

COURSE STRUCTURE
for
M.TECH. DEGREE
in
CONSTRUCTION TECHNOLOGY AND MANAGEMENT

(Applicable from the academic session 2026-2027)



Dr. B. C. Roy Engineering College

An Autonomous Institution

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

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

Jemua Road, Durgapur, West Bengal, India, 713206

The course structure and syllabus is finalized as per the resolution of the 3rd Board of Studies meeting held on 03rd Decemeber, 2025 and finally approved by university vetting committee (constituted vide Notification No. IC-302/2026/5092 dated 01.04.2026) on 19th May, 2026


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

Semester-Wise Breakup of Credit

Sem1	Sem2	Sem3	Sem4	Total
26	26	24	24	100

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

Theory						
Sl. No.	Paper Name	Paper Code	L	T	P	Credit
1	Construction Technology and Materials	CEM-101	3	1	0	4
2	Project Management	CEM-102	3	1	0	4
3	Construction Planning and Scheduling	CEM-103	3	1	0	4
4	Safety and Quality Management in Construction	CEM-104	3	1	0	4
5	Condition Assessment and Health Monitoring of Structures	CEM-105	3	1	0	4
	Total Theory		15	5	0	20
Practical						
1	Material Testing Laboratory	CEM-191	0	0	4	2
2	Project Planning by Softwares	CEM-192	0	0	4	2
3	Research Methodology	CEM-181	0	2	0	2
	Total Practical		0	0	12	6
	Total in 1 st Semester		15	5	12	26

M. Tech. 1stYr (2nd Semester)

Theory						
Sl. No.	Paper Name	Paper Code	L	T	P	Credit
1	Construction Equipment and Methods	CEM-201	3	1	0	4
2	Contracts and Tendering	CEM-202	3	1	0	4
3	Repair and Retrofitting of Structures	CEM-203	3	1	0	4
	Elective I					
4	Advanced Concrete Technology	CEM-204	3	1	0	4
5	Pavement and Foundations	CEM-205	3	1	0	4
6	Construction of Bridge and Industrial Structures	CEM-206	3	1	0	4
7	Advanced Quantity Surveying	CEM-207	3	1	0	4
	Elective II					
8	Construction Economics and Finance	CEM-208	3	1	0	4
9	Human Resource Management in Construction	CEM-209	3	1	0	4
10	Construction Marketing and Business Development	CEM-210	3	1	0	4
11	Sustainable Techniques in Construction Technology	CEM-211	3	1	0	4
	Total Theory		15	5	0	20
Practical						
2	Quantity Surveying	CEM-291	0	0	4	2
3	Dissertation on Literature review	CEM-282	0	2	0	2
	Total Practical		0	0	12	6
	Total of 2nd Semester		15	5	12	26

Total Credit in 1st Year: 5

M. Tech., 2nd Yr (3rd Semester)

Theory						
Sl. No.	Paper Name	Paper Code	L	T	P	Credit
1	Disaster Mitigation in Engineering	CEM-301	3	1	0	4
2	Dissertation with Evaluation or Industrial / Research Internship with Evaluation Part I	CEM-391	0	0	0	20
Total in 3 rd Semester			3	1	0	24

M. Tech. 2nd Yr (4th Semester)

Theory						
Sl. No.	Paper Name	Paper Code	L	T	P	Credit
1	Dissertation with Evaluation or Industrial / Research Internship with Evaluation Part II	CEM-491	0	0	0	24
Total of 4 th Semester			0	0	0	24

Total Credit in 2nd Year: 48

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Department of Civil Engineering
(Detailed Autonomous Syllabus)

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

Theory

Construction Technology and Materials (CEM-101)

L-3, T-1, Credit-4

Prerequisite: Concrete Technology, Building Materials and Construction

Module 1: Fundamentals of Concrete and Construction Materials

Construction materials; Lime; Brick; Cement, Sand, Aggregates, Admixtures (mineral & chemical); Hydration, microstructure and strength development; Concrete production and quality control: conventional and RMC.

