Fourth 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) & PG (MBA and MCA)
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS

(With effect from 2021-22)

Civil Engineering

FOURTH YEAR

(VII and VIII 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 TechnicalEducation (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 ahandful 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 two of the PG programs namely MBA and MCA programs, have accreditation from the NBA.

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

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

CONTENTS

ABOUT THE DEPARTMENT

A vibrant Department, established in 2012, aims at contributing graduate engineers equipped for careersin the public and private sectors. The Department is NBA accredited and has got a highly qualified teamof 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 thesociety.

DEPARTMENT MISSION

- Deliver curricula for students to meet the local, national and global demands of industry, societyand 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 practicalproblems using modern techniques.

PE0 2: To develop in students the ability to plan, analyze, design and construct structures from thefoundation 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 suitablesolutions.

PE0 5: To train students to understand the ethical responsibility of Civil Engineering profession andapply 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 engineeringproblems reaching substantiated conclusions using first principles of mathematics, natural sciences, andengineering 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 ofthe 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 engineeringcommunity 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 engineeringand 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 researchin novel areas of Civil Engineering.
PSO2: Qualify in the competitive examinations and succeed in obtaining opportunities in the public andprivate sectors.

VII Semester (B.E. - CIVILEngineering)						Teaching Hours/Week			Examination				
SI. No.	Course and Course Code		Course Title	Teaching Department	Paper Setting Board	Theory Lecture	Tutorial	Practical /Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
						L	T	P					
1	PCC	21CIV701	Prestressed Concrete	CIV	CIV	3	-	-	03	50	50	100	3
2	PCC	21CIV702	Quantity Surveying and Contract Management	CIV	CIV	2	2	-	03	50	50	100	3
3	PEC	21CIV703X	Professional Elective - 2	CIV	CIV	3	-	-	03	50	50	100	3
4	PEC	21CIV704X	Professional Elective - 3	CIV	CIV	3	-	-	03	50	50	100	3
5	OEC	21CIV705X	Open Elective - 2	CIV	CIV	3	-	-	03	50	50	100	3
6	SDC	21CVS706	Technical Seminar	CIV	CIV	-	-	2	-	100	--	100	1
7	SDC	21CVP707	Major Project Work (Phase I & II)	CIV	CIV	-	-	6	03	50	50	100	5
					Total	**14**	**02**	**08**	**18**	**400**	**300**	**700**	**21**

21CIV703X : Professional Elective II			
21CIV7031	Alternative Building Materials	21CIV7033	Matrix Method of Structural Analysis
21CIV7032	Railway, Harbour, Tunneling and Airports	21CIV7034	Ground Water Hydraulics
21CIV704X : Professional Elective III			
21CIV7041	Urban Transport Planning	21CIV7043	Bridge Engineering
21CIV7042	Earthquake Engineering	21CIV7044	Pavement Design

21CIV705X : Open Elective II			
21CIV7051	Finite Elemental Methods	21CIV7053	Environmental Protection and Management
21CIV7052	Intelligent Transportation Engineering	21CIV7054	Water Resource Management

VIII Semester (B.E. - CIVILEngineering)														
SI. 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 Marks**	
						L	**T**	**P**					
1	SDC	21AEC801	MOOC	Any MOOC topic (Choices are given by respective department) with minimum 8 weeks to be completed between III Sem to VIII Sem								100	2
2	SDC	21CVP802	Major Project Work (Final presentation and report submission)	CIV		--	--	2	03	50	50	100	5
3	INT	21INT803	Research / Industry Internship						03	50	50	100	10
					Total		--	2	**06**	**100**	**100**	**200**	**17**

Note: Research Internship / Industry Internship is to be carried out during the 8th semester for 15 weeks.

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 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.

VII Semester

PRESTRESSED CONCRETE			
Course Code	**21CIV701**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the concept, materials, and types of pre-stressing.
- Analyze the member due to stress and losses in concrete under various loading conditions.
- Interpret deflections in a pre-stressed concrete member.
- Analyze the section for flexure and shear for pre-stressed concrete members.
- Design end blocks as per the limit state method

Module-1 Introduction and Analysis of Members (8 hours)

Concept of Pre-stressing - Types of Pre-stressing - Advantages - Limitations – Pre-stressing systems - Anchoring devices - Materials - Mechanical Properties of High Strength Concrete - High Strength Steel -Stress-Strain curve for High Strength Concrete. Pre-tensioning of slabs (Theory only). Comparison of behavior of reinforced concrete & pre-stressed concrete.

Analysis of members at transfer - Stress concept - Force concept - Load balancing concept - Kern point - Pressure line – Centre of thrust, cable profiles

Applications: Manufacturing of pre-tensioned and post-tensioned members, Evaluation of stresses, Anchoring devices

Module-2 Losses in Pre-Stress and Deflection Evaluation (8 hours)

Losses in Pre stress: Estimation of immediate losses of pre stresses due to Elastic shortening, Friction, Anchorage slip, Relaxation of steel, and time-dependent losses such as Creep and shrinkage of concrete. Estimation of total loss and determination of jacking force.

Deflections in Prestressed Concrete Beams: Deflection due to gravity loads - Deflection due to prestressing force - Total deflection - Limits of deflection - Limits of span-to-effective depth ratio - Effect of creep on deflection - Load versus deflection curve - Methods of reducing deflection, Calculation of Crack Width - Limits of crack width, Control of cracking.

Applications: Evaluation of Jacking force or Design force, Evaluation of Serviceability criteria in the design of long-span girders for gravity loads in pre-stressed concrete structures

Module-3 Analysis and Design for Flexure (8 hours)

Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1 members. **Applications**: Evaluation of ultimate strength of rectangular and flanged sections, Design of tension-free girders. **Software application:** Analysis of PSC beams in ETABS

Module-4 Design for Shear (8 hours)

Analysis for shear - Components of shear resistance - Modes of Failure - Limit State of collapse for shear - Design of shear reinforcement

Applications: To evaluate different types of failures in beams, and evaluate the ultimate shear carrying capacity of the beam.

Module-5 Anchorage Systems and End Block (8 hours)

Different anchorage systems, Transmission of prestress in post-tensioned members, Transmission length, and Anchorage stress in post-tensioned members. Stresses in end blocks - Bearing stress and bursting tensile force - Methods and design of end block by latest IS codes.

Applications: Design of anchorage systems

Course Outcomes: At the end of the course the student will be able to:	
21CIV701.1	Describe the materials and basic properties of pre-stressed concrete structures.
21CIV701.2	Analyze the concrete members at the transfer of pre-stress by using different concepts.

21CIV701.3	Describe and estimate the Immediate and Time-dependent losses in pre-stressed concrete structures as per current code recommendation.
21CIV701.4	Evaluate the short-term and long-term deflections in the pre-stressed concrete structures for safety.
21CIV701.5	Analyze the flexural and shear behavior of simple pre-stressed concrete structures.
21CIV701.6	Interpret different Anchorage systems and design of end blocks as per IS CODE.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Prestressed Concrete	Krishna Raju N	Tata McGraw Hill Publishing Company, New Delhi	5th edition, 2014
2	Prestressed Concrete	Rajagopalan N	Narosa Publishing House, New Delhi	2nd edition, 2013
Reference Books				
1	Fundamentals of Prestressed Concrete	Sinha N C; Roy S K	S. Chand and Co	1st edition, 2011
2	Design of Prestressed Concrete Structures	Lin T Y; Burns Ned H	Wiley India	3rd Edition,2010
3	Prestressed Concrete Structures	Dayaratnam Pasala	Oxford and IBH	5th Edition,2024
4	IS: 1343: 1987-Indian Standard code of practice for Prestressed concrete, BIS, New Delhi			

Web links and Video Lectures (e-Resources):

- Design of Prestressed Concrete Structures- http://nptel.ac.in/courses/105106118/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV701.1	2				`									2
21CIV701.2	2	3												2
21CIV701.3		3						2						2
21CIV701.4		3			2									
21CIV701.5			2					2						
21CIV701.6			2					2						

1: Low 2: Medium 3: High

QUANTITY SURVEYING AND CONTRACT MANAGEMENT			
Course Code	**21CIV702**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Estimate the quantities of different items of work by using Centre line method and Long wall and Short wall method to know the approximate construction cost of buildings.
- Able to read and understand the specifications. To carry out bar bending schedule and calculate the quantity of steel for RCC structures. Estimate the quantities of items of work and cost of the manhole, septic tank, and RCC culvert.
- Should know the rates of materials and be able to analyze the rates of different items of work of buildings.
- To know the contract and tendering systems from the point of contractor's interest to avoid conflicts between clients and contractors.
- To apply the concept of Valuation for Properties

Module-1 Quantity Estimation for Building: (8 hours)

Different types of estimates, study of various drawings attached with estimates, important terms, units of measurements, abstract, approximate methods of estimating buildings, cost from materials and labor, equations recommended by CBRI-examples. Building estimate: Methods of taking out quantities and cost, center line method, long and short wall method or crossing method, preparation of detailed and abstract estimates for the following - masonry structures and framed structures with flat sloped RCC roofs, beams, columns, and column footings, RCC roof slabs.

