Master of Technology

(Construction Technology and Management)

CURRICULUM

(Effective from 2024 - 25 Onwards)

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

TIRUCHIRAPPALLI - 620 015, INDIA.

VISION OF THE INSTITUTE

To be a university globally trusted for technical excellence where learning and research integrate to sustain society and industry.

MISSION OF THE INSTITUTE

To offer undergraduate, postgraduate, doctoral and modular programmes in multi-disciplinary / inter-disciplinary and emerging areas.
To create a converging learning environment to serve a dynamically evolving society.
To promote innovation for sustainable solutions by forging global collaborations with academia and industry in cutting-edge research.
To be an intellectual ecosystem where human capabilities can develop holistically.

VISION OF THE DEPARTMENT

Shaping infrastructure development with societal focus

MISSION OF THE DEPARTMENT

Achieve International Recognition by:
Developing Professional Civil Engineers
Offering Continuing Education
Interacting with Industry with emphasis on R&D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Excel in a professional career and develop research skills in the field of Construction Technology and Management.
PEO2	Exhibit professionalism through lifelong learning and be able to work together in a collaborative manner
PEO3	Graduates will communicate effectively in their team, adapt to emerging trends for sustained growth in independent and reflective learning and exhibit social responsibility and professional ethics.

PROGRAMME OUTCOMES (POs)

PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

CURRICULUM STRUCTURE

M. Tech. (CONSTRUCTION TECHNOLOGY AND MANAGEMENT)

Components	Number of Courses	Credits	Total Credits
Programme Core (PC)	4 in Semester I 3 in Semester II (7 / year)	27	27
Programme Elective (PE)*/	2 PE in Semester I 3 PE in Semester II (5 / year)	15 to 20	21
Open Elective (OE) / Online Course (OC)#@	Based on selection of PE credits	1 to 6	
Essential Laboratory Requirements (ELR)	3 / year	6	6
Internship/Industrial Training/ Academic Attachment (I/A)	1	2	2
Project Phase-I	1	12	12
Project Phase-II	1	12	12
Total	20	80	80

Note:

**** ONLINE COURSES EQUIVALENT TO PROGRAMME ELECTIVES (Optional):***
Out of 5 programme electives, students have the option to study two online courses (Maximum of 1 per semester in the 1st year of Study) equivalent to programme elective courses through NPTEL / Swayam.

 # OPEN ELECTIVES (OE) / ONLINE COURSE (OC) (Compulsory): Students must complete 6 credits between I and IV semester either through online courses of their choice from NPTEL / Swayam (discipline electives / other electives) or through open electives offered by the PG programmes of the institute other than the progamme specialization.

@ MICROCREDITS (Compulsory++/Optional): Students may opt 3 courses of 1 credit (4-week duration) each as microcredits or 2 courses (2 credits (8-week duration) and 1 credit (4-week duration) instead of 1 OE/OC) (++ Depending on selection of credits, either 3 or 4, for PE)

CURRICULUM

SEMESTER I

Code	Course of Study	Credit
CE751	Construction Planning and Control	4
CE753	Contracts and Specifications	4
CE755	Lean Construction Concepts, Tools and Practices	4
CE757	Construction Economics and Finance	3
	Programme Elective I	3 to 4
	Programme Elective II	3 to 4
CE759	Construction Management Software Laboratory	2
		23 to 25

SEMESTER II

Code	Course of Study	Credit
CE752	Construction Quality and Safety Management	4
CE754	Organizational Behaviour	4
CE756	Construction Methods and Equipment	4
	Programme Elective III	3 to 4
	Programme Elective IV	3 to 4
	Programme Elective V	3 to 4
CE758	Construction Engineering and Information Laboratory	2
CE760	Construction Materials Laboratory	2
		25 to 28

SUMMER TERM **(evaluation in the III semester)**

Code	Course of Study	Credit
CE796	Internship / Industrial Training / Academic Attachment (I/A) (6 weeks to 8 weeks)	2

SEMESTER III

Code	Course of Study	Credit
CE797	Project Work (Phase I)	12

SEMESTER IV

Code	Course of Study	Credit
CE798	Project Work (Phase II)	12

OPEN ELECTIVES (OE) / ONLINE COURSE (OC)/ MICROCREDITS (MC) (Students can opt 3 courses of 1 credit (4 weeks) each as microcredits instead of 1 OE/OC)

Code	Course of Study	Credit
	# (To be completed between I to IV semester)	1 to 6

PROGRAMME ELCTIVES (PE)

Sl. No.	Code	Course of Study	Credit
1.	CE761	Modern Construction Materials	3
2.	CE762	Functional Efficiency of Buildings	3
3.	CE763	Disaster Mitigation and Management	3
4.	CE764	Construction Supply Chain Management	3
5.	CE765	Planning of Prefabricated Structures	3
6.	CE766	Safety in Material Handling at Construction	3
7.	CE767	Non Destructive Evaluation	3
8.	CE768	Value Engineering	3
9.	CE769	Quantitative Methods in Construction Management	3
10.	CE770	Formwork Design	3
11.	CE771	Construction Personnel Management	3
12.	CE772	Project Risk Analysis and Management Techniques	3
13.	CE773	Strategic Management in Construction	3
14.	CE774	Infrastructure Planning and Management	3
15.	CE775	Sustainable Construction	3
16.	CE776	Construction Project Modelling	3
17.	CE777	Smart Buildings	3
18.	CE778	Soft Computing Techniques in Civil Engineering	3
19.	CE779	Estimation and Quantity Surveying	3
20.	CE780	Urban Water Infrastructure	3

OPEN ELECTIVES (OE) (List some courses from Programme Electives, that will be Open Electives for other Specialization, if it is offered as Programme Elective for the respective specialization)

Sl. No.	Code	Course of Study	Credit
1.	CE769	Quantitative Methods in Construction Management	3
2.	CE772	Project Risk Analysis and Management Techniques	3
3.	CE773	Strategic Management in Construction	3
4.	CE774	Infrastructure Planning and Management	3
5.	CE777	Smart Buildings	3

6.	CE778	Soft Computing Techniques in Civil Engineering	3
7.	CE779	Estimation and Quantity Surveying	3

COURSES FROM OTHER SPECIALIZATION/DEPARTMENTS (To be offered as program elective)

Sl. No.	Code	Course of Study	Credit
TRANSPORTATION ENGINEERING AND MANAGEMENT			
1.	CE601	Highway Traffic Analysis and Design	4
2.	CE603	Pavement Analysis and Design	4
3.	CE604	Transportation Planning	4
4.	CE606	Pavement Construction and Maintenance	4
5.	CE619	Intelligent Transportation Systems	3
6.	CE621	Geospatial Techniques	3
7.	CE624	Urban Planning Techniques and Practices	3
STRUCTURAL ENGINEERING			
1.	CE667	Forensic Engineering and Rehabilitation of Structures	3
2.	CE678	Advanced Concrete Technology	3
3.	CE689	Hydraulic Structures	3
ENVIRONMENTAL ENGINEERING			
1.	CE701	Environmental Process Chemistry and Microbiology	4
2.	CE702	Biological Process Design for Wastewater Treatment	4
3.	CE703	Physico-chemical Processes for Water and Wastewater Treatment	4
4.	CE711	Transport of Water and Wastewater	3
5.	CE712	Membrane Technologies for Water and Wastewater Treatment	3
6.	CE713	Industrial Wastewater Management	3
GEOTECHNICAL ENGINEERING			
1.	CE815	Ground Improvement Techniques	3
2.	CE816	Analysis of Deep Foundation	3
3.	CE818	Marine Foundation Engineering	3
4.	CE820	Geotechnical Constitutive Modelling	3
5.	CE826	Geosynthetics Engineering	3

6.	CE829	Ports and Harbour Structures	3
ENERGY AND ENVIRONMENT			
1.	EN620	Energy Efficient Buildings	3
2.	EN636	Smart Grid Systems	3
ELECTRICAL AND ELECTRONICS ENGINEERING			
1.	EE662	High Voltage DC Transmission	3
2.	EE671	Fuzzy Logic Control Systems	3
3.	EE673	Renewable Power Generation Technologies	3
4.	EE680	Smart Grid Technologies	3
5.	EE684	Distributed Generation and Micro-Grids	3
6.	EE703	E-Vehicle Technology and Mobility	3

COURSE OUTCOME AND PROGRAMME OUTCOME MAPPING

PROGRAMME CORE (PC)

Course Outcomes: On successful completion of the course, students will be able to:

Course Code	Course Title	CO	Course outcomes At the end of the course student will be able	PO 1	PO 2	PO 3
CE751	Construction Planning and Control	CO1	Explain different organizational structures with emphasis on project and matrix structures.	1	2	3
		CO2	Describe the project life cycle and create project feasibility reports considering socio-techno-economic-environmental impacts.	3	3	3
		CO3	Outline project clearance procedures and necessary documentation for major works.	2	3	2
		CO4	Define the roles and responsibilities of project managers and project management consultants.	1	2	3
		CO5	Apply various scheduling techniques including Gantt charts, CPM, PERT, PDM, and RPM.	3	2	3
CE752	Construction Quality and Safety Management	CO1	Explain the importance of quality in construction and its planning and control during structural design.	2	2	3
		CO2	Implement quality assurance procedures during construction, including material quality assurance.	3	2	3
		CO3	Develop quality manuals, checklists, and inspection reports for construction projects.	2	3	3
		CO4	Design and implement comprehensive safety programs, including safety committees, training, incentives, and monitoring, inspection reports for construction operations	2	3	3

		CO5	Assess and gain the ability to apply sustainability principles, practices and standards in construction	2	2	3
CE753	Contracts and Specifications	CO1	Formulate winning bidding strategies to secure contracts in the competitive construction market	2	1	3
		CO2	Navigate various types of tenders and applications with proficiency; evaluate and select qualified bidders based on defined criteria	3	2	3
		CO3	Interpret and navigate both owner's and contractor's estimates for effective project planning	3	1	3
		CO4	Adhere to construction specifications, ensuring quality workmanship and material usage.	2	2	2
		CO5	Manage contractual aspects, claims, and disputes using appropriate dispute resolution techniques	3	2	3
CE754	Organizational Behaviour	CO1	Comprehend the nuances of various organization structure and design, and its implications	2	2	3
		CO2	Understanding the individual differences and gain the ability to manage people at workplace	2	1	3
		CO3	Assess the significance of group behaviour in determining the organizational performance	3	2	3
		CO4	Analyze the key facets of conflict by demarcating the functional and dysfunctional aspects of workplace conflict	3	2	3
		CO5	Apply the organizational development interventions for facilitating the implementation of organizational change	3	2	3
CE755	Lean Construction Concepts,	CO1	Understand the importance of lean thinking and its application in construction work processes	2	1	3

	Tools and Practices	CO2	Comprehend the various factors affecting construction productivity and analyse the approaches for productivity improvement in project sites	2	2	3
		CO3	Apply various lean construction tools and report their usefulness in improving the performance of projects	3	3	3
		CO4	Assess the challenges in the implementation of lean construction and report the challenges to project managers and organisation leaders	2	2	3
		CO5	Comprehend lean concepts in design and supply chain management and learn the implementation challenges of integrated project delivery	2	1	3
CE756	Construction Methods and Equipment	CO1	Apply advanced construction methods with a focus on safety and material expertise	2	1	3
		CO2	Successfully plan, design, and execute projects with innovation and safety integration	3	1	3
		CO3	Analyse construction equipment characteristics, maximizing production outputs and cost efficiency	3	2	2
		CO4	Optimize equipment management, costing, and utilization with effective documentation	3	1	3
		CO5	Demonstrate precision in erecting diverse structures, overcoming challenges in various construction methods	3	2	3
CE757	Construction Economics and Finance	CO1	To know the economic theory and concepts applied in the execution of construction projects.	2	1	3
		CO2	To examine the importance of time value of money and its impact on selection of suitable construction projects.	3	2	3