Module 2: Advanced Concretes

High-performance concrete properties, Concrete mix design methods (ACI 211, IS 10262); Self-compacting concrete (SCC) and its properties; Slump flow test and V-funnel test. Precast and Prestressed Concrete. Introduction to Ultra High-Performance Concrete

Module 3: Sustainable Materials

Recycled aggregates in concrete; Fly ash-based concretes; Geopolymer concrete; Bamboo-based composites; Sustainability concepts; Basics of life-cycle assessment (LCA).

Module 4: Formwork Systems

Types of formwork systems; Slipform design; Tunnel formwork, Aluminium formwork systems, Steel formwork systems; Formwork safety standards as per IS 14687.

Module 5: Special Concreting

Vacuum dewatering technique, underwater concreting using the tremie method; precast concrete techniques; shotcrete materials and shotcrete applications in construction.

Module 6: Emerging Technologies

Introduction to 3D concrete printing, Materials and processes for 3D printing; Ultra-high-performance concrete (UHPC), Applications of UHPC and Case studies of Indian construction projects. Prefabricated Structures

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain hydration, microstructure, and quality control principles of concrete production.

CO2: Design advanced concrete mixes using standard methods and performance requirements.

CO3:Evaluate sustainable materials using durability and life-cycle performance criteria.

CO4: Analyze formwork systems & safety requirements for modern construction applications.

CO5:Apply special techniques for challenging construction conditions.

CO6:Assess emerging technologies & prefabrication methods for infrastructure development.

Textbooks & References:

1. M.S. Shetty- Concrete Technology: Theory and Practice.
2. A.M. Neville & J.J. Brooks- Concrete Technology.
3. P.C. Varghese – Advanced Concrete Technology (Volumes 1 & 2).
4. Relevant IS Codes.

Project Management (CEM-102)

L-3, T-1, Credit-4

Prerequisite: Fundamentals of Organizational Behaviour

Module 1: Project Management Body of Knowledge (PMBOK) Domains and Processes

Management types: scope, schedule, cost, quality, resource, communication, risk, procurement, stakeholder and integration management. Management Process: initiating, planning, executing, monitoring/controlling and closing); Project Lifecycle phases: feasibility, design, execution and handover). Leadership styles, motivation theories and conflict resolution

Module 2: Risk Management

Risk identifications of projects; SWOT Analysis; Qualitative and quantitative analysis: Data Collection, Probabilistic Considerations & Simulation Techniques; Response strategies; Effect of delays, cost overruns and safety hazards.

Module 3: Stakeholder Analysis and Communication

Stakeholder register, power-interest grid, engagement assessment; Communication models; Reporting formats: Sigmoid Curves/S-curves, dashboards); 3C Concepts

Module 4: Agile and Hybrid Methods in Construction

Construction sequence and its impacts; Traditional waterfall vs. agile (Scrum, Kanban); hybrid approaches: iterative design-build; lean construction principles (value stream mapping, last planner system).

Module 5: Project Feasibility Study and Detailed Project Report

Types of feasibility: technical, financial, economic, legal & regulatory, environmental & social; Feasibility tools and techniques: market demand assessment, site selection analysis, SWOT and PESTLE analysis; and Decision analysis. Detailed Project Report (DPR) Preparation: Structure and components

Course Outcomes (COs)

After successful completion of the course, students will be able to:

- CO1:** Explain PMBOK domains, project lifecycle phases, and leadership concepts.
- CO2:** Examine project risks using qualitative and quantitative assessment techniques.
- CO3:** Interpret stakeholder engagement strategies & communication frameworks effectively.
- CO4:** Compare agile, waterfall, and hybrid construction management approaches.
- CO5:** Prepare feasibility studies using technical, financial and environmental considerations.
- CO6:** Develop detailed project reports for construction planning and execution.