Module-2 Quantity Estimation for Special Structure (8 hours)

Steel truss (Fink and Howe truss), RCC slab culverts manhole, and septic tanks. Specification: The objective of writing specifications essentials in specifications, general and detailed specifications of items of works in buildings, specifications of aluminum and wooden partitions, false ceilings, aluminum and fiber doors, windows, and various types of claddings.

Module-3 Rate Analysis (8 hours)

Working out quantities and rates for the following standard items of works earthwork in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and formwork for different RCC items, wood and steel works for doors, windows and ventilators.

Module-4 Contract Management- Pre -Process (8 hours)

Types of contract, essentials of contract agreement-legal aspects, penal provisions on breach of contract, definition of the terms: tender, earnest money deposit, security deposit, tender forms, Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: Letter of intent, Award of contract, letter of acceptance, and notice to proceed. Features/elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC). Law of Contract as per Indian Contract Act 1872, Types of Contracts, Joint venture. Contract Forms: FIDIC contract Forms, CPWD, NHAI, NTPC, NHEPC.

Module-5 Contract Management-Post award (8 hours)

Essentials of contract agreement aspects, penal provisions on breach of contract Termination of contract, completion certificate, quality control, right of contractor, refund of deposit, administrative approval, technical sanction, nominal muster roll, measurements-preparation of bills. Documents and types, comparative statements, acceptance of contract documents and the issue of work orders, duties,

and liabilities Tenders – TTT Act – e-tender –Document – Contracts –Drafting of contract documents – Arbitration and legal requirements. Valuation: Definitions of terms used in the valuation process, Purpose of valuation, Cost, Estimate, Value and its relationship, Capitalized value. Freehold and leasehold and easement, Sinking fund, depreciation–methods of estimating depreciation, Outgoings, Process and methods of valuation: Rent fixation, valuation for mortgage, valuation of land.

Course Outcomes: At the end of the course, the student will be able to:	
21CIV702.1	Arrive with approximate quantities of different items of work and the cost of buildings.
21CIV702.2	Write the different specifications of items of work of buildings.
21CIV702.3	Calculate the quantities of dry materials and analyze the rates of different items of work by using rates of dry materials.
21CIV702.4	Interpret contract and tender documents of domestic and international construction works
21CIV702.5	To study the tender process and other legal aspects
21CIV702.6	Evaluate immovable assets and properties of public and private buildings

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Estimating & Costing in Civil Engineering, Theory and Practices	B. N Dutta.	UBS publishers and distributors, New Delhi	27th edition, 2012
2	Estimating, Costing, specification and valuation in Civil Engineering	N. Chakraborti	Chakraborti	29th edition, 2006
3	Estimating, Costing and Valuation.	Rangwala, C.	Charotar Publishing House Pvt. Ltd.	17th edition, 2020
Reference Books				
1	Estimating and Costing (Civil Engineering)	G. S. Birdie	Dhanpat Rai Books	6th edition, 2014
2	A Textbook of Estimating, Costing & Accounts	D D Kohli R C Kohli	S. Chand Publishing,	13th edition, 2013
3	Estimating and Tendering for Construction Work	Martin Brook	London, Routledge	4th edition, 2008
4	Quantity Surveying Practice	Ivor H. Seeley (Author)	Martin Brook	2nd edition, 1997
Web links and Video Lectures (e-Resources): ● http://nptel.ac.in/courses/105103093/14				

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV702.1		2				2		1						
21CIV702.2		2				2		1				2		
21CIV702.3						2					1			
21CIV702.4		2						1				2		
21CIV702.5		2						1						
21CIV702.6		2						1						

1: Low 2: Medium 3: High

ALTERNATIVE BUILDING MATERIALS			
Course Code	**21CIV7031**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand environmental issues due to building materials and the energy consumption in manufacturing building materials.
- Study the various masonry blocks, masonry mortar, and structural behavior of masonry under compression.
- Study alternative building materials in the present context.
- Understand the alternative building technologies that are followed in the present construction field.

Module-1 Introduction to Building Energy and Green Concepts in Buildings (8 Hours)

Energy in building materials, Environmental issues concerned with building materials, Embodied energy and life-cycle energy, Global warming, and the construction industry, Green concepts in buildings, Green building ratings – IGBC, BREEAM, and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmentally friendly and cost-effective building materials and technologies, Requirements for buildings of different climatic regions

Module-2 Masonry Units and Mortars (8 hours)

Requirements of masonry units, characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal-G blocks, and Stabilized mud blocks. Manufacture of stabilized blocks, AAC blocks. Mortars, cementations materials, natural & manufactured sand, types of mortars, requirements of mortar, selection of mortar.

Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry. Masonry and plastering practical demonstration.

Module-3 Sustainable Building Materials (8 hours)

Lime, Pozzolana cement, Raw materials, Manufacturing Process, Properties, and uses. Fibers-metal and synthetic, Properties and applications. Fiber-reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties, and Applications. Building materials from construction and demolition wastes, agro wastes, industrial wastes, and recycled plastics, Properties, and applications, smart materials.

Module-4 Alternate Building Technologies (8 hours)

Use of arches in the foundation, alternatives for wall constructions - composite masonry, confined masonry, cavity walls, rammed earth, rat trap bond, Ferro cement and ferroconcrete building components, Materials and Properties, Construction methods, and Applications. Top-down construction, Aluminum formwork Construction Technique, Alternate Roofing Systems - Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes, smart construction, Modular construction, 3D printing of concrete

Module-5 Equipment for Production of Alternative Materials (8 hours)

Equipment for production of stabilized blocks, Moulds, and methods of production of precast elements, Cost concepts in buildings, Cost-saving techniques in planning, design, and construction, Automation and Robotics in the production of materials, Cost analysis: Case studies using alternatives.

Course Outcomes: At the end of the course, the student will be able to:	
21CIV7031.1	Solve the problems of Environmental issues concerned to building materials and

	evaluate the environmental implications of green building ratings for the construction industry and society
21CIV7031.2	Discover various kinds of masonry units employed in construction projects
21CIV7031.3	Identify the different types of mortar and their appropriate uses in masonry construction
21CIV7031.4	Evaluate the environmental impact of alternate building materials and their contribution to sustainable construction
21CIV7031.5	Apply knowledge of alternate building technologies to design and construct sustainable buildings
21CIV7031.6	Identify the components and processes involved in the production of alternative materials

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Alternative Building Materials and Technologies	KS Jagadish, BV Venkatarama Reddy and KS Nanjunda Rao	New Age International Pvt Ltd.	2nd edition, 2017
2	Structural Masonry	Arnold W Hendry	Macmillan Publishers	1998
Reference Books				
1	Building Materials	SK Duggal	Taylor and Francis	1st edition, 2017
2	Building Materials	Varghese PC	Prentice Hall of India	2nd edition, 2015

Web links and Video Lectures (e-Resources):

- Sustainable Materials and Green buildings: https://archive.nptel.ac.in/courses/105/102/105102195/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7031.1	3						2							
21CIV7031.2	3	2												
21CIV7031.3	3					2								
21CIV7031.4	3						2							
21CIV7031.5	3					2								
21CIV7031.6	3					2								

1: Low 2: Medium 3: High

Railways, Harbors, Tunneling and Airports			
Course Code	**21CIV7032**	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:

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

Module-1 Railways (8 Hours)

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

Module-2 Railway Construction and Maintenance (8 hours)

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

Module-3 Harbor and Tunnel Engineering (8 hours)

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

Module-4 Airport Planning (8 hours)

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

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

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

Course Outcomes: At the end of the course the student will be able to:	
21CIV7032.1	Understand the history and development, role of railways, railway planning and development based on essential criteria.
21CIV7032.2	Track material estimate. Locomotive hauling. Components, properties. Construction quantities. Geometry, crossings, maintenance.
21CIV7032.3	Apply design features of tunnels, harbors, dock and necessary navigational aids.
21CIV7032.4	Expose them to various methods of tunneling and tunnel accessories.
21CIV7032.5	Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids.
21CIV7032.6	Airport Maintenance, Signage and marking in the airport.