		CO3	To perform basic analysis of financial statements and write a report on the financial performance, conditions and effectiveness of the firm	3	3	3
		CO4	To analyse and evaluate construction projects using costing methods	3	2	3
		CO5	To analyse the working capital requirement and financial control over the execution of construction projects.	3	2	3

LABORATORY

Course Code	Course Title	CO	Course Outcomes At the end of the course student will be able	PO1	PO2	PO3
CE758	Construction Engineering and Information Laboratory	CO1	Apply deterministic and probabilistic inventory models to construction management scenarios.	3	2	3
		CO2	Utilize software applications for inventory management in construction projects	2	2	3
		CO3	Explain the core concepts and benefits of Building Information Modelling (BIM) in construction	2	3	3
		CO4	Perform model-based cost estimating and 4D construction scheduling using BIM tools	3	2	3
		CO5	Apply BIM principles to design coordination and field implementation	3	2	3
CE759	Construction Management Software Laboratory	CO1	Introduction to cost estimation principles. Utilizing specialized software for accurate cost predictions	2	2	3
		CO2	Spreadsheet fundamentals. Advanced features for data analysis and decision-making in construction	3	2	3

		CO3	Importance of data organization in construction. Application of database tools for efficient project data management	2	2	3
		CO4	Overview of project management software. Hands-on application for project planning and control	2	1	3
		CO5	Principles of network analysis, Application of CPM and PERT for effective project scheduling	3	2	3
CE760	Construction Materials Laboratory	CO1	Analyze and evaluate the properties of building materials	3	2	3
		CO2	Apply standard testing methods and specifications to assess building material strength and other properties	3	2	3
		CO3	Design and test concrete mixes for specific construction requirements	3	2	3
		CO4	Utilize non-destructive testing methods to assess building material integrity	3	2	3
		CO5	Analyze and evaluate simple building system components	3	2	3

PROGRAMME ELECTIVES (PE)

Course Code	Course Title	CO	Course Outcomes At the end of the course student will be able	PO 1	PO 2	PO 3
CE761	Modern Construction Materials	CO1	Assess and select appropriate aggregate types for specific construction projects, considering factors such as weight, strength, and sustainability.	3	2	3
		CO2	Design fiber-reinforced concrete mixes tailored to specific structural requirements, optimizing mechanical and physical properties.	3	2	3

		CO3	Formulate and specify special concrete mixes for advanced construction applications, demonstrating an understanding of their unique properties and benefits.	3	2	3
		CO4	Propose and justify steel construction solutions for various projects, considering structural efficiency and construction methods.	3	2	3
		CO5	Integrate advanced materials into construction designs, with a particular emphasis on polymer-based products and environmentally friendly alternatives.	3	3	3
CE762	Functional Efficiency of Building	CO1	Apply environmental control strategies in building design	3	2	3
		CO2	Analyze and respond to climatic factors in architectural design	3	2	3
		CO3	Assess and optimize thermal performance of buildings	3	2	3
		CO4	Design buildings for acoustic comfort and noise control	3	2	3
		CO5	Evaluate and implement sustainable building practices	3	2	3
CE763	Disaster Mitigation and Management	CO1	Understand the necessity of disaster management measures and tools.	2	2	3
		CO2	Get a sound knowledge on the technology involved in disaster management planning and mapping.	3	2	3
		CO3	Acquire knowledge on the various mitigation measures.	2	2	3
		CO4	Understand the effect role of communication and its effectiveness in the disaster preparedness and mitigation activity	2	3	3
		CO5	Gain knowledge to develop the technical and technological measures that aid in the prevention and mitigation of disasters	3	2	3

CE764	Construction Supply Chain Management	CO1	Understand the importance of construction supply chain in the overall construction business for its better performance	2	1	3
		CO2	Learn the various sourcing decisions in a supply chain and analyse their pricing and risk management strategies	2	1	3
		CO3	Comprehend different construction supply chain configurations and assess their application in real-time projects	3	2	3
		CO4	Analyse supply chain logistics challenges and write reports to devise solutions for effective supply chain management	3	3	3
		CO5	Apply construction supply chain concepts in the context of sustainable development	3	1	3
CE765	Planning of Prefabricated Structures	CO1	Analyze and compare different prefabrication systems and structural schemes	3	2	3
		CO2	Plan and organize prefabricated structure production processes	2	2	3
		CO3	Apply dimensional tolerances and erection techniques in prefabricated construction	2	2	3
		CO4	Develop planning and erection methodologies for specific prefabricated structure types	3	2	3
		CO5	Evaluate real-world applications of prefabricated construction through case studies	3	3	3
CE766	Safety in Material Handling at Construction	CO1	Recognize the practical solutions to eliminate and/or minimize hazards in manual material handling	3	2	3
		CO2	Recognise the different types of existing hazards at construction site	2	2	3

		CO3	Disseminate the basic safety concepts and techniques in mechanical material handling equipments like cranes, forklifts, trucks, etc	2	3	3
		CO4	Recognise the safe use, inspection and maintenance of chains, links, etc.	2	2	3
		CO5	Demonstrate the importance for improving health & safety in construction	2	3	3
CE767	Non Destructive Evaluation	CO1	Select appropriate NDT methods for flaw detection on the material surface.	3	2	3
		CO2	Use the various testing methods for understanding the internal defects of Engineering materials.	3	2	3
		CO3	Perform Non-destructive examination of weldments	3	2	3
		CO4	Acquire the knowledge to identify strengths and weaknesses in materials used in fabrication.	2	2	3
		CO5	Utilize different NDT techniques to realize the defects and characterization of bulk materials especially concretes, etc. and also pipelines.	3	2	3
CE768	Value Engineering	CO1	Apply value analysis principles to improve project outcomes	3	2	3
		CO2	Perform life cycle costing analysis for project selection and total value management	3	2	3
		CO3	Implement various value engineering methods in project management	3	2	3
		CO4	Navigate through the phases of value engineering to optimize project value	3	2	3
		CO5	Integrate reliability estimation into value engineering decisions	3	2	3

CE769	Quantitative Methods in Construction Management	CO1	Utilize various optimization techniques in engineering planning, design, and construction contexts	3	2	2
		CO2	Formulate and solve linear optimization models	3	1	2
		CO3	Apply approximation methods to solve transportation problems in construction projects	3	1	2
		CO4	Utilize decision theory, queuing theory, games theory, and Monte Carlo simulation to analyze and solve complex construction management problems	3	1	2
		CO5	Utilize decision theory, queuing theory, games theory, and Monte Carlo simulation to analyze and solve complex construction management problems	3	2	2
CE770	Formwork Design	CO1	Analyze and select appropriate formwork and falsework systems for construction projects.	3	2	3
		CO2	Design timber and steel formwork systems considering concrete pressure	3	2	3
		CO3	Design and evaluate deck and falsework systems for various construction scenarios	3	2	3
		CO4	Apply special formwork systems to complex construction projects	3	2	3
		CO5	Implement safe and efficient formwork and falsework practices in construction	2	2	3
CE771	Construction Personnel Management	CO1	To understand the elements of personnel management and role of a personnel manager	2	2	3
		CO2	To apply the best Personnel management and Human Resource practices	3	2	3
		CO3	To design and develop employee recruitment and selection strategies	3	2	3

		CO4	To develop a tool kit for talent management and competency of the workforce	3	3	3
		CO5	To design the communication and crisis management strategies	3	3	3
CE772	Project Risk Analysis and Management Techniques	CO1	Understand and appreciate the importance of project uncertainties and risks in the context of construction projects and businesses	2	1	3
		CO2	Learn and apply the various risk management frameworks, risk identification and assessment tools, and devise risk management strategies in the context of construction projects	3	3	3
		CO3	Comprehend the role of key stakeholders in the context of construction project risk management	2	2	3
		CO4	Analyse and report the challenges in the development of risk management culture in construction projects and organisations	3	3	3
		CO5	Learn and assess the effective usage of various internal and external project risk coverage tools and policies	2	1	2
CE773	Strategic Management in Construction	CO1	Understand the concepts related to strategy management in construction projects and businesses	2	1	2
		CO2	Examine and apply strategy management frameworks and models in the context of construction organisations and megaprojects	3	2	3
		CO3	Comprehend and assess the role of different internal and external stakeholders in the context of construction strategy management	3	2	3

		CO4	Analyse and report the challenges in the implementation of strategy management models for use in the construction industry	3	3	3
		CO5	Learn and assess the role of strategy management evaluation and control and report strategy audits in construction organisations	2	2	2
CE774	Infrastructure Planning and Management	CO1	Understand how infrastructure projects are conceptualised and planned, and appreciate the key project lifecycle phases	1	1	3
		CO2	Learn and apply the concepts related to economics and financing aspects of infrastructure projects	2	1	3
		CO3	Comprehend and assess the use of various risk management processes and practices in the context of infrastructure projects	2	1	3
		CO4	Examine and report the role of various internal and external stakeholders and their management strategies in the context of infrastructure projects	3	3	3
		CO5	Learn and appreciate the evolution of new contract management models and technological advancements in the context of infrastructure projects	2	1	2
CE775	Sustainable Construction	CO1	Comprehend and appreciate why sustainable construction is important for the present and future economies	2	1	3
		CO2	Learn and apply concepts related to lifecycle energy use in buildings and methods to reduce it	3	3	3
		CO3	Assess and apply life cycle assessment (LCA) techniques and software tools in the context of building construction	3	3	3

		CO4	Examine emissions and report parameters that influence emissions in building construction	2	2	3
		CO5	Learn and appreciate the use of various green building ratings in International and Indian contexts and social aspects of sustainability in the construction industry	2	1	2
CE776	Construction Project Modelling	CO1	Understand the basics of construction project modelling and types of models available in the construction context	2	1	3
		CO2	Learn and apply concepts and tools related to schedule network modelling to optimise the schedule of projects	3	1	3
		CO3	Comprehend the relationship between time and cost in projects and apply concepts and related to management of time and cost in projects	3	2	3
		CO4	Examine and apply various linear programming techniques and sequencing methods in the context of construction projects	3	2	3
		CO5	Examine and apply transportation and assignment technique to minimize the project cost	3	1	3
CE777	Smart Buildings	CO1	Understand the terminologies around smart buildings and appreciate the need for smart buildings	2	1	2
		CO2	Comprehend and learn concepts related to building automation hardware and software and their application in smart buildings	2	1	3
		CO3	Examine and apply lighting control applications in the context of smart buildings	3	1	3
		CO4	Examine and apply air conditioning and related applications in the context of smart buildings	3	1	3

		CO5	Assess and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems	3	2	3
CE778	Soft Computing Techniques in Civil Engineering	CO1	Understand and appreciate the basics concepts related to soft computing techniques and the need for soft computing techniques	2	1	3
		CO2	Learn and apply concepts related to genetic algorithms in the context of construction project management	3	2	3
		CO3	Comprehend and apply concepts related to fuzzy logic and its application in the context of construction project management	3	2	3
		CO4	Assess and apply concepts related to artificial neural networks in the context of construction project management	3	1	3
		CO5	Examine and apply concepts related to hybrid systems in the context of construction project management	3	1	3
CE779	Estimation and Quantity Surveying	CO1	Understand and appreciate the application of economics and finance concepts in the management of construction projects	3	1	3
		CO2	Apply estimation techniques related to quantity estimation of key construction activities and derived quantities from engineering drawings	2	3	3
		CO3	Apply estimation techniques related to the estimation of key project resources and arrive at a rate analysis by estimating the required labour, material and plant and machinery (LMP)	2	3	3
		CO4	Comprehend and apply various costing models for the optimisation of project costs	2	1	2

		CO5	Examine and apply concepts related to the valuation of buildings and structures	3	2	3
CE780	Urban Water Infrastructure	CO1	Examine the trends, causes, and socioeconomic effects of urbanization in India.	3	2	3
		CO2	Analyse the components of urban water infrastructure including design, operation and suitable technological applications	3	2	3
		CO3	Interpret water supply network scenarios, National Water Policy, water rights and privatization of water supply.	3	3	3
		CO4	Develop plans for urban sewerage systems involving development scenarios and sewer system types.	3	3	3
		CO5	Propose innovative solutions for urban water infrastructure challenges by understanding various case studies.	3	3	3

3 - High; 2 - Medium; 1 - Low

PROGRAMME CORE

SEMESTER I

Course Code	:	CE751
Course Title	:	**Construction Planning and Control**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	Understand fundamental project management concepts and organizational structures.
CLO2	Learn various project scheduling techniques and their applications.
CLO3	Develop skills in project control, resource planning, and optimization.
CLO4	Gain knowledge of performance measurement and earned value analysis.
CLO5	Explore real-time applications in project management.