Textbooks and References:

1. Construction Project Management by Kumar Neeraj Jha (Pearson, 2nd Ed., 2015).
2. Construction Project Management by S. Seetharaman and C. Madan Mohan (McGraw Hill).
3. A Guide to the Project Management Body of Knowledge (PMBOK Guide), PMI (7th Ed.).

Construction Planning and Scheduling (CEM-103)

L-3, T-1, Credit-4

Prerequisite: Basic Engineering Mathematics, Basic Construction Technology.

Module 1: Network Techniques

Construction project life cycle and phases of construction; Bar charts (Gantt charts) and milestone charts; CPM: Float calculations, Critical path determination with examples; Introduction to PERT

Module 2: Resource Management

Types of construction resources; Resource allocation, levelling, smoothing, histograms Cumulative resource curves, multi-project scheduling, Resource-constrained scheduling

Module 3: Time-Cost Optimization

Time-cost trade-off concept, Project crashing, Cost slope calculation, Selection of critical activities, Fast-tracking, Linear programming models, Optimization of project duration & cost

Module 4: Software Applications

Overview of MS Project & Primavera P6 and its applications (linked to CEM-192)

Module 5: Advanced Scheduling

Uncertainty in activity duration: PERT and Probabilistic Scheduling, Monte Carlo simulation Schedule sensitivity, BIM-integrated (4D) scheduling

Course Outcomes (COs)

After successful completion of the course, students will be able to:

- CO1:** Explain construction scheduling techniques and project lifecycle phases.
- CO2:** Analyze critical paths and floats using CPM and PERT methods.
- CO3:** Evaluate resource allocation and optimization strategies in construction projects.

CO4: Determine project duration and costs using crashing and optimization techniques.

CO5: Utilize MS Project and Primavera for construction scheduling applications.

CO6: Assess probabilistic scheduling and BIM-integrated planning for complex projects.

Textbooks & References:

1. P. Menon – Construction Project Management.

2. Dr. B. C. Punmia, K. K. Khandelwal & Ashok Kumar Jain – Project Planning and Control with PERT & CPM.

3. Prasanna Chandra – Projects: Planning, Analysis, Selection, Implementation and Review.

Safety and Quality Management in Construction (CEM-104)

L-3, T-1, Credit-4

Prerequisite: Construction materials and process of construction.

Module 1: Safety Management Systems

Occupational Health and Safety Management System Standard: ISO 45001 and OHSAS 18001; hierarchy of controls; Personal Protective Equipment (PPE); Safety policy.

Module 2: Risk Assessment Techniques

Hazard and Operability Study (HAZOP), Failure Modes and Effects Analysis (FMEA), Job Safety Analysis (JSA), bow-tie analysis, and construction hazard identification

Module 3: Quality Management Standards

Quality Management System, ISO 9001, Total Quality Management (TQM) Quality audits, Six Sigma methodology (DMAIC).

Module 4: Construction Safety Practices

Safety Code for Scaffolding and Ladders (IS 3696) and other constructional equipment; formwork safety, electrical safety, fire prevention, and behavioural safety programs.

Module 5: Performance Measurement and Safety Audits

Leading & lagging indicators, safety culture surveys, third-party certifications

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain occupational health, safety standards, and control measures in construction.

CO2: Examine construction hazards using systematic risk assessment techniques.

CO3: Understand quality management & continuous improvement methodologies effectively.

CO4: Apply construction safety practices following relevant standards and safety regulations.

CO5: Assess workplace safety performance using audits and safety indicators.

CO6: Develop strategies promoting safety culture and quality assurance in projects.

Reference Books

1. Construction Safety Management by Jimmie Hinze (Wiley).
2. Construction Quality Management by Paul Bosela (Cengage).
3. Safety and Health for Engineers by Roger L. Brauer (Wiley, 3rd Ed.).