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

Web links and Video Lectures (e-Resources):
Introduction to Railway Engineering https://nptel.ac.in/courses/105107123

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7032.1	2	2												
21CIV7032.2				2										
21CIV7032.3	2													
21CiV7032.4				2										
21CIV7032.5			2											
21CIV7032.6	2	2												

1: Low 2: Medium 3: High

MATRIX METHOD OF STRUCTURAL ANALYSIS			
Course Code	21CIV7033	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	Exam Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: This course will enable students to,

- Gain basic knowledge of structural systems and application of concepts of flexibility and stiffness matrices for simple elements.
- Analyze the trusses, continuous beams, and rigid plane frames by flexibility and stiffness matrix method.
- To define the stiffness and flexibility matrix for solving problems involving temperature changes and lack of fit.
- To summarize the direct stiffness method, local and global coordinates, and analyze the trusses, continuous beams, and rigid frames

Module-1 Introduction (8 Hours)

Structural systems, geometric and material non-linearity, principle of superposition, equilibrium and compatibility conditions, static and kinematic indeterminacy, principle of minimum potential energy and minimum complementary energy, concepts of stiffness and flexibility, flexibility and stiffness matrices of beam elements. Highlights of slope deflection method.

Module-2 Element Stiffness Method (8 Hours)

Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, rigid frames.

Module-3 Impact of Temperature Change (8 Hours)

Effects of Temperature Changes and Lack of Fit: Related numerical problems by stiffness method as in Module 2.

Module-4 Analysis of Continuous Beams by Direct Stiffness Method (8 Hours)

Local and global coordinate system, principle of contra gradience, global stiffness matrices of beam elements, analysis of continuous beams

Module-5 Analysis of Frames And Truss by Direct Stiffness Method (8 Hours)

Analysis of single bay portal frames and regular trusses by direct stiffness method.
Self-Learning: Use of spreadsheet and software tools to perform matrix structural analysis

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

21CIV7033.1	Evaluate the structural systems to the application of concepts of flexibility and stiffness matrices for simple problems.
21CIV7033.2	Determine the member forces in continuous beams.
21CIV7033.3	Solve engineering problems by application of concepts of stresses due to lack of fit and temperature change applied to beams by stiffness matrix method.
21CIV7033.4	Explain the direct stiffness matrix with the help of a coordinate system and Analyze continuous beams by the direct stiffness method.
21CIV7033.5	Analyze the rigid plane frames by direct stiffness method.
21CIV7033.6	Analyze the regular trusses by direct stiffness method.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Matrix Analysis of Framed Structures	Weaver W and Gere J H	CBS publications, New Delhi.	3rd Edition, 1990
2	Mechanics of Materials	Ferdinand P. Beer, E. Russell Johnston and Jr. John T. De Wolf	Tata McGraw-Hill,	3rd Edition, 2001
Reference Books				
1	Matrix Method of Structural Analysis	Godbole P N et.al	PHI ltd, New Delhi	1st Edition, 2014
2	Theory of Structures Vol II	Pundit and Gupta	TMH publications, New Delhi	1st Edition, 2017
3	Advanced Structural Analysis	Manikaselvam	Khanna Publishers, New Delhi.	7th Edition
4	Elements of Matrix Analysis and Stability of Structures	A K Jain	Nemchand Publications, Roorkee	3rd Edition, 2015
MOOC/NPTEL Resources: 1. Matrix Method of Structural Analysis - https://archive.nptel.ac.in/courses/105/105/105105180/				

Course Articulation Matrix:

Program Outcomes (POs)														
Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV7033.1	1	3												
21CIV7033.2		3		2										
21CIV7033.3		3			3									
21CIV7033.4	2	3												
21CIV7033.5		3			2									
21CIV7033.6		3								2			1	

1: Low 2: Medium 3: High

Ground Water Hydraulics			
Course Code	**21CIV7034**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: This Course will enable the students to:

- Develop an understanding on the fundamentals of groundwater hydrology, appraise its Significance and Inspect the techniques of groundwater exploration, development and management.
- Explain the occurrence and distribution of subsurface water, list and distinguish the types of aquifers, wells and their characteristic properties.
- Explain aquifer parameters, analyze pump test and Darcy' Law governing the steady unidirectional groundwater flow.
- Explain Well hydraulics and estimate the aquifer parameters in steady and unsteady state radial flow into unconfined and confined aquifers.

Module-1 Introduction (8 hours)

Vertical distribution of subsurface water and its occurrence. Aquifer and its types, water bearing properties of rocks and their classification. Numerical problems on aquifers

Module-2 Fundamentals of Groundwater Flow: (8 hours)

Aquifer parameters-porosity, permeability, Specific yield, specific retention, hydraulic conductivity, storage coefficient, transmissibility, Pump tests, recuperation tests, interference of wells; Darcy's law, steady unidirectional flow in confined and unconfined aquifers. (Numerical)

Module-3 Well Hydraulics (8 hours)

Steady-state Radial flow in a confined and unconfined aquifer, Thiem's equilibrium formulae; Estimation of Discharge and Transmissivity.

Module-4 Unsteady State Radial flow (8 hours)

Theis's method- General equation derivation, Cooper-Jacob method, Chow's method, solution of unsteady flow equations.

Module-5 Groundwater Exploration, Development, and Management (8 hours)

Remote sensing and Geophysical methods, Electrical Resistivity methods, types of wells and yield of a well. Methods of construction, tube well design, dug wells, well development, pumps for lifting water - working principles, power requirement. Resource Management, Conjunctive use - necessity, techniques, and economics. Case studies.

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

21CIV7034.1	Illustrate the vertical distribution and occurrence of subsurface water, List and distinguish the water-bearing properties of the rocks, the types of aquifers, and their characteristic properties
21CIV7034.2	List and explain aquifer parameters, analyze pump test and Darcy's Law in steady state unidirectional groundwater flow.
21CIV7034.3	Explain equilibrium Well hydraulics and estimate the aquifer parameters in steady-state radial flow in the unconfined and confined aquifers
21CIV7034.4	Explain in-equilibrium Well hydraulics and estimate the aquifer parameters in unsteady state radial flow in the unconfined and confined aquifers using appropriate methods.

21CIV7034.5	List and categorize types of wells, inspect and explain advanced techniques of groundwater exploration,
21CIV7034.6	Development and management using remote sensing, geophysics, and GIS.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Groundwater Hydrology,	Todd, D. K.	John Wiley and Sons, Singapore	1st edition, 2006
2	Ground Water,	Ramakrishnan, S.	Scitech publications (India) Pvt. Ltd., Chennai	2nd edition, 2011
3	Hydrology and Water Resources Engineering	Garg, S. K.	Khanna Publishers, New Delhi	2nd edition, 2010
Reference Books				
1	Groundwater,	Raghunath, H.M.,	New Age International Publishers, New Delhi	3rd edition, 2007

Web links and Video Lectures (e-Resources):

Basics of groundwater hydrology https://www.youtube.com/watch?v=2Z6tJ9zdxVI

Groundwater Exploration https://www.youtube.com/watch?v=DvAdCsk0NeM

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7034.1	3													
21CIV7034.2	3					2								
21CIV7034.3	3	1												
21CIV7034.4	2	2												
21CIV7034.5							2			2				
21CIV7034.6	2													

1: Low 2: Medium 3: High

URBAN TRANSPORT PLANNING			
Course Code	**21CIV7041**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: This course will enable students to:

- Understand and apply basic concepts and methods of urban transportation planning.
- Apprise about the methods of designing, conducting and administering surveys to provide the data required for transportation planning.
- Understand the process of developing an organized mathematical modelling approach to solve select urban transportation planning problem.
- Excel in use of various types of models used for travel forecasting, prediction of future travel patterns.