Course Content

Project Management: Basic forms of organization with emphasis on Project and matrix structures; project life cycle, planning for achieving time, cost, quality, project feasibility reports based on socio-techno-economic-environmental impact analysis, project clearance procedures and necessary documentation for major works like dams, multistoried structures, ports, tunnels, Qualities, role and responsibilities of project Manager, Role of Project Management Consultants, Web based project management.

Project Scheduling - Non-Networking Techniques: Gantt-Chart, Networking Techniques: Formulation and Applications of Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT), Precedence Diagram Method (PDM), RPM (Repetitive Project Modeling) techniques. Linear Scheduling, LOB technique, Mass haul diagrams.

Project Control - Man-Material-Machine-money optimization, scheduling, monitoring, updating. Resource Planning - Resource Constrained Scheduling, Resource Levelling. Time- cost trade offs - Network crashing
Performance Measurement, Earned Value, Multiple Construction Projects, Real time Applications

References

1.	Project Management for Engineering and Construction, GD. Oberlender, McGraw- Hill, 3rd Edition, 2014.
2.	Construction Project Management, SK. Sears, GA. Sears, RH. Clough, John Wiley and Sons, 6th Edition, 2016.

3.	Construction Project Scheduling, Callaghan, MT., Quackenbush, DG. and Rowings, JE., McGraw-Hill, 1992.
4.	A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Sixth Edition, An American National Standard, 2018
5.	Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019
6.	Jerome D. Wiest and Ferdinand K. Levy, "A Management Guide to PERT/CPM", Prentice Hall of India Publishers Ltd., New Delhi, 2012.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Explain different organizational structures with emphasis on project and matrix structures.
CO2	Describe the project life cycle and create project feasibility reports considering socio-techno-economic-environmental impacts.
CO3	Outline project clearance procedures and necessary documentation for major works.
CO4	Define the roles and responsibilities of project managers and project management consultants.
CO5	Apply various scheduling techniques including Gantt charts, CPM, PERT, PDM, and RPM.

Course Code	:	CE753
Course Title	:	**Contracts and Specifications**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	Interpret and navigate both owner's and contractor's estimates for effective project planning and negotiation
CLO2	Formulate competitive bidding models and strategies to secure contracts in the competitive construction market.
CLO3	Adhere to construction specifications to ensure the use of appropriate materials and maintain high standards of workmanship
CLO4	Navigate various types of tenders and applications to participate effectively in the tendering process
CLO5	Manage contractual aspects, including different contract types (e.g., FIDIC), contract claims, compensation issues, delays, and disputes, using appropriate resolution techniques.

Course Content

Project cost estimation, rate analysis, overhead charges, bidding models and bidding strategies. Qualification of bidders, Owner's and contractor's estimate. Construction specifications - standard specifications, development, interpretation, GST calculations.

Comprehensive study of different types of Tenders, Applications to various works

Type of contracts, International Contracts, FIDIC, Indian Contract Act 1872, Problems in the operation of contracts Claims, compensation and disputes, Dispute resolution Techniques, Delay analysis

Risk management, risk identification techniques, risk analysis - overview of quantitative & qualitative techniques, pre-bid, execution and post-execution risk analysis, contractual risk implications

Arbitration and Conciliation Act 1996, Arbitration case studies, Joint Ventures (JVs), Consortium, and other contemporary contract models - partnering, relational contracting,

Professional practices, ethics, duties and responsibilities, Management Information systems, Case studies

References

1.	BJ. Vasavada, "Engineering Contracts and Arbitration", Jubilee Publications, 1996.
2.	Dr. Vandana Bhatt and Pinky Vyas :- Laws for Engineers (Contract, Arbitration, Evidence, Limitation), 2015
3.	Gajria, G. T., Law Relating to Building and Engineering Contracts in India, 4th Edition, N. M. Tripathi Pvt. Ltd., Mumbai, 2000.
4.	Hinze, J., Construction Contracts. Third Edition, McGraw Hill, 2013.
5.	Sweet J., and Schneier, M.C., Legal Aspects of Architecture, Engineering and the Construction Process, 9th Edition, Thomson, Toronto, Canada, 2012.
6.	FIDIC Contract Documents including: Conditions of Contract for Construction - Red Book 2nd Edition, 2013; Short Form of Contract; Conditions of Contract for EPC Turnkey Projects.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Formulate winning bidding strategies to secure contracts in the competitive construction market
CO2	Navigate various types of tenders and applications with proficiency. Evaluate and select qualified bidders based on defined criteria

CO3	Interpret and navigate both owner's and contractor's estimates for effective project planning.
CO4	Adhere to construction specifications, ensuring quality workmanship and material usage.
CO5	Manage contractual aspects, claims, and disputes using appropriate dispute resolution techniques

Course Code	:	CE755
Course Title	:	**Lean Construction Concepts, Tools and Practices**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45 Hours
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To develop a basic understanding of lean thinking and its application to the construction work processes
CLO2	To understand various factors affecting construction productivity and analyse the approaches for productivity improvement in project sites
CLO3	To learn various lean construction tools and how it is applied at project sites
CLO4	To analyse the implementation challenges of lean construction through case studies
CLO5	To comprehend lean concepts in design and supply chain management and learn the implementation challenges of integrated project delivery

Course Content

Overview and introduction to lean thinking, Manufacturing vs construction supply chains, Introduction to waste and value, Types of waste, Total Quality Management, Six Sigma.

Productivity measurement and improvement, construction productivity, factors affecting construction productivity, productivity improvement approach.

Lean tools in construction – Work sampling, Value stream mapping, Foreman delay surveys, Crew balance chart, 5S, Last Planner System, Big room approach and Secondary lean tools.

Training and implementation of lean construction in project sites and organisations, Challenges in lean implementation and sustenance, Lean implementation case studies, Lean culture.

Overview of lean in design and supply chain management, Integrated project delivery strategy, Continuous improvement.

References

1	Tzortzopoulos, P., Kagioglou, M., and Koskela, L. (Eds.). (2020). Lean construction: Core concepts and new frontiers. Routledge.
2	Rubrich, L. (2012). An introduction to lean construction: Applying lean to construction organizations and processes. WCM Associates LLC.
3	Forbes, L. H., and Ahmed, S. M. (2010). Modern construction: lean project delivery and integrated practices. CRC press.

Course Outcomes (CO)

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

CO1	Understand the importance of lean thinking and its application in construction work processes
CO2	Comprehend the various factors affecting construction productivity and analyse the approaches for productivity improvement in project sites
CO3	Apply various lean construction tools and report their usefulness in improving the performance of projects
CO4	Assess the challenges in the implementation of lean construction and report the challenges to project managers and organisation leaders
CO5	Comprehend lean concepts in design and supply chain management and learn the implementation challenges of integrated project delivery

Course Code	:	CE757
Course Title	:	**Construction Economics and Finance**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To bring about an exposure to construction economics, financing and accounting methods and their usefulness in controlling construction projects.
CLO2	To analyse and evaluate the projects using investment appraisal techniques base time value of money.
CLO3	To understand the accounting methods and financial statement analysis in of construction firms.
CLO4	To know about various analysis on costing methods used in selecting construction projects
CLO5	To understand the working capital management and financial control of construction firms.

Course Content

Construction economics – Basic Principles – concept of time value of money - cash flow diagram - Single payment now compared to a single payment in future (F/P) - Future payment compared to a uniform series of payments (F/A) - one present payment compared to a uniform series of payments (A/P) - arithmetic Gradient G, Geometric gradient.

Financial Returns analysis - Comparing Alternatives - Present Worth Method-Annual payments method- Future worth methods, Rate of Return (ROR), Incremental Rate of Return (IROR), Break even comparisons, Cost Benefit analysis.

Accounting methods - Depreciation accounting, meaning- types of Depreciation-methods of calculating depreciation, income tax accounting, Tax on impact on depreciation and cash flows- Inflation accounting methods.

Construction costing - Methods of construction costing- percentage completion method – Fixed contract Pricing- cost plus pricing- Escalation clause- Sources of Finance, Infrastructure financing; Life-cycle costing, Construction cost control; Personnel costs; Equipment costs, Job in directs and markup

Analysis Financial Statements - Balance sheet and Profit and Loss accounts – ratios analysis, Working Capital Management, Financial Control - Management accounting;

References

1.	Blank, L.T., and Tarquin,a.J (1988) Engineering Economy,4thEdn. Mc-Graw Hill Book Co
2.	Collier C and GlaGola C (1998) Engineering Economics and Cost Analysis, 3ndEdn. Addison Wesley Education Publishers
3.	Patel, B M (2000) Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi
4.	Steiner, H.M. (1996) Engineering Economic principles, 2ndEdn. Mc-Graw Hill Book Co.
5.	Pandey, I.M (2021) Financial Management 12th edition. Pearson India Education Services Pvt. Ltd.

Course Outcomes (CO)

At the end of the course student will be able

CO1	To know the economic theory and concepts applied in the execution of construction projects.
CO2	To examine the importance of time value of money and its impact on selection of suitable construction projects.
CO3	To perform basic analysis of financial statements and write a report on the financial performance, conditions and effectiveness of the firm
CO4	To analyse and evaluate construction projects using costing methods.

CO5	To analyse the working capital requirement and financial control over the execution of construction projects.

Course Code	:	CE759
Course Title	:	**Construction Management Software Laboratory**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	Utilize specialized software for accurate cost estimation and budgeting in construction projects.
CLO2	Manage construction project data efficiently through database applications, ensuring easy retrieval and organization.
CLO3	Understand the principles of network analysis, critical path methods (CPM), and program evaluation and review technique (PERT) for optimized project scheduling
CLO4	Explore simulation and optimization tools for scenario testing, risk analysis, and resource optimization in construction management.
CLO5	Apply linear programming models to solve construction problems, optimizing resource allocation and decision-making.

Course Content

Computer aided Cost Estimation, Spreadsheet, Database applications, Project management software - Network preparation and computations, Scheduling and allocation, Simulation and Optimization Software etc., application of L.P. in construction problem - Construction applications

References

1.	Kenneth C Laudon and Jane Price Laudon, Management Information Systems Organization and Technology, Prentice Hall, 1996
2.	Vinayagam P, Vimala A, Planning and Managing Projects with PRIMAVERA (P6) Project Planner, I K International Publishing House Pvt. Ltd, 2017.
3.	Kathy Schwalbe, Information Technology Project Management, CENGAGE Learning Custom Publishing; 6th Revised ed. Edition, 2010.
4.	Paul E, Harris, Planning and Control Using Microsoft Project 2013, 2016 and 2019, Eastwood Harris Pty Ltd, 2019.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Introduction to cost estimation principles. Utilizing specialized software for accurate cost predictions
CO2	Spreadsheet fundamentals. Advanced features for data analysis and decision-making in construction
CO3	Importance of data organization in construction. Application of database tools for efficient project data management
CO4	Overview of project management software. Hands-on application for project planning and control
CO5	Principles of network analysis, Application of CPM and PERT for effective project scheduling

SEMESTER II

Course Code	:	CE752
Course Title	:	**Construction Quality and Safety Management**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	Understand the principles of quality management in construction.
CLO2	Learn about quality assurance and control processes during design and construction phases.
CLO3	Explore quality standards, codes, and international quality management systems
CLO4	Comprehend the concepts of construction safety management, study safety programs, procedures, and legal requirements in construction
CLO5	Comprehend sustainability principles, practices and standards to put in use in construction

Course Content

Construction Quality Management - Introduction to quality. Planning and control of quality during design of structures. Quality assurance during construction. Material Quality Assurance; Specifications and Tolerances - Inspection of materials and machinery. Preparation of quality manuals, checklist and inspection report. Establishing a quality assurance system. Quality standards/codes in design and construction. Total quality management concepts; ISO 9000 family of standards; QA/QC systems and organizations, Quality Audits; Problem solving techniques; Statistical Quality Control; Quality Function Deployment.