Condition Assessment and Health Monitoring of Structures (CEM-105)

L-3, T-1, Credit-4

Prerequisite: Structural Mechanics, Strength of Materials

Module 1: Condition Assessment of Structures

Deterioration of structures, effect of environment on structural materials, effect of natural hazards, Structural assessment: tilt, settlement, cracks etc. Visual Inspection, Non-destructive testing of concrete & steel structure, Data Analysis and inference.

Module 2: Structural Health Monitoring Techniques

Introduction, classification, type of SHM, Sensor and instrumentation: strain gauges, LVDT, accelerometer, temperature sensor, Data acquisition systems, introduction to signal processing, feature extraction and AI & ML Applications

Module 3: Application and Case Studies

Condition assessment and health monitoring of concrete and steel structures.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

- CO1:** Explain deterioration mechanisms affecting concrete and steel structural performance.
- CO2:** Examine structural defects using visual inspection and non-destructive testing methods.
- CO3:** Analyze structural response data for condition assessment and damage identification.
- CO4:** Apply sensing and instrumentation techniques for structural health monitoring systems.
- CO5:** Interpret signal processing and feature extraction methods in SHM applications.
- CO6:** Evaluate SHM case studies using AI and machine learning approaches.

Reference Books

1. Structural Health Monitoring by Charles R. Farrar (Wiley).
2. Health Monitoring of Structural Materials by Victor Giurgiutiu (Springer).
3. Structural Health Monitoring with Piezoelectric Wafer Active Sensors by Victor Giurgiutiu (Academic Press).

Material Testing Laboratory (CEM-191)

L-0, T-0, P-4, Credit-2

Prerequisite: Concrete Technology Laboratory, Transportation Engineering Laboratory, Solid Mechanics Laboratory, and Soil Mechanics Laboratory.

Module 1: Construction Material Testing

Aggregate properties: Coarse and fine aggregates, cement, bricks, bitumen

Module 2: Concrete and Reinforcement Testing

Compressive strength, tensile strength, workability tests, Testing for SCC, Tensile testing of reinforcement bars

Module 3: Soil Testing

Soil Classification; Atterberg Limits; Proctor test

Module 4: Advanced Tests and Report Writing

Non-Destructive Testing: Schmidt Hammer, UPV, Rebar Locator, Corrosion Susceptibility

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain properties and testing procedures of common construction materials.

CO2: Analyze concrete performance using strength and workability assessment methods.

CO3: Evaluate self-compacting concrete properties using standard laboratory testing.

CO4: Interpret reinforcement bar behavior using tensile testing and performance criteria.

CO5: Classify soils using index properties and compaction characteristics effectively.

CO6: Assess structural conditions using non-destructive testing and technical reporting.

Reference Books

1. Concrete Technology by M.S. Shetty (S. Chand, 2013).
2. Highway Engineering Lab Manual by Khanna & Justo.
3. Relevant IS Codes.

Project Planning by Softwares (CEM-192)

L-0, T-0, P-4, Credit-2

Prerequisite: Project Planning and Management.

Module 1: Hands on Experience

Understanding and application of MS Project for building and infrastructure project

Understanding and application of PRIMAVERA for building and infrastructure project

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain project scheduling concepts using MS Project and Primavera applications.

CO2: Develop project schedules for building and infrastructure construction activities.

CO3: Analyze task dependencies, resource allocation, and project timelines effectively.

CO4: Apply project tracking and monitoring techniques using scheduling software tools.

CO5: Interpret project performance reports for construction planning and control.

CO6: Evaluate construction project outcomes using software-based management techniques.

Reference Books

1. Planning and Scheduling Using Primavera P6 by Paul E. Harris (Eastwood Harris).
2. Project Planning and Control with Primavera P6 by Paul E. Harris.
3. Oracle Primavera P6 User's Guide (Oracle Documentation).