Module-1- Urban Transport Planning (8 Hours)

Urbanization, urban class groups, transportation problems and identification, impacts of transportation, urban transport system planning process, modeling techniques in planning. Urban mass transportation systems: urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.

Module-2- Data Collection And Inventories (8 Hours)

Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, RoadSide Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Ownership.

Module-3- Trip Generation & Distribution (8 Hours)

UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction Models, Commercial Trip Rates; Trip Distribution by Growth Factor Methods including numerical.

Module-4-Trip Distribution (8 Hours)

Trip Distribution: Gravity Models, Opportunity Models, Time Function Iteration Models. Travel demand modeling: gravity model, opportunity models, Desire line diagram. Modal split analysis.

Module-5-Traffic Assignment (8 Hours)

Traffic Assignment: Diversion Curves; Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment. Numerical problems on Traffic Assignment. Introduction to land use planning models, land use and transportation interaction.

Course Outcomes:

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

21CIV7041.1	Understand the basic concepts and methods of Urban Transportation Planning
21CIV7041.2	Analyze the methods of designing, conducting, and administering surveys to provide the data required for transportation planning.
21CIV7041.3	Describe the process of developing different mathematical modeling approaches for trip generation and distribution.
21CIV7041.4	Apply the different approaches for trip generation rates to analyze and solve various urban transportation planning problems
21CIV7041.5	Evaluate different methods of Trip distribution and solving numerical problems

21CIV7041.6	Analyze and apply different traffic assignment techniques for better land use developments and transportation interaction.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Traffic Engineering and Transportation Planning	Kadiyali. L. R.,	Khanna Publishers, New Delhi	1st edition, 1999
2	Introduction to Urban System Planning	Hutchinson, B.G,	McGraw Hill.	1st edition, 1974
Reference Books				
1	Urban Transportation Planning: A decision-oriented Approach	Mayer M and Miller E	McGraw Hill.	1st edition, 2001
2	Introduction to Transportation Planning	Bruton M.J.,	Hutchinson of London.	1st edition, 1985

Web links/Video Lectures/MOOCs

1. **URBAN TRANSPORT PLANNING**:

   https://archive.nptel.ac.in/courses/105/105/105105208/

Course Articulation Matrix

Course Outcomes (CO)	Program Outcomes (PO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV7041.1	2													
21CIV7041.2	2													
21CIV7041.3		2												
21CIV7041.4		2												
21CIV7041.5			2							2				
21CIV7041.6	2									2				

1: Low 2: Medium 3: High

Earthquake Engineering			
Course Code	**21CIV7042**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to learn about

- Fundamentals of engineering seismology
- Irregularities in building that are detrimental to its earthquake performance
- Different methods of computation of seismic lateral forces for framed and masonry structures
- Earthquake resistant design requirements for RCC and Masonry structures
- Relevant clauses of IS codes of practice pertinent to earthquake-resistant design of structures

Module-1: **Engineering Seismology (8 Hours)**

Engineering Seismology: Terminologies (Focus, Focal depth, Epicenter, etc.); Causes of Earthquakes; Theory of plate tectonics; Types and characteristics faults; Classification of Earthquakes; Major past earthquakes and their consequences; Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration; Seismic zoning map of India; (Problems on computation of wave velocities. Location of epicenter, Magnitude of earthquake).

Module-2: Response Spectrum (8 Hours)

Response Spectrum: Basics of structural dynamics; Free and forced vibration of SDOF system; Effect of frequency of input motion and Resonance; Numerical evaluation of the response of SDOF system (Linear acceleration method), Earthquake Response spectrum: Definition, construction, Characteristics, and application; Elastic design spectrum.

Module-3: **Seismic Performance of Buildings (8 Hours)**

Types of damages to buildings observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak story; Torsional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code-based seismic design methods.

Module-4: Determination of Design Lateral Forces (8 Hours)

Determination of Design Lateral Forces: Equivalent lateral force procedure and dynamic analysis procedure. Step-by-step procedures for seismic analysis of RC buildings using Equivalent static lateral force method and response spectrum methods (maximum of 4 stories and without infill walls).

Module-5: Analysis and Design of Earthquake-Resistant Buildings (8 Hours)

Earthquake Resistant Analysis and Design of RC Buildings: Typical failures of RC frame structures, Ductility in Reinforced Concrete, Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column, Concept of weak beam-strong column, Detailing of Beam-Column Joints to enhance ductility, Detailing as per IS-13920. Retrofitting of RC buildings Earthquake Resistant Design of Masonry Buildings: Performance of Unreinforced, Reinforced, Infill Masonry Walls, Box Action, Lintel and sill Bands, elastic properties of structural masonry, lateral load analysis, Recommendations for Improving performance of Masonry Buildings during earthquakes; Retrofitting of Masonry buildings.

Course Outcomes: At the end of the course the student will be able to:	
21CIV7042.1	Acquire basic knowledge of engineering seismology.
21CIV7042.2	Develop response spectra for a given earthquake time history and its

	implementation to estimate response of a given structure
21CIV7042.3	Understanding of causes and types of damages to civil engineering structures during different earthquake scenarios
21CIV7042.4	Analyze multi-storied structures modeled as shear frames and determine lateral force distribution due to earthquake input motion using IS-1893 procedures.
21CIV7042.5	Detail earthquake resistant reinforced concrete structures as per the relevant Indian Standard Codes structures thorough exposure to different IS-codes of practices.
21CIV7042.6	Develop a feasible solution via retrofitting to the Reinforced Concrete structures to mitigate the affect due to earthquakes

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Dynamics of Structures Theory and Application to Earthquake Engineering	Anil K. Chopra,	Pearson Education	5th edition, Oct 2019
2	Earthquake Resistant Design of Structures,	Duggal S K,	Oxford University Press	2nd Edition 19th Sep 2013
3	Earthquake resistant design of structures	Pankaj Agarwal, Manish Shrikande	Shree Hari Publications	Jan 2017
Reference Books				
1	Seismic Design of Reinforced Concrete and Masonry Buildings,	T Paulay and M J N Priestley,	Wiley India Pvt Ltd	29th January 2013
2	IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993		BIS	Latest revision

Web links/Video Lectures/MOOCs/papers

1.Earthquake Resistant design of foundations: https://archive.nptel.ac.in/courses/105/107/105107204/

2. Introduction to earthquake Engineering: https://archive.nptel.ac.in/courses/105/101/105101004/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7042.1	2	2												
21CIV7042.2		2											2	
21CIV7042.3				2										
21CIV7042.4						2		2						
21CIV7042.5								2						
21CIV7042.6			2											

1: Low 2: Medium 3: High

Bridge Engineering			
Course Code	**21CIV7043**	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:

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

Module 1 Design of Bridges (8 hours)

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

Module 2 Design of Pipe Culverts and Box Culverts (8 hours)

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

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

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

Module 4 T-beam Bridges (8 hours)

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

Module-5 Bridge Substructures, Abutments, and Piers (8 Hours)

Types of abutments and piers, stability analysis of piers and abutments, base pressure distribution. Bridge bearings, types, and their suitability. Bridge foundation and its types.
AI Application: program in C or C++ or Python for the Design of Deck slab with Hydraulic design and structural design by applying IRC loading standards (Not for Exam)

Course Outcomes: At the end of the course the student will be able to:	
21CIV7043.1	Select the type of bridge based on the site investigation inputs and be able to compute design discharge, linear waterway, economic span, and depth of scour.
21CIV7043.2	Design pipe culverts and Box culverts

21CIV7043.3	Design deck slabs for critical loads
21CIV7043.4	Analyze the stability of bridge piers and abutments
21CIV7043.5	Recommend suitable bearings for the given type of bridge and support condition
21CIV7043.6	Design abutments, piers, and bearings

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

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

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7043.1	2			2										
21CIV7043.2			2											
21CIV7043.3			3											
21CIV7043.4	2	2												
21CIV7043.5						2								
21CIV7043.6			2											

1: Low 2: Medium 3: High

Pavement Design			
Course Code	**21CIV7044**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

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

Module-1 Introduction to Pavement (8 hours)

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

Module-2 Design of Flexible Pavement (8 hours)

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

Module-3 Flexible Pavement Failures (8 hours)

Flexible Pavement Failures, Maintenance and Evaluation, Types of failures, Causes, Remedial/Maintenance measures in flexible pavements, Functional Evaluation by Visual inspection and unevenness measurements, Structural evaluation by Benkleman beam deflection method, Falling weight deflectometer, GPR method. Design factors for runway pavements, Design methods for Airfield pavement, and problems on the above.