Construction Safety Management - Concept of safety. Factors affecting safety: Physiological, Psychological and Technological. Roles, duties and responsibilities of workers, Supervisors, Managers and Owners, safety program components - safety committee, safety training, incentives and monitoring. ISO 45001 standard for health and safety at work - Safety Procedures for various construction operations, preparation of safety manuals, safety checklists and inspection reports, safety audits; Safety laws, Labor laws, legal requirement and cost aspects of accidents on site, Incentive for safety practices, Case studies on various construction projects

Introduction and definition of Sustainability, Business Responsibility and Sustainability Reporting (BRSR) guidelines and Reasonable Assurance Audit, Scope 1 and Scope 2 definition, Carbon emission materials and ways of reducing emissions, Fossil fuels (Diesel, petrol, etc based equipment) and Thermal power (Electricity), Green Energy sources, uses and usage in construction works. Energy and Emission intensity, Concept of water neutrality in construction works and ways of reducing water usage, Different types of waste in construction and handling mechanisms including 3Rs,

Overview on SDGs, features of LEED, IGBC and TERI Griha ratings, Performance ratings of green buildings. Zero energy building, Initiatives to achieve carbon and water neutrality in construction operations

References

1.	Jimmy W. Hinze, Construction Safety, Pearson College Division, 2nd Edition, 2013
2.	Richard J Coble, Jimmy W. Hinze and Theo C Haupt, Construction Safety and Health Management, Pearson, 2000
3.	John L Ashford, The Management of Quality in Construction, Routledge, 1st edition, 2002.
4.	Juran Frank, J.M. and Gryna F.M. Quality Planning and Analysis: From Product Development Through Use (Mcgraw-Hill Series in Industrial Engineering and Management Science) 3rd Edition, 1993.
5.	Grant E.L., and Leavens worth, "Statistical Quality Control", Mc Graw Hill, 1996.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Explain the importance of quality in construction and its planning and control during structural design.
CO2	Implement quality assurance procedures during construction, including material quality assurance.
CO3	Develop quality manuals, checklists, and inspection reports for construction projects.
CO4	Design and implement comprehensive safety programs, including safety committees, training, incentives, and monitoring, inspection reports for construction operations.
CO5	Assess and gain the ability to apply sustainability principles, practices and standards in construction

Course Code	:	CE754
Course Title	:	**Organizational Behaviour**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the significance of various organization structure and design
CLO2	To learn how individuals behave in the context of an organization
CLO3	To comprehend the group behavior and its implications on organizational performance

CLO4	To analyze conflict at the workplace and its impact on the organizational performance
CLO5	To apply the organizational developmental interventions for managing change initiatives

Course Content

Organization - Characteristics of Organizations; Organizational Behaviour – Models of Organizational Behaviour; Organization Structure and Design, Organizational Culture and climate.
Individuals in Organizations – Job attitudes – Personality - Perception – Individual decision-making; Motivation and Behavior – Motivation at Work; Designing motivating jobs

Group Dynamics: Group formation – Types of groups – Group properties - Group decision Making – Communication – Leadership: Styles – theories of leadership and applications - Power and Politics

Functional and Dysfunctional conflict –conflict management strategies – Principles and Tactics of Negotiation- Factors affecting Intergroup Relations and Managing Intergroup Relations

Organizational Change and development - Managing Innovation and Technology in changing environments – Organizational Development Interventions - Case studies of OD interventions in mega-construction projects

References

1.	Rhoden, M and Cato B, Construction Management and Organisational Behaviour, Wiley-Blackwell, 2016 (ISBN: 978-1-118-67481-9)
2.	Stephen P. Robbins, Timothy A. Judge and Neharika Vohra, “Organizational Behaviour”, Pearson, updated 18th edition (2022).
3.	Anderson, D.L, Organization Development: The Process of Leading Organizational Change Sixth Edition, Sage, 2023

Course Outcomes (CO)

At the end of the course student will be able

CO1	Comprehend the nuances of various organization structure and design, and its implications
CO2	Understanding the individual differences and gain the ability to manage people at workplace
CO3	Assess the significance of group behavior in determining the organizational performance
CO4	Analyze the key facets of conflict by demarcating the functional and dysfunctional aspects of workplace conflict
CO5	Apply the organizational development interventions for facilitating the implementation of organizational change

Course Code	:	CE756
Course Title	:	**Construction Methods and Equipment**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To Understand specialized methods for high-rise buildings, emphasizing safety and efficiency.
CLO2	To gain expertise in planning, designing, and executing projects, focusing on safety and innovative methodologies
CLO3	To develop skills in erecting diverse structures, emphasizing precision and efficiency.
CLO4	To explore tunneling methodologies, addressing challenges in execution of the different construction methods.
CLO5	To develop skills in equipment management, costing, and optimization, considering technical and economic aspects

Course Content

Construction Methods - High rise Buildings, Highways, Bridges, Erection of Girders, Underground Utilities, Offshore platforms, Slip form for Chimneys and Cooling Towers, Steel construction-fabrication and erection.

Underground Construction - Tunnel boring machineries, Tunnel-Shaft sinking, Micro Tunneling, Tunnel driving in hard and soft strata, bedding of conduits.

Underwater construction - Problems encountered. Underwater drilling, blasting, Grouting methods in soft and hard soil including Jet grouting and Chemical grouting, Dewatering in shallow and deep excavations using different methods, Vacuum Dewatering and Well point system.

Pile Construction- Piling - Single pile and a group piles (Bored and Driven); driven and cast- in-situ piles, Piles in land and marine structures. Precast piles, prestressed piles, steel piles and friction piles. Methods of pile driving by Vibration and Construction of micro piles, Diaphragm Walls.

CofferDams - Types, construction of single, double wall. Cofferdam. Sheet pile cofferdams, concrete wall movable cofferdam, land cofferdams, soldier construction method. Cofferdam wall by ICOS method. Caissons - Types, box, pneumatic and open caissons, Well foundation

Construction engineering fundamentals- Concrete construction batching, mixing, transport, placement, finishing, formwork, scaffolding.

Construction Equipment Management - Costing, Optimum utilization and Equipment selection - Technical and economical, depreciation, interest on capital, Manpower, Spare parts, Documentation, Log-Books, History Books, Periodical MIS Report.

Construction equipment and machinery- Earthwork, Hoisting and lifting, Material handling, Concreting, Pile driving, dewatering equipment. Characteristics and performances analysis of production outputs and costs

References

1.	Peurifoy, R.L., Schexnayder, J.C., and Shapira, A, Construction Planning, Equipment and Methods, Tata McGraw Hill, New Delhi, Ninth Edition, 2018.
2.	F. Harris, Modern Construction and Ground Engineering Equipment and Method, Prentice Hall 2nd Edition, 1994.
3.	Stephens W. Nunnally, Managing Construction Equipment: Pearson 8th Edition, 2011.
4.	K.N. Jha, Construction Project Management: Theory and Practice, Pearson Education India, 2nd Edition, 2015.
5.	Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2016

Course Outcomes (CO)

At the end of the course student will be able

CO1	Apply advanced construction methods with a focus on safety and material expertise
CO2	Successfully plan, design, and execute projects with innovation and safety integration
CO3	Analyze construction equipment characteristics, maximizing production outputs and cost efficiency
CO4	Optimize equipment management, costing, and utilization with effective documentation
CO5	Demonstrate precision in erecting diverse structures, overcoming challenges in various construction methods.

Course Code	:	CE758
Course Title	:	**Construction Engineering and Information Laboratory**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	Understand deterministic and probabilistic inventory models.
CLO2	Learn software applications for inventory management.
CLO3	Comprehend the fundamentals of Building Information Modeling (BIM).
CLO4	Explore BIM applications in cost estimating and construction scheduling.
CLO5	Study the use of BIM in design coordination and field implementation.

Course Content

Deterministic and Probabilistic Inventory Models - Software applications.

Building Information Modelling (BIM) - Introduction to BIM, Model-based Cost Estimating, Construction Scheduling and 4D Simulation, Design Coordination, BIM to the Field, Artificial Intelligence (AI), Machine Learning (ML) and Digital Construction overview

References

1.	Eastman, C.; Teicholz, P.; Sacks, R.; Liston, K., BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. New York: Wiley, 2011.
2.	Dana K. Smith and Michael Tardif, Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers, John Wiley and sons, Inc., 2009.
3.	Willem Kymmell, Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations. McGraw Hill Construction Series, 2008.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Apply deterministic and probabilistic inventory models to construction management scenarios.
CO2	Utilize software applications for inventory management in construction projects
CO3	Explain the core concepts and benefits of Building Information Modeling (BIM) in construction
CO4	Perform model-based cost estimating and 4D construction scheduling using BIM tools
CO5	Apply BIM principles to design coordination and field implementation

Course Code	:	CE760
Course Title	:	**Construction Materials Laboratory**
Type of Course	:	PC
Prerequisites	:	-
Contact Hours	:	36

Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	Understand the properties of various building materials.
CLO2	Learn testing methods and standard specifications for building materials.
CLO3	Master concrete mix design and testing procedures.
CLO4	Explore non destructive testing methods for building materials.
CLO5	Study simple building system components.

Course Content

Study of properties of building materials; study of testing methods and standard specifications for strength and other properties of building materials; concrete mix design and testing; nondestructive testing methods; Studies on simple building system components.

References

1.	"Building Construction" by B C Punmia and Ashok Kumar Jain
2.	“Building Materials" by S K Duggal
3.	“Building and Construction Materials: Testing and Quality Control (Lab Manual Series)" by M L Gambhir and Neha Jamwal
4.	Applicable Indian Standard Codes

Course Outcomes (CO)

At the end of the course student will be able

CO1	Analyze and evaluate the properties of building materials
CO2	Apply standard testing methods and specifications to assess building material strength and other properties
CO3	Design and test concrete mixes for specific construction requirements
CO4	Utilize non destructive testing methods to assess building material integrity
CO5	Analyze and evaluate simple building system components

PROGRAMME ELECTIVES

Course Code	:	CE761
Course Title	:	**Modern Construction Materials**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understand the properties and applications of various types of aggregates and lightweight aggregate concrete.
CLO2	Analyze the effects of different fiber types on concrete properties and performance.
CLO3	Examine the characteristics and applications of special concrete, including high-strength and self-compacting concrete.
CLO4	Evaluate the role of steel in modern construction, including its types, methods of utilization, and advantages.
CLO5	Explore advanced materials and their applications in the construction industry, with a focus on polymers and sustainable options.

Course Content

Aggregates: Introduction, Historical background of Lightweight aggregate concrete, Artificial aggregates, Physical properties of aggregates, Lightweight aggregate concrete, Applications of lightweight aggregate concrete, Properties of green light weight aggregate concrete, Effect of size aggregate on the strength properties of LWAC made with palm oil shells, Recycled aggregate, Pre placed aggregate concrete. Fibers in Concrete: Types of Fibers - Glass fiber reinforced concrete, Natural fiber reinforced concrete, Polymer Fiber Reinforced Concrete, Steel Fiber reinforced Concrete. Behavior - Workability, Mechanical and Physical properties of Fiber in reinforced concrete.

Special Concretes: High strength concrete, Effect of RHA on the properties of HSC, High performance concrete -applications, Self-Compacting Concrete, Concrete made with waste rubber, Special Concretes, Sulfur Concrete, Ferro cement, Geo synthetics, Nano Concrete, Changes in concrete with respect to time.