Research Methodology (CEM-181)

L-0, T-2, P-0 Credit-4

Module 1: Introduction

Introduction to Research Fundamentals, Types of research, Different literature review tools

Module 2: Data Collection Methods and Sampling Techniques

Data Collection: Surveys, experiments, case studies; sampling techniques

Module 3: Statistical Analysis

Statistical Analysis: Descriptive stats, regression, ANOVA, SPSS & R

Module 4: Report Writing

Report Writing Techniques, Plagiarism tools, Ethics in research (COPE guidelines).

A mid-semester and end-semester seminar presentation shall be conducted on a topic selected by the student, which will subsequently be pursued as the dissertation or project internship topic, highlighting the application of research methodology concepts in the proposed dissertation or project internship work.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain research fundamentals and different types of research methodologies.

CO2: Analyze literature using modern review tools and research databases.

CO3: Apply data collection methods and sampling techniques in research studies.

CO4: Interpret statistical results using regression, ANOVA, SPSS, and R tools.

CO5: Develop technical reports following standard academic writing practices effectively.

CO6: Evaluate ethical issues and plagiarism concerns in research activities.



Department of Civil Engineering
(Detailed Autonomous Syllabus)

M. Tech., 1stYr (2nd Semester)

Theory

Construction Equipment and Methods (CEM-201)

L-3, T-1, Credit-4

Prerequisite: Soil Mechanics, Engineering Mechanics, and Engineering Economics.

Module 1: Earthmoving Equipment

Excavators, bulldozers, scrapers, graders; cycle time calculations, productivity factors (soil type, weather, operator efficiency), matching equipment to job conditions, cost analysis.

Module 2: Cranes and Lifting Equipment

Tower cranes, mobile cranes, hoists; load charts, stability analysis, erection/dismantling procedures, safety standards (IS 3177, OSHA), wind effects.

Module 3: Concrete Production and Placement Equipment

Batch plants, transit mixers, pumps, vibrators; capacity selection, automation, slipform pavers, tunnelling equipment (TBM).

Module 4: Equipment Economics and Management

Owning&operating costs (AASHTO method), replacement analysis, queuing models, fleet management and maintenance scheduling.

Module 5: Automation and Emerging Technologies

Robotic total stations, drones for surveying, autonomous haulers, BIM-integrated equipment tracking, and GPS-guided machinery.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain operational principles of major construction and earthmoving equipment.

CO2: Analyze equipment productivity using cycle time and performance factors.

CO3: Evaluate crane stability and lifting operations under safety requirements.

CO4: Select concrete production equipment for efficient construction operations.

CO5: Assess equipment economics using cost and replacement analysis techniques.

CO6: Examine emerging technologies in modern construction equipment management.

Reference Books

1. Construction Equipment and Methods by S. D. Sharma (Khanna Publishers, 2018).
2. Construction Planning, Equipment and Methods by R. L. Peurifoy and G. D. Oberlender (McGraw-Hill, 9th Ed.).
3. Equipment Management in Construction by R. B. Harris (McGraw-Hill).

Contracts and Tendering (CEM-202)

L-3, T-1, Credit-4

Prerequisite: Fundamentals of Civil Engineering Practice, Quantity Surveying and Estimation.

Module 1: Contract Forms and Types

Contracts: Lump sum, item rate, costplus&BOT; Engineering Procurement and Construction(EPC); Indian Contract Act 1872, General conditions of contract (GCC), Different standard forms.

Module 2: Tendering Processes

Notice inviting tenders (NIT), pre-bid meetings, e-tendering, Government e-Marketplace, Bid preparation, two or three envelope system, earnest money deposit.

Module 3: Estimation and Bid Evaluation and Award

Financial&technical evaluation, Lowest Responsive Bidder (L1 bidder), reverse auction, negotiation, letter of acceptance (LOA), performance security.

Module 4: Claims and Dispute Resolution

Time extensions, price escalation, variations, arbitration, adjudication, dispute review boards.

Module 5: Risk Allocation and Insurance

Force majeure, liquidated damages, insurance clauses, indemnity

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain construction contract types and standard contractual provisions effectively.