Module-4 Stresses in Rigid Pavement (8 hours)

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

Module-5 Rigid Pavement Failures (8 hours)

Rigid Pavement Failures, Maintenance and Evaluation:
Types of failures, causes, remedial/maintenance measures in rigid pavements, Functional evaluation by Visual inspection and unevenness measurements, wheel load and its repetition, properties of subgrade, properties of concrete. External conditions, joints, Reinforcement, Requirements of joints, Types of joints, Expansion joint, contraction joint, warping joint, construction joint, longitudinal joint, Design of joints.

Course Outcomes: At the end of the course the student will be able to:	
21CIV7044.1	Apply the knowledge of components of pavement for the design requirements

	of pavement.
21CIV7044.2	Compute stresses and deflections in the pavement using Boussinesq's theory and Burmister's theory for the design of pavement
21CIV7044.3	Design the flexible pavement by using the Mcleod Method, Kansas method, CBR method, and IRC-37-2001
21CIV7044.4	Design the rigid pavement by analyzing the stresses using Westergaard's and Modified Westergaard equations
21CIV7044.5	Analyze flexible pavement failures using the Benkleman beam deflection method, Falling weight deflectometer, and GPR method
21CIV7044.6	Analyze rigid pavement failures using Visual inspection and unevenness measurements

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Highway Engineering	S K Khanna, C E G Justo, and A Veeraragavan	Nem Chand& Brothers	10th edition, 2010
2	Principles and Practices of Highway Engineering	L.R.Kadiyali and Dr.N.B.Lal	Khanna Publishers	7th edition, 2009
Reference Books				
1	Pavement Analysis and Design	Yang H. Huang	University of Kentucky	2nd edition, 2008
2	Highway Engineering	Rangawala	Charotar publishing house pvt.ltd	12th edition, 2022
3	Transportation Engineering	K.P.Subramanium	SciTech Publications, Chennai.	6th edition, 2015
4	IRC-37-2001 & IRC: 58-2002	Indian Road Congress	Indian Road Congress	2001&2002

Web links and Video Lectures (e-Resources):

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

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7044.1	3													
21CIV7044.2		2												
21CIV7044.3			2											
21CIV7044.4			2											
21CIV7044.5			2						3	3				
21CIV7044.6			2											

1: Low 2: Medium 3: High

FINITE ELEMENTAL METHODS			
Course Code	**21CIV7051**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

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

Module-1 Introduction (8 hours)

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

Module-2 One-dimensional problems (8 hours)

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

Module-3 Two-dimensional problems (8 hours)

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

Module-4 Isoperimetric formulations (8 hours)

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

Module-5 Introduction to software (8 hours)

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

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

Overview of AI techniques and their potential applications in FEM simulations

Course Outcomes: At the end of the course, the student will be able to:	
21CIV7051.1	Summarize the basics of finite element formulation
21CIV7051.2	Apply finite element formulations to solve one-dimensional Problems
21CIV7051.3	Develop shape functions for different elements
21CIV7051.4	Apply finite element formulations to solve two-dimensional scalar Problems.
21CIV7051.5	Apply finite element method to solve problems on isoparametric element
21CIV7051.6	Develop the algorithm of the computer program for Finite Element Analysis

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

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

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV7051.1	3	3												
21CIV7051.2			2	2										
21CIV7051.3		2	3											
21CIV7051.4		3	3	2										
21CIV7051.5		3	3											
21CIV7051.6					1									

1: Low 2: Medium 3: High

Intelligent Transportation Engineering			
Course Code	**21CV7052**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Provide students with a comprehensive understanding of the principles, strategies, and techniques related to ITS.
- Equip students with the knowledge and skills necessary to ITS functional areas
- Develop an overview of ITS implementation in developing countries

Module-1 Introduction to Intelligent Transport System (8 hours)
Introduction to Intelligent Transportation Systems (ITS) -Definition, Role and Responsibilities, Advanced Traveller Information System, Fleet Oriented ITS Services, Electronic Toll Collection, Security, Safety.
Module-2 ITS Architecture and Hardware (8 hours)
Architecture –ITS Architecture Framework, Hardware Sensors, Vehicle Detection, Techniques, Dynamic Message Sign – GPRS – GPS – Toll Collection
Module-3 Advanced Transport Management System (8 hours)
Video Detection, Virtual Loop, Cameras, ANPR, IR Lighting, Integrated Traffic Management, Control Centre, Junction Management Strategies, ATMS – Advanced Traveler Information Systems (ATIS), Route Guidance, Dynamic Traffic Assignment (DTA)
Module-4 Advanced Traveller and Information System (8 hours)
Travel Information – Pre-Trip and Enroute Methods, Basic ATIS Concepts, Smart Route System, Data Collection, Process, Dissemination to Travelers, Evaluation of Information, Value of Information – Business Opportunities
Module-5 Case Studies (8 hours)
Automated Highway Systems, Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Course Outcomes: At the end of the course the student will be able to:	
21CIV7052.1	Apply the fundamentals of principles, strategies, and techniques related to ITS.
21CIV7052.2	Evaluate the effectiveness of ITS architecture and hardware to conduct post-implementation analysis
21CIV7052.3	Utilize advanced transport management system to predict and assess the volume of traffic
21CIV7052.4	Demonstrate knowledge of advanced traveler and information system to analyze the traffic data
21CIV7052.5	Make use of Automated Highway Systems (AHS) and Integration in Intelligent Transportation System
21CIV7052.6	Comprehend the case studies related to ITS implementations in developing and developed countries.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Intelligent Transportation Systems	R Shrinivas Kumar	Orient Blackswan Pvt Ltd	2nd edition, 2021
2	Intelligent Transportation Systems	Pradip Kumar Sarkar and Amit Kumar Jain	PHI Learning	1st edition, 2018
Reference Books				
1	Highway Engineering	Rangawala	Charotar publishing house pvt.ltd	12th edition, 2022
2	Transportation Engineering	K.P.Subramanium	SciTech Publications, Chennai.	6th edition, 2015

Web links and Video Lectures (e-Resources):
Sustainable transportation system: Sustainable Transportation Systems - Course (nptel.ac.in)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV7052.1	2	2				2								
21CIV7052.2	2	2				2								
21CIV7052.3	2	2				2								
21CIV7052.4	2	2				2								
21CIV7052.5	2	2				2								
21CIV7052.6	2	2				2								

1: Low 2: Medium 3: High

ENVIRONMENTAL PROTECTION AND MANAGEMENT			
Course Code	**21CIV7053**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	Exam Hours	03 hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

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

Module 1 Environmental Management Standards (8 Hours)

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

Module 2 Environmental Standards (8 Hours)

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

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

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

Module 4 Environmental Audit (8 Hours)

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

Module 5 Applications of EMS Audit (8 Hours)

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

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

21CIV7053 .1	Evaluate national policies on environmental protection, pollution abatement, and resource conservation to recommend improvements in existing frameworks.
21CIV7053 .2	Analyze the unique characteristics of environmental problems and apply a systems approach to develop effective corporate environmental management strategies.

21CIV7053 .3	Classify and assess various environmental impact reduction efforts and the principles of the Business Charter for sustainable production and consumption.
21CIV7053 .4	Implement Environmental Management Systems (EMS) such as ISO 14001, focusing on continual improvement, pollution prevention, and compliance with legal requirements.
21CIV7053 .5	Develop and utilize environmental performance indicators and benchmarks to monitor and improve environmental quality and standards.
21CIV7053 .6	Conduct comprehensive environmental audits and waste audits, and devise waste minimization plans tailored to various industries.

