11 th edition, 2020
2	Structural Analysis	Hibbeler R C	Prentice Hall	Eighth Edition 2019
3	Intermediate structural analysis	C.K.Wang	McGraw Hill Education	1 st Edition, 2017

Web links and Video Lectures (e-Resources):

- Structural analysis – II, IITB <https://nptel.ac.in/courses/105/101/105101086/>
- Structural analysis – II, IITKH <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
21CIV607.1	2	3	-	-	-	-	-	-	-	-	-	-	-	1
21CIV607.2	2	3	-	-	-	-	-	-	-	-	-	-	-	1
21CIV607.3	2	3	-	-	-	-	-	-	-	-	-	-	-	1
21CIV607.4	-	3	-	-	2	-	-	-	-	-	-	-	-	1
21CIV607.5	-	3	-	-	2	-	-	-	-	-	-	-	-	1
21CIV607.6	-	3	-	-	-	-	-	-	-	-	-	-	-	1

1: Low 2: Medium 3: High

Extensive Survey Project			
Course Code	21CIV608	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:0:2	SEE	3 Hours
Total Hours	13 Hrs Theory+13 Lab slots	Credits	02
<p>Course Learning Objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Understand the practical applications of Surveying. 2. Use Total station and other Measurement Equipment. 3. Work in teams and learn time management, communication and presentation skills 			
Module-1 New Tank Project (3 hours)			
<ul style="list-style-type: none"> ❖ Reconnaissance survey for selection of site and conceptualization of project. ❖ Alignment of center line of the proposed bund, Longitudinal and cross sections of the center line. ❖ Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement ❖ Design and preparation of drawing with a report. <p>Applications: To identify location for construction of a new tank across a valley/river</p>			
Module-2 Water Supply & Sanitary Project. (3 hours)			
<ul style="list-style-type: none"> ❖ Reconnaissance survey for selection of site and conceptualization of project. ❖ Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. ❖ Preparation of village map by using total station. ❖ Survey work required for laying of water supply and UGD ❖ Location of sites for water tank. Selection of type of water tank to be provided. (ground level, overhead and underground) ❖ Design of all elements and preparation of drawing with report <p>Applications: To design water supply networking for distribution after assessing the quality of drinking water</p>			
Module-3 Highway Project (3 hours)			
<ul style="list-style-type: none"> ❖ Reconnaissance survey for selection of site and conceptualization of project. ❖ Alignment of center line of the proposed road, Longitudinal and cross sections of the center line. ❖ Detailed survey required for project execution like fixing the gradient. ❖ Design of horizontal and vertical curves and estimation of quantity with a report. <p>Applications: To develop a proposal for a new road between stations</p>			
Module-4 Restoration of Existing Tank (2 hours)			
<ul style="list-style-type: none"> ❖ Reconnaissance survey for selection of site and conceptualization of project. ❖ Alignment of center line of the existing bund, Longitudinal and cross sections of the center line. ❖ Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement ❖ Design of all elements and preparation of drawing with report <p>Applications: To plan and design restoration process on an existing bund/tank</p>			
Module-5 Town Planning(2 hours)			
<ul style="list-style-type: none"> ❖ Reconnaissance survey for selection of site and conceptualization of project. ❖ Detailed survey required for project execution like contour surveys 			

- ❖ Preparation of layout plans as per regulations
- ❖ Centerline marking-transfer of center lines from plan to ground
- ❖ Design of all elements and preparation of drawing with report as per regulations

Applications: To plan a new township

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

21CIV608.1	Apply Surveying knowledge and tools effectively for the projects
21CIV608.2	Understanding Task environment, Goals, responsibilities, Task focus, working in teams towards common goals, Organizational performance expectations, technical and behavioral competencies.
21CIV608.3	Application of individual effectiveness skills in team and organizational context, goal setting, time management, communication and presentation skills.
21CIV608.4	Practice Professional etiquettes at workplace, meeting and general
21CIV608.5	Establishing trust based relationships in teams & organizational environment
21CIV608.6	Orientation towards conflicts in team and organizational environment, Understanding sources of conflicts, Conflict resolution styles and techniques

Sl. No.	Title of the Book	Name of Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Surveying	B.C. Punmia	Laxmi Publications Pvt. Ltd., New Delhi	Vol.1, 2009
2	Surveying and Levelling	Kanetkar T P and S V Kulkarni	Pune Vidyarthi Griha Prakashan	Part I, 2006
Reference Books				
1	Surveying Vol.1	S.K. Duggal,	Tata McGraw Hill Publishing Co. Ltd. New Delhi. –	3 rd Edition, 2009
2	Surveying Vol. 1	K.R. Arora	Standard Book House, New Delhi.	12 th Edition, 2010

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV608.1	2	-	-	-	2	-	-	-	-	-	-	-	-	-
21CIV608.2	-	-	-	2	-	-	-	-	2	-	-	-	-	-
21CIV608.3	-	-	-	2	-	-	-	-	2	-	-	-	-	-
21CIV608.4	-	-	-	2	-	2	-	2	-	-	-	-	-	-
21CIV608.5	-	-	-	2	-	-	2	-	-	-	-	-	-	-
21CIV608.6	-	-	-	2	-	-	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	21IIP609	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE	2 Hours
Total Hours	20 Hrs	Credits	-
Course Learning Objectives:			
<ol style="list-style-type: none"> 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:	
21IIP609.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
21IIP609.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
21IIP609.3	Demonstrate a comprehensive understanding of the patentability criteria, including

	novelty, non-obviousness, and utility.
21IIP609.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
21IIP609.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
21IIP609.6	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_landscape/s/
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
21IIP609.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
21IIP609.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
21IIP609.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
21IIP609.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
21IIP609.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
21IIP609.6	-	-	-	-	2	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

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

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi

Accredited by NAAC with A+ Grade

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