CO2: Interpret tendering procedures and bid submission requirements in construction projects.

CO3: Analyze technical and financial criteria during bid evaluation processes.

CO4: Apply contract administration principles for project compliance management

CO5: Examine dispute resolution mechanisms and claim settlement procedures critically.

CO6: Assess contractual risks, insurance provisions, and liability allocation strategies.

Reference Books

1. Contracts Management in Construction by Abdul Rashid (Satya Bhan, 2015).
2. FIDIC Contracts: Law and Practice by Ellis Baker (Informa Law).
3. Construction Contracts by Jimmie Hinze (McGraw Hill, 5th Ed.).

Repair and Retrofitting of Structures (CEM-203)

L-3, T-1, Credit-4

Prerequisite: Concrete Technology, Solid Mechanics, Design of RC Structure, Health Monitoring of Structures.

Module 1: Distress Diagnosis and Assessment

Visual inspection, NDT (rebound hammer, UPV, GPR), core testing, load tests, condition indexing.

Module 2: Materials for Repair

Epoxies, polymers, FRP composites, cementitious grouts, corrosion inhibitors, self-healing concrete.

Module 3: Surface Repair Techniques

Patch repairs, shotcrete, overlays, cathodic protection, electrochemical chloride extraction.

Module 4: Structural Retrofitting

Concrete jacketing, steel plate bonding, FRP strengthening, section enlargement, prestressing. **Module 5: Case**

Studies and Quality Control

Case studies related to failed structures: Indian bridges&buildings; repair audits, durability monitoring.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain structural distress mechanisms & assessment procedures for damaged structures.

CO2: Analyze structural conditions using non-destructive and load testing methods.

CO3: Evaluate repair materials for durability and structural rehabilitation applications.

CO4: Apply surface repair techniques for deteriorated concrete structures effectively.

CO5: Assess retrofitting methods for strengthening and restoring structural performance.

CO6: Interpret repair case studies and quality control practices in rehabilitation projects.

Reference Books

1. Concrete Structures: Protection, Repair and Rehabilitation by R. Dodge Woodson (Butterworth-Heinemann).
2. Repair and Rehabilitation of Concrete Structures by V. M. Malhotra (ACI).
3. Retrofitting of Concrete Structures by fib Bulletin 35.

Elective I

Advanced Concrete Technology (CEM-204)

L-3, T-1, Credit-4

Prerequisite: Concrete Technology.

Module 1: Concrete Materials – Advanced Concepts

Cement chemistry: hydration, heat of hydration, role of major compounds, and behaviour of blended cements. Different supplementary cementitious materials & their effects on hydration, strength, and durability. Aggregates: natural, manufactured, and recycled aggregates; microstructure and alkali-silica reactivity.

Module 2: Concrete Mix Design and Rheology

Rheology of fresh concrete: Bingham model, yield stress, viscosity, and thixotropy. Chemical admixtures: superplasticizers, VMAs, accelerators, retarders, and compatibility effects. Mix design approaches through IS Codes, performance-based design. Particle packing concepts and mix design for HSC, HPC, SCC, and lightweight & heavyweight concrete.

Module 3: Special Types of Concrete

High-strength and high-performance concrete: production and applications; Fibre reinforced concrete and self-compacting concrete (tests and behaviour); Ultra-high-performance concrete (UHPC) fundamentals; Overview of emerging concretes: geopolymer, roller compacted, permeable, shotcrete and 3D-printing concrete.

Module 4: Properties and Characterization of Fresh and Hardened Concrete

Fresh concrete: workability, flow and temperature effects; Hardened concrete: strength, creep, shrinkage and fracture behaviour; Microstructure and characterization techniques (SEM, XRD, TGA); Non-destructive testing: rebound hammer and ultrasonic pulse velocity.