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

Web links/Video Lectures/MOOCs/papers

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

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV7053 .1	3						2							2
21CIV7053 .2	2						2							
21CIV7053 .3						3	2							
21CIV7053 .4								2						
21CIV7053 .5							3							
21CIV7053 .6									2			2		

1: Low 2: Medium 3: High

Water Resource Management			
Course Code	**21CIV7054**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

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

Module-1 Surface and Groundwater Resources (8 Hours)

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

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

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

Module-3 Integrated Water Resources Management (8 hours)

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

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

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

Module- 5 Rainwater Harvesting (8 hours)

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

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

Course Outcomes: At the end of the course the student will be able to:	
21CIV7054.1	Assess the potential of groundwater and surface water resources.
21CIV7054.2	Address the issues related to planning and management of water resources.
21CIV7054.3	Understand how to implement Integrated Water Resources Management (IWRM) in different regions.
21CIV7054.4	Comprehend the legal issues of water policy.
21CIV7054.5	Analyze the key elements of rainwater harvesting.
21CIV7054.6	Select the appropriate method for water harvesting based on the area.

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

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

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV7054.1	3	2												
21CIV7054.2			2				2							
21CIV7054.3						2	2							
21CIV7054.4	2							3						
21CIV7054.5				3			2							
21CIV7054.6	2				2									

1: Low 2: Medium 3: High

Technical Seminar			
Course Code	**21CVS706**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE	-
Total Hours	20 hours	Credits	01

Course Learning Objectives:

1. To equip students with the ability to conduct in-depth research, analyze technical literature, and explore contemporary advancements in their field of study.
2. To effectively organize, design, and deliver technical presentations that convey complex information clearly to a diverse audience.
3. To encourage students to critically analyse and evaluate emerging trends, technologies, or methodologies relevant to their chosen seminar topic.
4. To enable students to improve their written and oral communication by preparing well-structured seminar reports and articulating ideas confidently during presentations.
5. To stimulate independent learning and problem-solving abilities by allowing students to explore specific topics of interest, enhancing self-directed research and learning.
6. To prepare students to effectively discuss and defend their technical knowledge in a professional setting, such as viva-voce, aligning with future industry or academic pursuits.

1. Selection of Technical Seminar Topic

- Students should select a technical topic related to their field of study, preferably focusing on recent advancements or emerging technologies. Inter-disciplinary/Multi-disciplinary topics are appreciated.
- Topics must be approved by the seminar coordinator within the first few weeks of the semester.

2 Research and Preparation

- Extensive research should be carried out using credible sources such as research papers, technical journals, books, and online databases.
- A minimum of 10-20 references is recommended, ensuring a mix of primary and secondary sources.

3. Seminar Report

- A detailed report (approximately 20-30 pages) must be prepared, summarizing the research findings and organized in a structured manner.
- The report should include sections like introduction, literature review, methodology, results, discussion, conclusion, and references.
- The report should follow a standard format as prescribed by the Department (font, spacing, citation style, etc.).

4. Oral Presentation

- Students must deliver an oral presentation lasting 15-20 minutes, followed by a question-and-answer session.
- Presentations should be well-structured, with appropriate use of visuals (slides, graphs, diagrams) to clearly convey technical content.
- All presentations must be conducted on scheduled dates, and attendance is mandatory for both presenters and all other students.

5. Question and Answer Session

- After the presentation, students will face a viva-voce where they are required to answer questions posed by the Departmental Seminar Evaluation Committee regarding their seminar topic.
- The viva will test the student's depth of understanding, research analysis, and ability to think critically about the subject matter.

6. Evaluation Criteria
• **Seminar Report**: Clarity, technical depth, comprehensiveness, quality of research, organization, and adherence to format (50 marks). • **Oral Presentation**: Communication skills, visual aids, clarity of content, timing, etc. (25 marks). • **Viva-Voce**: Ability to answer questions effectively, depth of understanding, and analytical skills (25 marks).
7. Submission Deadlines
• The report should be submitted at least one week prior to the scheduled presentation date. • Late submissions will be penalized as per department rules.
8. Plagiarism Check
• All seminar reports must be subjected to plagiarism checking, and the similarity index should be within acceptable limits specified by the Department. • Instances of plagiarism will result in penalties, which could include rejection of the report or a reduction in marks.
9. Mentorship and Feedback
• Students are required to consult with their faculty mentors regularly throughout the preparation phase to seek guidance and feedback. • At least three mentorship meetings should be recorded before the final presentation.
10. Attendance
• Students must attend all seminar sessions conducted by their peers, as it promotes collaborative learning and constructive feedback. • Attendance could be considered for internal evaluation.

Course Outcomes: At the end of the course the student will be able to :	
21CVS706.1	Demonstrate a thorough understanding of a specialized topic by conducting extensive research and presenting technical content effectively.
21CVS706.2	Exhibit proficiency in delivering well-organized and visually supported oral presentations, clearly articulating complex technical ideas to an audience.
21CVS706.3	Apply critical thinking and research methodologies to explore, analyze, and synthesize information from various sources, leading to sound conclusions.
21CVS706.4	Prepare a detailed and well-structured seminar report that adheres to technical writing standards, showcasing the ability to document research findings comprehensively.
21CVS706.5	Respond confidently and competently to questions during the viva-voce, defending the technical work and demonstrating an in-depth understanding of the topic.
21CVS706.6	Engage actively in peer seminars, providing constructive feedback, and reflecting on insights gained from discussions with fellow students and faculty.

Useful Links:
• https://homes.cs.washington.edu/~mernst/advice/giving-talk.html (How to give a technical presentation) • https://learnerbits.com/essential-tips-for-engineering-presentations • https://onlinecourses.nptel.ac.in/noc24_hs175/preview (Technical English for Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVS706.1	-	1	-	3	-	-	-	-	-	2	-	-	-	-
21CVS706.2	-	-	-	-	2	-	-	-	-	3	-	1	-	-
21CVS706.3	-	2	-	3	-	-	-	-	-	-	-	-	-	-
21CVS706.4	-	-	-	-	-	1	-	2	-	3	-	-	-	-
21CVS706.5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
21CVS706.6	-	-	-	-	-	1	-	-	-	3	-	2	-	-

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21CVP707**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:6)	SEE	3 Hrs
Total Hours	60 hours	Credits	05

Course Learning Objectives:

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

1. Project Selection

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

2. Project Proposal

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

3. Project Execution

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

4. Mid-term Review

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

5. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

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

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

7. Evaluation Criteria

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

8. Plagiarism Check

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

9. Mentorship and Feedback

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

10. Post Submission

- **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field.
- **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Project Synopsis Evaluation (Phase I)	Beginning of the 7th Semester	10 marks
2. Project Progress Evaluation	Middle of the 7th Semester	20 marks
3. Project Report Evaluation (Phase II)	End of the 7th Semester	20 marks
Semester End Examinations (SEE)		
4. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		
• When all the Project Objectives are met and the Project Work is successfully completed and final Project Report is submitted as reported by the Department Project Evaluation Committee (DPEC), the CIE and SEE performance of the 7th semester will be carried forward to the 8th semester. There will not be any separate CIE and SEE for such project batches in the 8th semester.		

- In case of any Project Objectives not met, Project Work not completed or final Project Report not submitted, as reported by the DPEC, the CIE and SEE will be conducted in the 7th semester for the completed portion of the Project Work. In such cases, the submission of the Draft Copy of the Project Report is mandatory for evaluation. The remaining part of the project shall be completed during the 8th semester and there will be a CIE and SEE for the Project Work in the 8th semester.

Students are advised to complete the Project Work during the 7th semester and devote the 8th semester for Industry Internship/Research Internship.

Course Outcomes: At the end of the course the student will be able to :	
21CVP707.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21CVP707.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21CVP707.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21CVP707.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21CVP707.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21CVP707.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CVP707.1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21CVP707.2	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21CVP707.3	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21CVP707.4	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**
21CVP707.5	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
21CVP707.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**

1: Low 2: Medium 3: High

VIII Semester

Massive Open Online Course (MOOC)			
Course Code	**21AEC801**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE	3 Hrs
Total Hours	20 hours	Credits	02

Course Learning Objectives:

1. Enable students to acquire a strong foundation in core engineering subjects through high-quality, accessible online resources.
2. Facilitate skill development in specific engineering domains using practical exercises, simulations, and projects offered through the MOOC platform.
3. Encourage students to develop autonomy in learning by navigating and managing their course content, assignments, and assessments independently.
4. Expose students to interdisciplinary concepts and applications, fostering an understanding of how engineering principles integrate with other fields.
5. Provide exposure to global best practices and trends in engineering, allowing students to learn from international faculty and peer collaboration.
6. Develop essential soft skills by participating in discussion forums, group projects, and peer assessments, enhancing communication and teamwork skills.