Steel construction, Types of steel used for construction, Methods of utilizing steel m construction, Advantages and Applications of steel in construction

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

References

1.	Adam M Neville, Properties of Concrete, 5th Edition, Longman Sc and Tech Publishers, 2012.
2.	Kumar Mehta. P and Paulo J M Monteiro, Concrete Microstructure, Properties and Materials, McGraw Hill, 4th Edition, 2013.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Assess and select appropriate aggregate types for specific construction projects, considering factors such as weight, strength, and sustainability.
CO2	Design fiber-reinforced concrete mixes tailored to specific structural requirements, optimizing mechanical and physical properties.
CO3	Formulate and specify special concrete mixes for advanced construction applications, demonstrating an understanding of their unique properties and benefits.
CO4	Propose and justify steel construction solutions for various projects, considering structural efficiency and construction methods.
CO5	Integrate advanced materials into construction designs, with a particular emphasis on polymer-based products and environmentally friendly alternatives.

Course Code	:	CE762
Course Title	:	**Functional Efficiency of Building**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understand environmental factors affecting building design and performance.
CLO2	Learn principles of climatic design for tropical environments
CLO3	Study thermal performance of buildings and comfort factors
CLO4	Explore acoustics and noise control in building design
CLO5	Comprehend sustainable building practices and rating systems

Course Content

Environmental factors: Solar Control and shading devices, Louvre design; ventilation; introduction to lighting; units of light, color, lamps, luminaries, Day light design of general lighting schemes; Energy management and lighting - codal requirements. GRIHA rating to evaluate the environmental performance of a building.

Climatic design - Climatic factors, classification of tropical climates, site climate, microclimate of human settlements, ventilation requirements for health, mechanisms and estimation of natural ventilation, airflow patterns in building.

Thermal performances of buildings - Thermal comfort factors, comfort indices, thermal quantities, heat exchange in buildings, periodic heat flow. Mechanical and structural means of thermal control. Moisture control in buildings.

Propagation of sound, sound insulation absorption and transmission, reverberation, Design of floor, roofing and walling system for sound absorption and insulation. Design of auditoria Noise control in buildings.

References

1.	Brown, G.Z. and DeKay, M., "Sun, Wind and Light - Architectural Design Strategies", John Wiley and Sons Inc,. 3rd Edition, 2014.
2.	Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2017.
3.	Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 (S and T) 1995
4.	Majumdar, M (Ed), "Energy - Efficient Buildings" in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.
5.	Moore, F., Environmental Control Systems: Heating, Cooling, Lighting Paperback - International Edition, McGraw Hill Inc., 1993.
6.	Tyagi, A.K. (Ed). "Handbook on Energy Audits and Management Tata Energy Research Institute", 2000.
7.	"GRIHA Manual", Ministry of New and Renewable Energy, Government of India, and The Energy and Resources Institute, TERI Press, New Delhi 2010.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Apply environmental control strategies in building design
CO2	Analyze and respond to climatic factors in architectural design
CO3	Assess and optimize thermal performance of buildings
CO4	Design buildings for acoustic comfort and noise control
CO5	Evaluate and implement sustainable building practices

Course Code	:	CE763
Course Title	:	**Disaster Mitigation and Management**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36 Hours
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understanding of the roles of the various phases of disaster management and issues concerning planning and policies in those phases.
CLO2	Understanding of the role of federal, state, and local governments in disaster planning and policies.
CLO3	Understanding of comprehensive emergency management from a planning and policy perspective, mitigation planning, factors affecting short and long-term recovery and rebuilding and the role of planners and policy-makers
CLO4	Understanding of the factors that give rise to disaster vulnerabilities (e.g. natural, physical, social, economic, policies, and governance).
CLO5	Knowledge and capabilities to assess and manage these vulnerabilities levels of community resilience

Course Content

Introduction to– Disaster, Hazards, Exposure, Vulnerability, Risk – Types of disasters – Natural and Man-made - Earth quake, Liquefaction, Landslide, Flood, Dam break, Cyclone and Tsunami, Drought and Forest fire, Chemical, industrial and accidents.

Institutional framework - Disaster Management Act, 2005, National Disaster Management Authority (NDMA), SDMA, DDMA National Executive Committee (NEC) - National Institute of Disaster Management (NIDM), National Disaster Response Force (NDRF) - Financial Arrangements, Financing the Relief Expenditure - National Disaster Response Fund (NDRF) - Monitoring of Expenditure from Relief Funds - Disaster Response Reserve - Plan and non-plan Schemes - International co-operation on DMM.

Disaster Management Cycle - Hazard identification - vulnerability and risk assessment - Mitigation strategies or measures - risk reduction and Infrastructure - Vulnerabilities caused by development - Soft computing tools in assessment of vulnerability and risk.

Pre and Post disaster activities - Search and rescue (SAR) – Evacuation - Logistics and supply - Communication and information management - Emergency operations management - Survivor response and coping, Security - Livelihood Restoration - Response and Recovery - Post-disaster assessment - Relief and Rehabilitation - Reconstruction - Resilience - Disaster Recovery and Rebuilding - Mitigation strategies - Prevention and Mitigation - Measuring and Mapping Vulnerability and risk - Risk reduction strategies - Structural and Non-Structural measures - Preparedness and Planning - Mitigation Planning and Policy Strategies: Local, State, and Federal Level Capacity building - Climate Change Adaptation. Emergency Management Planning - Tools for risk reduction measures - early warning - Emergency exercises/training - Emergency communications systems - The Emergency Operation Plan (EOP) - Evacuations plans and training - Emergency personnel/contact lists - Role of Information, Communication and Geo-informatics Technologies in Disasters - UNOSAT's Humanitarian Rapid Mapping Service, Applications of Remote sensing and GIS in DMM.

Case Studies and Application of DMM in Various Disasters – Vulnerability and Risk mapping for flood, landslide, drought, forest fire, Liquefaction and earthquake.

References

1.	Etkin, D. Disaster Theory: An Interdisciplinary Approach to Concepts and Causes, Elsevier Science & Technology, 2015
2.	Hans Jochen Scholl, (Eds.) Disaster Management and Information Technology, Professional Response and Recovery Management in the Age of Disasters, 2023, doi.org/10.1007/978-3-031-20939-0.
3.	Hans Jochen Scholl, (Eds.) Disaster Management and Information Technology, Professional Response and Recovery Management in the Age of Disasters, 2023, doi.org/10.1007/978-3-031-20939-0.
4.	Sahni, P.and Malagola M. (Eds.). Disaster Risk Reduction in South Asia, Prentice-Hall of India, New Delhi. 2003.
5.	Ramkumar, Mu, (Eds.). Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi, 2006.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Understand the necessity of disaster management measures and tools.
CO2	Get a sound knowledge on the technology involved in disaster management planning and mapping
CO3	Acquire knowledge on the various mitigation measures.
CO4	Understand the effect role of communication and its effectiveness in the disaster preparedness and mitigation activity
CO5	Gain knowledge to develop the technical and technological measures that aid in the prevention and mitigation of disasters

Course Code	:	CE764
Course Title	:	**Construction Supply Chain Management**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36 Hours
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the importance of construction supply chain and its involved processes and actors in determining project and organisation success
CLO2	To learn the various sourcing decisions in a supply chain and analyse their strategy with regard to pricing and risk management
CLO3	To comprehend different construction supply chain configurations and assess their application

CLO4	To analyse supply chain logistics challenges and learn to devise solutions for effective supply chain management
CLO5	To comprehend and apply construction supply chain concepts in the context of sustainable development through case studies

Course Content

Introduction to Construction Supply Chain Management - Supply Chain Performance: Achieving Strategic Fit and Scope - Supply Chain Drivers and Metrics - Managing cross- functional drivers in Supply Chain

Sourcing Decisions in a Supply Chain - Pricing and Revenue Management in Supply Chain - Supply Chain Risks - Framework agreements- Information Technology in Supply Chain - Coordination in Supply Chain

Different Construction Supply Chain Configurations – Make-to-Stock (MTS), Assemble-to-Order (ATO), Make-to-Order (MTO), Build-to-Order (BTO), Configure-to-Order (CTO) and Engineer-to-Order (ETO) – and its application.

Logistics Solutions in Construction projects - Planning and control mechanisms of construction logistics and supply chain - Demand Forecasting in a Supply Chain - Aggregate Planning in a Supply Chain - Inventories in Supply Chain - Distribution networks - Transportation networks - Network Design in an Uncertain Environment - Global Sourcing - Procurement and Centralized Decision Making - Bulk Material Handling - Improvement Strategies for Effective Supply Chain Management

Contemporary Opportunities and challenges for Construction Logistics and supply chain management in the context of Sustainable Development - Construction Supply Chain Case Studies

References

1	O'Brien, W. J., Formoso, C. T., Ruben, V., and London, K. (Eds.). (2008). Construction Supply Chain Management Handbook. Taylor and Francis.
2	Pryke, S. (Ed.). (2009). Construction supply chain management: concepts and case studies (Vol. 3). John Wiley and Sons.
3	Lundesjö, G. (Ed.). (2015). Supply chain management and logistics in construction: delivering tomorrow's built environment. Kogan Page Publishers.
4	Chopra, S., and Meindl, P. (2007). Supply chain management. Strategy, planning and operation (pp. 265-275). Gabler.
5	Sople, V. V. (2011). Supply Chain Management: Text and Cases. Pearson Education India.

Course Outcomes (CO)

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

CO1	Understand the importance of construction supply chain in the overall construction business for its better performance
CO2	Learn the various sourcing decisions in a supply chain and analyse their pricing and risk management strategies
CO3	Comprehend different construction supply chain configurations and assess their application in real-time projects
CO4	Analyse supply chain logistics challenges and write reports to devise solutions for effective supply chain management
CO5	Apply construction supply chain concepts in the context of sustainable development

Course Code	:	CE765
Course Title	:	**Planning of Prefabricated Structures**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understand types of prefabrication and structural schemes in prefabricated construction.
CLO2	Learn about prefabricated structure production processes and yard planning
CLO3	Study dimensional tolerances and erection techniques for prefabricated structures
CLO4	Explore planning and erection methodologies for various types of prefabricated structures
CLO5	Analyze case studies of prefabricated construction projects

Course Content

Types of prefabrication, prefabrication systems and structural schemes- Disuniting of structures- Structural behaviour of precast structures.

Prefabricated Structure Production - Yard planning, Equipment requirement, Shuttering and mould design, Stacking, Transportation and Erection. Dimensional tolerances- Erection of R.C. Structures, Total prefabricated buildings - Case Studies
Prefabricated Structure Planning and Erection Methodologies - 1) Industrial Structures 2) Multistorey Buildings, 3) Bridges, 4) Underground Metros and Tunnels 5) Offshore structures - Case Studies.

References

1.	Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 2012
2.	Kim S. Elliott, Precast Concrete Structures, CRC Press, 2nd edition, 2019
3.	Jack S. Goulding, Farzad Pour Rahimian, Offsite Production and Manufacturing for Innovative Construction: People, Process and Technology, Routledge, Taylor and Francis Group, 2019.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Analyze and compare different prefabrication systems and structural schemes
CO2	Plan and organize prefabricated structure production processes
CO3	Apply dimensional tolerances and erection techniques in prefabricated construction
CO4	Develop planning and erection methodologies for specific prefabricated structure types
CO5	Evaluate real-world applications of prefabricated construction through case studies

Course Code	:	CE766
Course Title	:	**Safety in Material Handling at Construction**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	To understand the hazards involved in manual and mechanical material handling
CLO2	To realize the safe work practices at construction sites
CLO3	To apply the basic safety concepts in handling the equipment's mechanically
CLO4	To identify the safe operating procedure in utilizing the chains, ropes, links, etc for handling the construction materials.
CLO5	To prevent and control occupational disease prevalent in construction site.