1. Selection of MOOCs

1.1 Accredited Platforms: Students shall select MOOCs from accredited platforms such as Coursera, edX, SWAYAM/NPTEL, Udacity, or any online learning platform recognized by the respective Engineering Department / Board of Studies (BoS). Engineering Departments with the approval of BoS shall publish a list of MOOCs courses in the beginning of every semester.

1.2 Prerequisites: Students shall ensure that he/she has completed any foundational courses or prerequisites required for the chosen MOOCs.

1.3 Relevant Courses: Students shall choose courses that are relevant to the Student's Engineering discipline and career goals. Students shall NOT opt for the course which is part of their curriculum (I to VIII semester B.E program) and Honors Degree/Minor Degree courses. In case of any overlapping in the contents of the MOOC Course with that in the curriculum or other courses, the maximum permitted overlapping in the course contents (syllabus) is 20-25%.

1.4 Credit Value: Students shall ensure that the selected MOOCs collectively account for 2 credits. Typically, a 2-credit MOOC will require around 20-25 hours of study and a 1-credit MOOC will require 10-12 hours of study.

1.5 Duration of Course: A 4-weeks MOOCs is eligible for 1-credit. Students are advised to enrol for one 8-weeks MOOCs course to earn 2 credits. However, Students can also take two 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied.

2. Approval Process

2.1 Pre-Approval: Students must seek pre-approval from the Department MOOCs Coordinator before enrolling in MOOCs.

2.2 Submission of Proposal: Students can submit a detailed proposal to Department MOOCs Coordinator including the name of the MOOCs, the platforms, course duration, credit value, and relevance to their field of study.

If a Student has already completed any MOOCs course/s from the beginning of the III semester B.E, that satisfies the criteria mentioned in the clause 1. Selection of MOOCs, such course/s can be considered by the Department for credit transfer, provided the student has NOT already claimed the benefit of completing the MOOCs under any assessment in any of the subject.

2.3 Evaluation: The Department will evaluate the proposal for relevance, academic rigor, and credit equivalence and will communicate the decision to the Students.

3. Registration and Enrollment
3.1 Official Enrollment: Students shall register for the approved MOOCs on the respective platforms. **3.2 Documentation:** Students shall keep documentation of registration and course details for future reference and provide the same when asked by the Department.
4. Course Completion
4.1 Active Participation: Students shall engage actively in all course activities including lectures, assignments, quizzes, and discussion forums. **4.2 Completion Certificate:** Students shall obtain a verified certificate of completion for MOOC Course. Free versions without certificates are NOT eligible for credit.
5. Assessment and Evaluation
5.1 Performance Tracking: Students shall maintain records of performance in all assessments throughout the course. **5.2 Final Assessment:** The Department may conduct a final assessment (proctored exam) to ensure that the knowledge gained aligns with the academic standards. This summative assessment (proctored exam) by the Engineering Department is mandatory in the absence of such assessment in the MOOC course/s by the online platform.
6. Credit Transfer
6.1 Submission of Certificates: Students shall submit the completion certificate/s and performance records to the Department MOOCs Coordinator. **6.2 Credit Evaluation:** The Department will evaluate the certificates and performance records to approve the credit transfer. **6.3 Grade Conversion:** College will take care to convert the grades from the MOOCs into the grading system as per established Academic Rules and Regulations.
7. Integration into Academic Record
7.1 Transcript Update: Upon approval, the credits and grades will be integrated into the student's academic transcript. **7.2 Grade Point Average (GPA) Calculation:** The MOOC grades are included in the calculation of the student's GPA.
8. Support and Resources
8.1 Academic Advising: The Department MOOCs Coordinator shall provide guidance and support to the students throughout the process. **8. 2 Technical Support:** The Department MOOCs Coordinator shall ensure that students have access to the necessary technical resources to complete MOOCs courses.
9. Feedback and Improvement
9.1 Student Feedback: Department MOOCs Coordinator shall collect feedback from students on their MOOC experiences to improve future implementations. **9.2 Continuous Improvement:** MOOCs guidelines and processes will be updated based on student feedback, Department feedback and evolving educational standards.

Course Outcomes: At the end of the course the student will be able to :	
21AEC801.1	Students will demonstrate a strong grasp of essential engineering concepts and methodologies relevant to their chosen field.
21AEC801.2	Students will apply engineering knowledge to solve real-world problems through projects and case studies presented in the course.
21AEC801.3	Students will proficiently use online tools and resources, including simulations, interactive modules, and digital libraries, to enhance their learning experience.
21AEC801.4	Students will gain insights into new technologies and innovations within engineering, preparing them to adapt to technological advancements.
21AEC801.5	Students will exhibit improved teamwork and communication skills by engaging in online discussions, group projects, and peer assessments.

21AEC801.6	Students will develop a broader understanding of how engineering intersects with other disciplines and cultural contexts, informed by national/global perspectives gained through the MOOC.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AEC801.1	3	2	-	-	1	-	-	-	-	-	-	-	-	-
21AEC801.2	3	-	2	-	-	-	-	-	-	-	-	2	-	-
21AEC801.3	-	-	-	-	3	-	-	-	-	-	-	2	-	-
21AEC801.4	3	-	-	-	2	-	-	-	-	-	-	1	-	-
21AEC801.5	-	-	-	-	-	-	-	-	2	3	-	1	-	-
21AEC801.6	-	2	-	-	-	2	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

<table>
<tr><th colspan="4">Major Project Work</th></tr>
<tr><td>Course Code</td><td>21CVP802</td><td>CIE Marks</td><td>50</td></tr>
<tr><td rowspan="2">Course Type
(Theory/Practical/Integrated)</td><td rowspan="2">Practical</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Total Marks</td><td>100</td></tr>
<tr><td>Teaching Hours/Week (L:T:P)</td><td>(0:0:2)</td><td>SEE</td><td>3 Hrs</td></tr>
<tr><td>Total Hours</td><td>20 hours</td><td>Credits</td><td>05</td></tr>
<tr><td colspan="4">Course Learning Objectives:
1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.</td></tr>
<tr><td colspan="4">1. Project Execution</td></tr>
<tr><td colspan="4">• Regular Meetings: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
• Documentation: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
• Milestones: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.</td></tr>
<tr><td colspan="4">2. Progress Review</td></tr>
<tr><td colspan="4">• Progress Presentation: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
• Feedback: Provide constructive feedback and guidance to help students refine their projects.</td></tr>
<tr><td colspan="4">3. Final Submission</td></tr>
<tr><td colspan="4">• Report: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
• Code and Data: If applicable, students should submit their code, datasets, and any other relevant materials.</td></tr>
<tr><td colspan="4">4. Project Presentations</td></tr>
<tr><td colspan="4">• Oral Presentation: Students should present their projects to a panel, explaining their work, findings, and contributions.
• Demonstration: If possible, include a live demonstration of the project or show relevant simulations and results.
• Q&A: Be prepared to answer questions from the panel and justify the project’s methodology and conclusions.</td></tr>
<tr><td colspan="4">5. Evaluation Criteria</td></tr>
<tr><td colspan="4">• Originality and Innovation: Assess the novelty and creativity of the project.
• Technical Competence: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
• Project Execution: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
• Presentation and Communication: Judge the clarity and coherence of the final report, presentation, and the ability to answer questions.</td></tr>
</table>

6. Plagiarism Check
• **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources. • **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).
7. Mentorship and Feedback
• **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback. • **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.
8. Post Submission
• **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field. • **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Progress Review	During the 8th semester	25 marks
2. Project Report Evaluation	End of the 8th Semester	25 marks
Semester End Examinations (SEE)		
3. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		

Course Outcomes: At the end of the course the student will be able to :	
21CVP802.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21CVP802.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21CVP802.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21CVP802.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21CVP802.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21CVP802.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CVP802.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
21CVP802.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
21CVP802.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
21CVP802.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
21CVP802.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
21CVP802.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Research Internship

Course Learning Objectives:

1. To equip students with the knowledge of fundamental research principles, methodologies, and techniques applicable to their engineering discipline.
2. To enable students to formulate research questions, design experiments or studies, and use appropriate data collection and analysis tools.
3. To foster the ability to think critically and innovatively while solving complex engineering problems during the research process.
4. To guide students in developing the skills necessary for writing clear and well-structured research reports, papers, and presentations.
5. To instill an understanding of ethical practices in research, including integrity, responsible data handling, and respect for intellectual property.
6. To prepare students to work effectively in research teams, communicate their ideas clearly, and present their findings to both technical and non-technical audiences.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) and the Research Supervisor to understand the research goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, research agreements and confidentiality agreements, if applicable.
3. **Research Proposal:** Develop a research proposal in consultation with the Research Supervisor and academic mentor outlining the objectives, methodology, and expected outcomes.