Course Content

Manual Material Handling
Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects - accessories for manual handling, hand

tools, jacks, hand trucks, dollies and wheel barrows - storage of specific materials - problems with hazardous materials, liquids, solids - storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading - personal protection - ergonomic considerations.

Lifting Tackles and Mechanical Material Handling
Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement - slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection , safe slinging practices - Testing procedures for wire rope slings, chain slings and lifting tackles like Shackles, eye bolts - Inspection and maintenance of lifting tackles, chain pulley block and slings.

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist - conveyors, precautions, types, applications. Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks - power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks - man lifts, construction, brakes, Inspection and examination of lift and hoist

References

1.	Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 2nd Edition, 2013.
2.	Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Recognize the practical solutions to eliminate and/or minimize hazards in manual material handling
CO2	Recognise the different types of existing hazards at construction site
CO3	Disseminate the basic safety concepts and techniques in mechanical material handling equipment's like cranes, forklifts, trucks, etc.
CO4	Recognise the safe use, inspection and maintenance of chains, links, etc.
CO5	Demonstrate the importance for improving health & safety in construction

Course Code	:	CE767
Course Title	:	**Non Destructive Evaluation**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36

Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	To understand the basic principles, testing procedures and limitations of various NDT methods used to detect the flaw on the surface.
CLO2	To realize different NDT techniques used for identifying the internal defect.
CLO3	To study the codes, standards or specifications related to each testing method.
CLO4	To identify the types of equipment used for each non-destructive examination for various industrial applications.
CLO5	To analyse the flaw significantly in concrete and pipelines using various NDT methods.

Course Content

Surface Methods -Visual Inspection - Liquid Penetrant Testing - Magnetic Particle Inspection, Cover meter testing

Volumetric Methods - Electro-Magnetic Methods - Acoustical Methods - Radiographic Methods - Thermal Methods - Optical Methods.

Applications In Construction Industry - Analysis of quality and durability of materials on building threats, break - downs and catastrophes. Testing of concrete in building structures. Testing of reinforcement in reinforced concrete structures (Radiographic testing and electromagnetic testing), Testing of walls, steel, wood and plastic of civil structures. Pipelines- Lifetime and quality assessments.

References

1.	Non Destructive Testing Handbook, 4th Edition, 2019.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Select appropriate NDT methods for flaw detection on the material surface.
CO2	Use the various testing methods for understanding the internal defects of Engineering materials.
CO3	Perform Non-destructive examination of weldments.
CO4	Acquire the knowledge to identify strengths and weaknesses in materials used in fabrication.
CO5	Utilize different NDT techniques to realize the defects and characterization of bulk materials especially concretes, etc. and also pipelines.

Course Code	:	CE768
Course Title	:	**Value Engineering**

Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understand the principles and applications of value analysis in project management.
CLO2	Learn about life cycle costing and its role in managing total value
CLO3	Study various methods of performing value engineering
CLO4	Explore the phases of value engineering, including creative thinking and evaluation
CLO5	Comprehend reliability estimation and its impact on value engineering decisions

Course Content

Value Analysis - Value - Meaning of value, basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, and economic. I 0 Commandments of value analysis; value analysis team; principles of value analysis, elements of a job plan viz. orientation, Information, presentation. Implementation, follow up action, benefits of value analysis, various applications; assessing effectiveness of value analysis.

Factors governing project selection - Types of Projects-Life Cycle Costing (LCC) for Managing the Total Value

Life cycle costing - Forecasting of Capital as well as operating and maintenance costs, time value, present worth analysis, DCF methods, ROR analysis, sensitivity analysis. Different methods of performing value engineering.

Phases of Value Engineering:
Creative thinking and creative judgment- positive or constructive discontent. Tangible and Intangible costs of implementation - False material-labour and overhead saving, Relationship between savings and probability of success-Reliability estimation, System reliability- Reliability elements in series and parallel. General Phase, Information Phase, Function Phase
-Type of costs, Evaluation of Functional Relationships. Checks for consistency-Function - cost-weight-matrix-VIP Index - High cost and Poor value areas. Creativity/Speculation Phase - Rules of creativity-Brainstorming- Idea activators-Result accelerators. Evaluation Phase - Estimation of costs of ideas- Evaluation by comparison.

References

1.	Value Engineering: Analysis And Methodology By Del Younk:e, 2003
2.	Industrial Engg. and Mgt., O.P.Khanna, Dhanpat Rai Publ., 2008

3.	Industrial Organization and Engg. Economics, T.R.Banga, S.C.Sharma, Khanna Publ., 2006
4.	Arthur E Mudge, "Value Engineering", McGraw Hill Book Company, 1989.
5.	Richard J Park, "Value Engineering - A Plan for Inventions", St.Lucie Press, London, 2017
6.	S S Iyer," Value Engineering - A How to Manual", 3rd edition, New Age Publishers, Chennai, 2009.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Apply value analysis principles to improve project outcomes
CO2	Perform life cycle costing analysis for project selection and total value management
CO3	Implement various value engineering methods in project management
CO4	Navigate through the phases of value engineering to optimize project value
CO5	Integrate reliability estimation into value engineering decisions

Course Code	:	CE769
Course Title	:	**Quantitative Methods in Construction Management**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understand Operations Research in Construction Management
CLO2	Identify and formulate optimization problems
CLO3	Formulate and solve linear programming problems specific to civil engineering applications
CLO4	Solve transportation and assignment problems
CLO5	Implement advanced quantitative methods

Course Content

Introduction - Use of Operations Research in Civil Engineering and Managerial Decision making process. Introduction to Optimization Techniques and their application in Engineering Planning, Design and Construction. Various models; Objective function and constraints, convex and concave functions, regions and sets and concepts of probability and statistics.

Linear programming - Formulation of Linear optimization models, Civil engineering applications. Simplex method, special cases in simplex method, Method of Big M, Two phase method, duality, sensitivity analysis.

Transportation problems - Approximation method, Assignment problems - Hungarian Methods of Solution.

Dynamic programming - Bellman's principle of optimality. Other Techniques - Decision theory, Queuing theory and Games theory - Monte Carlo Simulation.

References

1.	Hamdy A.Taha, Operations Research, Pearson Education India, 10th Edition, 2016.
2.	Ravindran, Engineering Optimization Methods and Applications, John Wiley and Sons, Inc., 9th Edition, 2011
3.	Vohra, N. D., Quantitative Techniques in Management, McGraw Hill Education, 5th Edition, 2017.
4.	Wangner, H.M., Principles of Operations Management by, Prentice Hall India Learning Private Limited, 1980.
5.	Hira and Gupta, S.Chand, Operation Research, S. Chand Publisher, 2007

Course Outcomes (CO)

At the end of the course student will be able

CO1	Demonstrate the application of operations research techniques to enhance managerial decision-making in construction projects
CO2	Utilize various optimization techniques in engineering planning, design, and construction contexts
CO3	Formulate and solve linear optimization models
CO4	Apply approximation methods to solve transportation problems in construction projects
CO5	Utilize decision theory, queuing theory, games theory, and Monte Carlo simulation to analyze and solve complex construction management problems

Course Code	:	CE770
Course Title	:	**Formwork Design**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives

CLO1	Understand the fundamentals of formwork and falsework in construction
CLO2	Learn design principles for formwork and falsework systems
CLO3	Study the design of decks and falseworks, including special considerations
CLO4	Explore special formwork systems and their applications.

CLO5	Comprehend construction sequences and safety practices in formwork use

Course Content

Introduction: Formwork and falsework, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and falsework systems, Special and proprietary forms, Slip form techniques

Formwork- Design: Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork

Design of Decks and False works: Types of beam, decking and column formwork, Design of decking, falsework design, Effects of wind load, Foundation and soil on falsework design.

Special Forms: The use and applications of special forms.
Construction Sequence and Safety in use of Formwork: Sequence of construction, Safety use of formwork and falsework.

References

1.	Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 3rd Edition, 1978.
2.	Michael P. Hurst, Construction Press, London and New York, 2003.
3.	Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 4th Edition, 2010.
4.	Tudor Dinescu and Constantin Radulescu, Slip Form Techniques, Abacus Press, Tum Bridge Wells, Kent, 2004
5.	L and T Formwork Manual.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Analyze and select appropriate formwork and falsework systems for construction projects.
CO2	Design timber and steel formwork systems considering concrete pressure
CO3	Design and evaluate deck and falsework systems for various construction scenarios.
CO4	Apply special formwork systems to complex construction projects
CO5	Implement safe and efficient formwork and falsework practices in construction

Course Code	:	CE771
Course Title	:	**Construction Personnel Management**
Type of Course	:	PE
Prerequisites	:	-

Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To know the concepts of Personnel Management in Construction field.
CLO2	To explore the factors influencing manpower requirement.
CLO3	To familiarize the recruitment and employee selection strategies.
CLO4	To learn about employee productivity and competency.
CL05	To get exposure on communication and team building.

Course Content

Elements of Personnel Management - Organization - Requirement of Organization, Organization structure, Organization Hierarchical charts, Functions of Management, Role of HR manager.

Manpower Planning process, Estimation of manpower requirement, Factors influencing supply and demand of human resources, Personnel Principles, Staffing, Staffing Plan, Managerial Staffing, Job analysis.

Recruitment, Selection strategies, Types of Interview, Placement, Performance appraisal, Rewards, Employee Training and Development, Welfare measurements, Employee Grievances.

Productivity - Assessment tools, Productivity Improvement, Development and Operation of human resources, Competency Development, Talent Management.

Team Behavior - Stages and Characteristics of Teamwork, Communications - Methods and Channels of communication and its function, Crisis Management - Features and Case studies.

References

1.	Carleton Coutler and Jill Justice Coutler, The Complete Standard Handbook of Construction Personnel Management, Prentice-Hall, Inc. 1989.
2.	Dwivedi R.S, Human Relations and Organizational Behaviors, Macmillan India Ltd., 2005.
3.	Josy.J. Familaro, Handbook of Human Resources Administration, McGraw-Hill International Edition, 1989.
4.	Memoria, C.B., Personnel Management, Himalaya Publishing Co.,13th Edition, 2019
5.	P Subba Rao, Personnel and Human Resource Management, Himalaya Publishing House, Mumbai, 2015
6.	K. Ashwathappa , Human Resources and Personal Management Text and Cases, Tata McGraw Hill, 2023

Course Outcomes (CO)

At the end of the course student will be able

CO1	To understand the elements of personnel management and role of a personnel manager.
CO2	To apply the best Personnel management and Human Resource practices.
CO3	To design and develop employee recruitment and selection strategies.
CO4	To develop a tool kit for talent management and competency of the workforce.
CO5	To design the communication and crisis management strategies.

Course Code	:	CE772
Course Title	:	**Project Risk Analysis and Management Techniques**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36 Hours
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the importance of uncertainties and risks in the context of construction projects and businesses
CLO2	To learn the various risk management frameworks, and apply risk identification and assessment tools, and risk management strategies in the context of construction projects
CLO3	To comprehend the role of key stakeholders in the context of construction project risk management
CLO4	To analyse the challenges in development of risk management culture in construction projects and organisations.
CLO5	To learn and assess the effective usage of various internal and external project risk coverage tools and policies

Course Content

Overview and importance of project risk and uncertainties, types of project risks, quantifiable and un-quantified risks, risk ownership, risk breakdown structure.

Project risk management cycle, project risk management frameworks, project risk identification and its methods, project risk assessment, quantitative and qualitative risk analysis methods, quantitative – sensitivity analysis, decision tree, scenario and Monte Carlo analysis, qualitative – probability impact matrix, risk categorisation, expert judgement, brainstorming, various risk management strategies, residual and secondary risks, risk register.

Micro, market, project level risk analysis approach, risk analysis and management for projects (RAMP), details of RAMP process, identifying risk events in projects, probability distribution.

Addressing and devising project risk management implementation strategies, project risk communication, involvement of stakeholders in risk management, risk management culture in projects and organisations.