During the Internship

1. **Work Plan:** Follow a structured research plan provided by the supervising researcher or mentor.
2. **Literature Review:** Conduct a comprehensive literature review to understand the current state of research in the chosen area.
3. **Regular Meetings:** Participate in regular meetings with academic and research mentors to discuss progress, challenges, and next steps.
4. **Lab Work/Field Work:** Engage in experimental work, simulations, or field studies as required by the research project.
5. **Data Collection and Analysis:** Collect, analyze, and interpret data using appropriate tools and techniques.
6. **Documentation:** Maintain detailed records of research activities, experiments, and findings.

Deliverables

1. **Weekly Reports:** Submit weekly progress reports to academic and research mentors.
2. **Monthly Reports:** Submit monthly progress reports to academic and research mentors.
3. **Mid-Term Review:** Participate in a mid-term review meeting to assess progress and realign research goals if necessary.
4. **Report and Research Paper:** Prepare a draft report and a research paper detailing the research problem, methodology, results and discussions, and conclusions.
5. **Presentation:** Deliver a presentation summarizing the research work to faculty, peers, and other stakeholders upon completion of the internship.

Assessment Criteria
1. **Research Quality:** Evaluate the quality and rigor of the research conducted. 2. **Report Quality:** Assess the clarity, organization, and thoroughness of the report and the research paper. 3. **Presentation:** Evaluate the effectiveness and clarity of the final presentation. 4. **Innovation and Creativity:** Consider the originality and innovative aspects of the research. 5. **Self-Reflection:** Review the student's ability to critically reflect on their research experience and identify areas for future growth.
Post-Internship
1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the research experience and areas of improvement. 2. **Publication:** Explore opportunities to publish the research findings in academic journals or conferences. 3. **Networking:** Maintain professional relationships established during the internship for future research collaborations.
Additional Tips
• **Curiosity:** Cultivate a curious mindset and a willingness to explore new ideas. • **Collaboration:** Work collaboratively with other researchers and team members. • **Adaptability:** Be open to modifying research approaches based on findings and feedback. • **Communication:** Develop strong written and oral communication skills to effectively present research findings. • **Time Management:** Prioritize tasks and manage time efficiently to meet research deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (Only OFFLINE)	Will be conducted during the 7th semester BE. Students shall submit the Research Internship Proposal and make a presentation and answer questions raised by the Departmental Internship Evaluation Committee (DIEC). Marks split-up: Research Internship Proposal – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): II (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on progress done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): III (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final internship report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
CIE Marks (Max 100)	Average of the CIE:I , CIE-II and CIE:III marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply appropriate research methodologies and tools to design and conduct experiments, analyze data, and draw conclusions.
21INT803.2	Demonstrate the ability to identify and solve complex engineering problems through innovative and systematic research approaches.
21INT803.3	Acquire proficiency in using advanced technologies, tools, and techniques relevant to their field of research.
21INT803.4	Develop skills in writing comprehensive research reports, documentation, and effectively presenting research findings.
21INT803.5	Understand and apply ethical standards in research, including plagiarism avoidance, proper citations, and data integrity.
21INT803.6	Gain experience in working collaboratively within a research team and contributing effectively to the shared goals of the project.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

3. VTU Mandatory Internship Guidelines 2021.
Available at https://vtu.ac.in/pdf/regulations2021/anex4.pdf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21INT803.1	**1**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.3	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**
21INT803.5	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**	**-**

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Industry Internship

Course Learning Objectives:

1. To develop practical engineering skills through hands-on experience in a real-world industrial environment.
2. To enhance the ability to identify, analyze, and solve complex engineering problems encountered during the internship.
3. To gain an understanding of the functioning of the industry, including exposure to its standards, practices, and emerging technologies.
4. To improve communication, collaboration, and teamwork skills by working with professionals in a multidisciplinary team setting.
5. To foster adaptability by learning to work in dynamic and fast-paced industrial environments while embracing lifelong learning.
6. To instill a sense of professional ethics, responsibility, and accountability in engineering practice by adhering to industry-specific codes of conduct.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) to understand the internship goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, internship agreements if applicable etc.
3. **Goal Setting:** Define specific, measurable, achievable, relevant, and time-bound (SMART) goals in consultation with academic and industry mentors.

During the Internship

1. **Work Plan:** Follow a structured work plan provided by the host organization.
2. **Mentorship:** Regularly meet with assigned industry and academic mentors to review progress and seek guidance.
3. **Work Diary/Daily Report/Learning Diary:** Maintain a diary/logbook documenting daily activities, learnings, challenges, and reflections.
4. **Professional Conduct:** Adhere to the professional and ethical standards of the host organization, including dress code, punctuality, and communication protocols.
5. **Skill Application:** Actively participate in projects and tasks assigned, applying theoretical knowledge to practical situations.

Deliverables

1. **Weekly Reports:** Submit the weekly progress reports to academic and industry mentors.
2. **Monthly Reports:** Submit the monthly progress reports to academic and industry mentors.
3. **Mid-Term Review/Evaluation:** Participate in a mid-term review meeting/evaluation to assess progress and realign goals if necessary.
4. **Final Report:** Prepare a comprehensive final report in the specified format detailing the projects undertaken, skills acquired, challenges faced, and overall learning experience.
5. **Presentation:** Deliver a presentation summarizing the internship experience to faculty evaluators and peers upon completion of the internship.

Assessment Criteria

1. **Performance Evaluation:** Receive feedback from the industry mentor based on work performance, technical skills, and professional behaviour.

2. **Report Quality:** Evaluate the quality, clarity, and comprehensiveness of the final report.
3. **Presentation:** Assess the effectiveness and clarity of the final presentation.
4. **Self-Reflection:** Review the student's ability to critically reflect on their learning experience and identify areas for future growth.

Post-Internship

1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the internship experience and areas of improvement.
2. **Certification:** Obtain an internship completion certificate from the host organization.
3. **Networking:** Maintain professional relationships established during the internship for future opportunities.

Additional Tips

- **Professionalism:** Demonstrate a professional attitude and work ethic at all times.
- **Adaptability:** Be open to learning and adapting to new environments and technologies.
- **Communication:** Develop strong communication skills to effectively collaborate with colleagues and mentors.
- **Time Management:** Prioritize tasks and manage time efficiently to meet deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on work done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
Continuous Internal Evaluation (CIE): II (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
CIE Marks (Max 100)	Average of the CIE:I and CIE:II marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply engineering concepts and theoretical knowledge to solve real-world industry problems.
21INT803.2	Enhance their problem-solving abilities by identifying, analyzing, and providing innovative solutions to engineering challenges in the industry.
21INT803.3	Develop key professional skills such as teamwork, communication, and time management in a corporate or industrial environment.
21INT803.4	Gain exposure to industry-standard tools, technologies, methodologies, and regulatory standards relevant to their field of study.
21INT803.5	Demonstrate understanding and adherence to professional ethics, safety regulations, and responsibilities in an industrial setting.
21INT803.6	Build a network of industry professionals and gain insights into career opportunities, preparing them for future employment in the engineering sector.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

3. VTU Mandatory Internship Guidelines 2021.
Available at https://vtu.ac.in/pdf/regulations2021/anex4.pdf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21INT803.1	3	2	-	-	-	1	-	-	-	-	1	-	-	-
21INT803.2	-	3	2	1	-	-	-	-	-	-	1	-	-	-
21INT803.3	-	-	-	-	-	-	-	-	3	2	-	-	-	-
21INT803.4	-	-	-	-	3	2	-	-	-	-	-	1	-	-
21INT803.5	-	-	-	-	-	2	-	3	-	-	-	-	-	-
21INT803.6	-	-	-	-	-	-	-	-	2	3	-	1	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

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

EXCELLENCE

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

ACCOUNTABILITY

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

CONTINUOUS ADAPTATION

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

COLLABORATION

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

Objectives

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

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi
Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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