Stages in investment, life-cycle; determination of NPV and its standard deviation for perfectly correlated, moderately correlated and uncorrelated cash flows, delay analysis, use of risk prompts, use of risk assessment tables, utility of grading of construction entities for reliable risk assessment, coverage of risk through CIDC's MOU with the Actuarial Society of India through risk premium such as (BIP) - Bidding Indemnity Policy (DIMO) - Delay in meeting obligation by client policy, (SOC) - Settlement of claims policy (LOP) - Loss of profit policy (TI). Transit Insurance policy (LOPCE) Loss of performance of construction equipment policy.

References

1	Bartlett, J. (2004). Project risk analysis and management guide. APM Publishing Limited.
2	Institution of Civil Engineers, and Institute and Faculty of Actuaries. (2014). Contents and Preliminary Pages. Risk Analysis and Management for Projects. ICE Publishing, United Kingdom.
3	Chapman, C., and Ward, S. (2003). Project risk management processes, techniques and insights. John Wiley and Sons Ltd.
4	K. K. Chitkara. (2019). Construction Project Management, 4th Edition, Tata Mcgraw Hill Publication, India.
5	Smith, N. J., Merna, T., and Jobling, P. (2014). Managing risk in construction projects. John Wiley and Sons.

Course Outcomes (CO)

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

CO1	Understand and appreciate the importance of project uncertainties and risks in the context of construction projects and businesses
CO2	Learn and apply the various risk management frameworks, risk identification and assessment tools, and devise risk management strategies in the context of construction projects
CO3	Comprehend the role of key stakeholders in the context of construction project risk management
CO4	Analyse and report the challenges in the development of risk management culture in construction projects and organisations
CO5	Learn and assess the effective usage of various internal and external project risk coverage tools and policies

Course Code	:	CE773
Course Title	:	**Strategic Management in Construction**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the concepts related to strategy management in construction projects and businesses
CLO2	To learn and apply the various strategy management frameworks and models in the context of construction organisations and megaprojects
CLO3	To comprehend the role of different internal and external stakeholders in the context of construction strategy management
CLO4	To analyse the challenges in the implementation of various strategy management models for use in the context of the construction industry
CLO5	To learn and assess the role of strategy management evaluation and control and use of strategy audits in construction organisations

Course Content

Introduction To Strategic Management Concepts, Introduction to Strategy in Construction Project and Business Context, Purpose, Objectives, Goals, Policies and Programs, 7-S Framework, Board of Directors – Roles, Responsibilities, Structure and Composition, Role of Top Management.

External and Internal Environment Analysis, Strategic Management Process, SWOT Analysis, Macro and Micro Environmental Factors. Importance of Value Chain, Decision And Analytical Tools, Competitive Environment-Five Forces Model, Factors Driving Industry Change, Key Factors for Success in Organization, Overall Cost Leadership, Focus and Differentiation Strategies

Financial Strategies, Growth Strategy, Stabilization Strategy and Retrenchment Strategy, Portfolio Strategies G.E, BCG and Arthur D. Little's Model.
Corporate Strategic Events, Corporate Parenting Strategy, Ansoffs Product Market Grid - Product Development, Market Development and Market Penetration and Diversification Strategies.

Strategic Management Evaluation and Control, Strategy Implementation and Evaluation Control of Strategic Performance-Performance Gap, ROI, Budget and Financial Ratios, Strategy Audit.

References

1	Langford, D., and Male, S. (2008). Strategic management in construction. John Wiley and Sons.

2	Fellows, R. F., Langford, D., Newcombe, R., and Urry, S. (2009). Construction management in practice. John Wiley and Sons.
3	Harris, F., McCaffer, R., Baldwin, A., and Edum-Fotwe, F. (2021). Modern construction management. John Wiley and Sons.
4	McCabe, S. (2010). Corporate strategy in construction: Understanding today's theory and practice. John Wiley and Sons.
5	Winch, G. M. (2009). Managing construction projects. John Wiley and Sons.

Course Outcomes (CO)

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

CO1	Understand the concepts related to strategy management in construction projects and businesses
CO2	Examine and apply strategy management frameworks and models in the context of construction organisations and megaprojects
CO3	Comprehend and assess the role of different internal and external stakeholders in the context of construction strategy management
CO4	Analyse and report the challenges in the implementation of strategy management models for use in the construction industry
CO5	Learn and assess the role of strategy management evaluation and control and report strategy audits in construction organisations

Course Code	:	**CE774**
Course Title	:	**Infrastructure Planning and Management**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand how infrastructure projects are conceptualised and planned and the project lifecycle phases
CLO2	To learn concepts related to infrastructure economics and finance, including various project feasibility models
CLO3	To understand and assess the use of various risk management processes and practices in the context of infrastructure projects
CLO4	To examine the role of various internal and external stakeholders and their management strategies in the context of infrastructure projects
CLO5	To provide exposure to new contract management models and technological advancements in the context of infrastructure projects

Course Content

Overview of Infrastructure Sectors, Policies and Programs in India, Phases of an Infrastructure Project and Key Players, Role of Government, Private Agencies, NGOs and Construction Organisations

Infrastructure Economics, Finance and Project Feasibility, Public-Private Partnerships, Case Studies

Risks in Infrastructure Projects with a Focus on Demand Risks, Political Risks, Economic Risks, Social Risks, Technical Risks, Technological Risks, Environmental Risks, Legal Risks, Case Studies

Internal and External Stakeholders, Stakeholder Roles and Responsibilities, Stakeholder Mapping, Stakeholder Engagement and Management Strategies, Negotiation Management Strategies for Infrastructure Projects, Case Studies

Exposure to New Public and Infrastructure Management, Infrastructure Megaprojects and Technological Advancements, Overview of Flexible Contracts, Real Options, Design Thinking and Relational Contracts in Infrastructure Projects

References

1	Goodman, A. S. and Hastak, M. (2006). Infrastructure planning handbook: Planning, engineering, and economics. McGraw-Hill Education.
2	Miller, R. and Lessard, R. D. (2001). The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance, MIT Press, Massachusetts. https://doi.org/10.7551/mitpress/6478.001.0001
3	Ashish Kumar Srivastava and Iva Ashish Srivastava. (Ed.). (2023). Administration in India: Challenges and Innovation, Routledge, London. https://doi.org/10.4324/9781003433187
4	Bent Flyvbjerg (ed.). (2017). The Oxford Handbook of Megaproject Management, Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198732242.001.0001
5	Assorted readings from Journal papers, conference papers, and other website sources prior to each class.

Course Outcomes (CO)

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

CO1	Understand how infrastructure projects are conceptualised and planned, and appreciate the key project lifecycle phases
CO2	Learn and apply the concepts related to economics and financing aspects of infrastructure projects
CO3	Comprehend and assess the use of various risk management processes and practices in the context of infrastructure projects
CO4	Examine and report the role of various internal and external stakeholders and their management strategies in the context of infrastructure projects

CO5	Learn and appreciate the evolution of new contract management models and technological advancements in the context of infrastructure projects

Course Code	:	CE775
Course Title	:	**Sustainable Construction**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the basics of why sustainable construction is important for the present and future economies
CLO2	To learn concepts related to lifecycle energy use in buildings and methods to reduce it
CLO3	To learn and apply life cycle assessment (LCA) techniques and software tools in the context of building construction
CLO4	To examine and calculate emissions and parameters that influence emissions in building construction
CLO5	To provide exposure to various green building ratings in International and Indian contexts and social aspects of sustainability in the construction industry

Course Content

Building Life Cycle, Resource Use in the Built Environment, Major Environmental Issues, Three Dimensions of Sustainability, Environment, Economy and Social Aspects, Construction Ecology and Principles of Green Engineering.

Life Cycle Energy Use in Buildings, Embodied Energy, Onsite Construction Energy, Operational Energy and Demolition Energy, Methods to Reduce Life Cycle Energy Use, Introduction to Net-Zero Energy Buildings.

Life Cycle Assessment (LCA), LCA Methods - Process LCA, EIO-LCA and Hybrid LCA, ISO Standards for LCA and Software Tools Available for LCA. Carbon Footprint, Parameters that Influence Emissions in Building Construction, Methods to Calculate Emissions and Carbon Calculators.

Green Building Ratings – LEED, GRIHA, BREEAM, Green Globes, CASBEE, ICCES SAVE.

Social Aspects of Sustainability: Occupational Health and Safety of Construction Workers, Introduction to Sustainable Civil Infrastructure Development, Case Studies.

References

1	Adler, A., Armstrong, J., Azerbegi, R., Guy, G.B., Fuller, S.K., Kalin, M., Karolides, A., Lelek, M., Lippiatt, B., Macaluso, J., Spencer, E., Waier, P., Walker, A., Green Building: Project Planning and Cost Estimating, Second Edition, RS Means, Reed Construction Data, Inc., 2006.
2	Hendrickson, C. T., Lave, L. B., and Matthews, H. S. (2010). Environmental life cycle assessment of goods and services: an input-output approach. Routledge.
3	Liv Haselbach, The Engineering Guide to LEED-New Directions (Green Source): Sustainable construction, McGraw-Hill Professional, 2008.
4	Martin Melaver and Phyllis Mueller, The Green building Bottom line: The real cost of sustainable building, McGraw-Hill Professional, 2008
5	Indian Green Building Council, Green building rating system: New construction and major renovations (LEED-India NC) reference guide version 1.0, Confederation of Indian Industry, CII-Sohrabaji Godrej Green Business Centre, Hyderabad, 2007.
7	The Energy and Resources Institute Press, Green Rating for Integrated Habitat Assessment (GRIHA), Ministry of New and Renewable Energy and The Energy and Resources Institute, New Delhi, 2010.

Course Outcomes (CO)

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

CO1	Comprehend and appreciate why sustainable construction is important for the present and future economies
CO2	Learn and apply concepts related to lifecycle energy use in buildings and methods to reduce it
CO3	Assess and apply life cycle assessment (LCA) techniques and software tools in the context of building construction
CO4	Examine emissions and report parameters that influence emissions in building construction
CO5	Learn and appreciate the use of various green building ratings in International and Indian contexts and social aspects of sustainability in the construction industry

Course Code	:	CE776
Course Title	:	**Construction Project Modelling**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the basics of construction project modelling and types of models available
CLO2	To learn and apply concepts and tools related to schedule network modelling
CLO3	To learn and apply concepts and related to management of time and cost in projects
CLO4	To select and apply various linear programming techniques and sequencing methods in the context of construction projects
CLO5	To select and apply transportation and assignment technique to minimize the project cost

Course Content

Introduction to Project Modelling, Steps in the Problem-Solving Process and Modelling, Types of Models

Network Modelling, Probabilistic Model – Various Types of Activity Times Estimation, Program Evaluation Review Techniques (PERT), Probability of Completing the Project, Deterministic Model – Critical Path Method (CPM), Critical Path Calculation, Crashing of Simple Networks.

Project Duration and Control, Importance and Options to Accelerate Project Completion, Time Cost Trade-Off, Fixed Variable and Total Costs, Project Performance Measures, Project Control Process, S-Graph/Curve, Earned Value Management (EVM), Planned Cost of Work Schedule (PV), Budgeted/Earned Cost of Work Completed (EV) and Actual Cost of Work Completed (AC), Schedule and Cost Variances (SV, CV), Forecasting Final Project Costs.

Linear Programming Problem Formulation, Graphical Solution, Simplex Method, Artificial Variables Techniques-Two–Phase Method, Big-M Method, Duality Principle, Introduction to Sequencing, Sequencing of N Jobs Through Two Machines, N Jobs Through Three Machines –Two Jobs Through ‘M’ Machines

Transportation Problem, Formulation, Basic Feasible Solution, Optimal Solution, U-V Method, Unbalanced Transportation Problems, Degeneracy, Assignment Problem, Formulation, Optimal Solution, Variants of Assignment Problem-Traveling Salesman Problem.

References

1	Taha, H. A. (2013). Operations research: an introduction. Pearson Education India.
2	Anderson, D. R., Sweeney, D. J., Williams, T. A., and Wisniewski, M. (2000). An introduction to management science: quantitative approaches to decision making. South-Western College Publication.
3	Prasanna Chandra, Projects Planning, Implementation and Control, Tata McGraw Hill Publishing Company Limited, New Delhi, 1995.

4	Driscoll, P. J., Parnell, G. S., and Henderson, D. L. (Eds.). (2022). Decision making in systems engineering and management. John Wiley and Sons.
5	Assorted readings from Journal papers, conference papers, and other website sources prior to each class.

Course Outcomes (CO)

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

CO1	Understand the basics of construction project modelling and types of models available in the construction context
CO2	Learn and apply concepts and tools related to schedule network modelling to optimise the schedule of projects
CO3	Comprehend the relationship between time and cost in projects and apply concepts and related to management of time and cost in projects
CO4	Examine and apply various linear programming techniques and sequencing methods in the context of construction projects
CO5	Examine and apply transportation and assignment technique to minimize the project cost

Course Code	:	CE777
Course Title	:	**Smart Buildings**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the terminologies around smart buildings and the need for smart buildings
CLO2	To learn building automation hardware and software concepts and their application in smart buildings
CLO3	To examine and apply lighting control applications in the context of smart buildings
CLO4	To examine and apply air conditioning and related applications in the context of smart buildings
CLO5	To examine and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems

Course Content

Introduction to Smart Buildings, Terminologies and Expectations of Users, Need for Smart Buildings

Building Automation Hardware, Controllers, Sensors, Actuators, Communication Network, Building Automation Software, Communication Protocols, Building

Management Systems (BMS), Facilities Management Systems, Integration of Facilities Management Operations With Intelligent Control, Control Strategies And Algorithms

Application to Lighting Control, Use of Light Sensors and Occupancy Sensors for Dimming Control, Active Control of Day Lighting and Shading Devices such as Light Shelves, Light Pipes, Mirror Ducts, Use of Automated Systems – Window Blinds

Application to Air Conditioning, Use of Active Technologies for Improving the Performance of Air Conditioning and Ventilation Systems, Global Optimization of Water-Cooled Chiller System, Pre-Cooling Strategies, Energy Recovery Wheels, Thermal Storage Systems and Dehumidification Technologies – Active Technologies In Energy Efficient Air Conditioning

Other Applications, Security, Access Control, Fire Safety, Elevators, CCTV and IP Cameras for Surveillance and Monitoring, Modern Access Control Systems Using RFID and Biometrics, Integration of Fire Alarm Systems with Other Building Systems, Energy Management Systems – Techniques for Predicting and Monitoring the Energy Consumption of Buildings, Artificial Intelligence, Machine Learning, Optimization and Data Analytics in the Control of Building Systems

References

1	Raphael, B. (2022). Construction and Building Automation: From Concepts to Implementation. Routledge.
2	Clements-Croome, D. (Ed.). (2004). Intelligent buildings: Design, management and operation. Thomas Telford.
3	Sinopoli, J. M. (2009). Smart buildings systems for architects, owners and builders. Butterworth-Heinemann.
4	Merz, H., Hansemann, T., and Hübner, C. (2009). Building automation. Heidelberg: Springer.
5	Wang, S. (2009). Intelligent buildings and building automation. Routledge.

Course Outcomes (CO)

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

CO1	Understand the terminologies around smart buildings and appreciate the need for smart buildings
CO2	Comprehend and learn concepts related to building automation hardware and software and their application in smart buildings
CO3	Examine and apply lighting control applications in the context of smart buildings
CO4	Examine and apply air conditioning and related applications in the context of smart buildings
CO5	Assess and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems

Course Code	:	CE778
Course Title	:	**Soft Computing Techniques in Civil Engineering**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	45
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand the basics concepts related to soft computing techniques and appreciate the need for soft computing techniques
CLO2	To learn and apply concepts related to genetic algorithms in the context of construction project management
CLO3	To learn and apply concepts related to fuzzy logic and its application in the context of construction project management
CLO4	To learn and apply concepts related to artificial neural networks in the context of construction project management
CLO5	To examine and apply concepts related to hybrid systems in the context of construction project management

Course Content

Introduction to Soft Computing Techniques, Terminologies and Broad Level Classification of Techniques, Need for Soft Computing Techniques

Genetic Algorithms – Goals of optimization – Comparison with traditional methods – Schemata – Terminology in GA – Strings, Structure, Parameter string – Data Structures – Operators – Coding fitness function – Algorithm – Applications

Fuzzy Logic – Concepts of uncertainty and imprecision – Sets – Concepts, properties and operations on Classical sets and Fuzzy Sets - Classical and Fuzzy Relations – Membership Functions – Fuzzy Logic – Fuzzification - Fuzzy Rule-based Systems – Fuzzy propositions – Applications

Artificial Neural Networks – Basics of ANN; Models of a Neuron – Topology: Multi-Layer Feed Forward Network (MLFFN), Radial Basis Function Network (RBFN), and Recurring Neural Network (RNN) – Learning Processes: Supervised and unsupervised learning. Error-correction learning, Hebbian learning; Single layer perceptrons - Multilayer perceptrons - Least mean square algorithm, Back propagation algorithm Applications

Hybrid Systems – Fuzzy neural systems – Genetic Fuzzy Systems – Genetic Neural Systems

References

1	H.J. Zimmermann (2006) Fuzzy set theory and its applications, 4thEdition, Kluwer Academic Publishers.
2	Suran Goonatilake and Sukhdev Khebbal (1995) Intelligent Hybrid Systems, 1st Edition Wiley.
3	Timothy J. Ross (2016) Fuzzy Logic with Engineering Applications, 4th Edition McGrawHill.
4	Simon Haykin (2008) Neural Networks and Learning Technique, 3rd Edition Prentice Hall.
5	J. M. Zurada (1992) Introduction to Artificial Neural Systems, 1st Edition. Jaico Publishers.

Course Outcomes (CO)

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

CO1	Understand and appreciate the basics concepts related to soft computing techniques and the need for soft computing techniques
CO2	Learn and apply concepts related to genetic algorithms in the context of construction project management
CO3	Comprehend and apply concepts related to fuzzy logic and its application in the context of construction project management
CO4	Assess and apply concepts related to artificial neural networks in the context of construction project management
CO5	Examine and apply concepts related to hybrid systems in the context of construction project management

Course Code	:	CE779
Course Title	:	**Estimation and Quantity Surveying**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand and learn the basic concepts related to construction economics and finance
CLO2	To learn and apply estimation techniques related to quantity estimation of key construction activities
CLO3	To learn and apply estimation techniques related to the estimation of key project resources such as labour, material and plant and machinery (LMP)
CLO4	To comprehend and apply various costing models for the optimisation of project costs
CLO5	To examine and apply concepts related to the valuation of buildings and structures

Course Content

Engineering Economics – Time Value of Money, Discounted Cash Flows, Evaluating Alternatives, Replacement Analysis, Cost-Benefit Analysis, Break-even Analysis, Probabilistic Decision Analysis

Estimation and Tendering, Quantity Estimation of Key Activities – Estimating Earthwork, Estimating Reinforced Concrete Structures, Formwork, Reinforcement, MEP elements, Case Studies

Estimating Project Resources, Estimating Labour Costs, Estimating Material Costs, Estimating Plant and Machinery Costs, Rate Analysis, Bid Process Management, Contracts

Costing and Costing Modeling – Cost Estimation System, Use of Cost Models, Establishing Cost Targets, Objectives of Costing, Cost Target Team and Organization, Classification of Costs based on Complexity, Datum Creation, Matrix and Functional Cost Model, Quality Cost Model, Equipment Cost Model, Billing Cost Model

Methods of Valuation, Rental Method – Essential Ingredients, Forms of Rent, Year Purchase, Capitalized Value, Shares and Debentures, Bonds of Gilt-Edged Securities, Life of Structures, Case Studies in Rental Method of Evaluation, Land and Building Method – Cost Of Construction, Estimate on Area Basis, Estimate on Cubic Basis, Estimate by Cost Index, Residual or Demolition Value of Old Building and Case Studies, Profit Method of Valuation with Case Studies

References

1	Brook, M. (2016). Estimating and tendering for construction work. Routledge.
2	Holm, L. and Schaufelberger, J. E. (2021). Construction cost estimating. Routledge.
3	Anil Kumar, M (2003) Value Engineering: Concept, Technique and Application, SAGE Publishers.
4	Dell'isola, J. Alphonse (1988) Value Engineering in the Construction Industry, 3rd Edition. Smith, Hinchman and Grylls.
5	James J. O' Brien (1976) Value analysis in design and construction, 1st Edition McGraw Hill Book Company.

Course Outcomes (CO)

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

CO1	Understand and appreciate the application of economics and finance concepts in the management of construction projects

CO2	Apply estimation techniques related to quantity estimation of key construction activities and derive quantities from engineering drawings
CO3	Apply estimation techniques related to the estimation of key project resources and arrive at a rate analysis by estimating the required labour, material and plant and machinery (LMP)
CO4	Comprehend and apply various costing models for the optimisation of project costs
CO5	Examine and apply concepts related to the valuation of buildings and structures

Course Code	:	CE780
Course Title	:	**Urban Water Infrastructure**
Type of Course	:	PE
Prerequisites	:	-
Contact Hours	:	36
Course Assessment Methods	:	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To understand urbanization trends, causes, patterns, and water issues of metropolitan areas in India.
CLO2	To assess the characteristics of urban water infrastructure and to understand the concepts of for its design and operation.
CLO3	To evaluate water supply network management, National Water Policies, and community participation in water provision
CLO4	To plan and manage sewerage systems with focus on sewerage network scenario, sewer system type and different drainage management techniques
CLO5	To apply theoretical knowledge to real-world scenarios by analysing different case studies on urban water infrastructure projects and smart city concepts.

Course Content

Role of Infrastructure in Development: Urbanization in India, Patterns of Urbanization, Growth of Cities, Causes of Urbanization, The cost of Urbanization, The prospect of Urbanization, Growth Trends, Problems of Metropolitan cities Water issues in India

Urban Water infrastructure Characteristics – Urban services overview, classification and significance, Concepts and theories for design and operation, components, interrelationship, requirements of appropriate technology, cost recovery, Gap analysis.

WATER SUPPLY NETWORK: City & Household Network Scenario, Norms, National water policy, Water rights: excess and underutilization of water, role of community in water provision, water harvesting, privatization of water supply and its implications.

SEWERAGE NETWORK: Urban Water Balance, Impacts of shift to an urban water balance -Historical development of water supply and management, Virtual Water-

Planning of sewerage systems City & Household Network Scenario, Norms. Types of Sewer systems: Combined system and separate system-Urban Drainage management: Sponge City Concept, Water Sensitive Urban Design, LID Techniques, etc. Urban floods and infrastructural considerations.

Case Studies: Lift Irrigation Projects, Intake structures (River and Sea intake), Transmission and Distribution network, Smart city concepts

References

1	Technological Solutions for Water Sustainability: Challenges and Prospects, 2023, IWA Publishing
2	Mohammad Karamouz, “Water Systems Analysis, Design, and Planning: Urban Infrastructure”, 2021, 1st Edition, CRC Press, Taylor & Francis Group, LLC.
3	Terence Mcghee, Water Supply and Sewerage, 6th Edition, 2013, McGraw Hill Education
4	Prof. Dr. Sajjad Haider Sheikh, Water Supply & Sewerage (Theory & Application): A Text Book for Environmental & Civil Engineering (First Edition 1), 2022.

Course Outcomes (CO)

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

CO1	Examine the trends, causes, and socioeconomic effects of urbanization in India.
CO2	Analyse the components of urban water infrastructure including design, operation and suitable technological applications.
CO3	Interpret water supply network scenarios, National Water Policy, water rights and privatization of water supply.
CO4	Develop plans for urban sewerage systems involving development scenarios and sewer system types.
CO5	Propose innovative solutions for urban water infrastructure challenges by understanding various case studies