Module 5: Durability, Deterioration and Rehabilitation of Concrete Structures

Durability concepts: permeability, carbonation and chloride ingress; Deterioration mechanisms: corrosion, sulphate and acid attack; Service life prediction basics (diffusion models); Rehabilitation and strengthening: grouting, polymer mortars, FRP and corrosion protection.

Course Outcomes (COs)

After completing the course, the student will be able to:

CO1: Explain concrete materials and effects of supplementary cementitious materials.

CO2: Analyze concrete rheology & admixture compatibility for mix designs.

CO3: Design specialized concrete mixes using particle packing and IS code provisions.

CO4: Evaluate fresh and hardened concrete properties using characterization techniques.

CO5: Assess durability and deterioration mechanisms affecting reinforced concrete structures.

CO6: Recommend rehabilitation and strengthening methods for damaged concrete structures.

Textbooks & References:

1. A.M. Neville – Properties of Concrete
2. Gambhir – Concrete Technology
3. Relevant IS Codes

Prerequisite: Transportation Engineering, Pavement Design and Materials, Geotechnical Engineering, and Foundation Engineering.

Module 1: Basic Foundation Engineering Concept

Bearing Capacity determination, Terzaghi's Theory, IS code Method to determine Bearing Capacity and Settlement, Soil behaviour under Seismic condition and machine foundation, Stress Distribution, Ground liquefaction

Module 2: Site Investigations and Pavement Subgrade Characterization

Planning of geotechnical investigation programmes, Methods of site investigations: Direct methods, semi direct methods and indirect methods; Drilling methods: Boring in soils and rocks, methods of stabilizing the bore holes, measurement of water table, field record; Field tests: In-situ shear test, in-situ permeability test, SPT, DCPT, SCPT, in-situ vane shear test, pressure meter test, plate load test, subgrade evaluation for pavements

Module 3: Materials for Pavements and Ground Improvement

Aggregates testing; Bitumen binders (VG grades), polymer modified and crumb rubber bitumen; Bituminous mixes; Soil stabilization materials; Marshall mix design and soil stabilization mix design concepts.

Module 4: Pavement and Ground Design Methods

Flexible and rigid pavement design as per IRC & its quality control; IRC layer thickness design and overlay concepts; Mechanistic-empirical pavement concepts; Ground improvement design for pavements and infrastructure.

Module 5: Deep Ground Improvement and Recycling Technologies

Stone columns, sand drains, prefabricated drains, lime columns; Vibro-floatation, dynamic compaction, electro-osmosis, grouting; Dewatering systems for pavement and infrastructure projects; Recycled Asphalt Pavement (RAP), Warm Mix Asphalt (WMA); Perpetual pavements and geopolymer concrete pavements.

Module 6: Case Studies and Forensic Engineering

Pavement failures: rutting, fatigue cracking, roughness (IRI); Industrial structures, earthen dams, landslides and debris flows; National highway pavement case studies and sustainable roads; Forensic geotechnical and pavement investigation.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain foundation behavior under static, seismic, and machine loading conditions.

CO2: Analyze geotechnical investigation data using field and laboratory testing methods.

CO3: Evaluate pavement & stabilization materials for performance requirements.

CO4: Design pavement systems using IRC and mechanistic-empirical design approaches.

CO5: Assess ground improvement & recycling technologies for infrastructure development.

CO6: Interpret forensic case studies related to pavement and geotechnical failures.

Reference Books:

1. Raj Purushothama, Ground Improvement Techniques, Laxmi Publications.
2. Khanna, S.K. & Justo, C.E.G. Highway Engineering, Nem Chand & Bros
3. Pavement Engineering Principles and Practice – Kandhal & Mallick, CRC Press.
4. Relevant IS and IRC Codes.

Construction of Bridge and Industrial Structures (CEM-206)

L-3, T-1, Credit-4

Prerequisites: Basic knowledge of Structural Engineering, Reinforced Concrete and Steel Structures, Construction Materials and Methods

Module 1: Bridge Construction

Types of bridges in Indian practice: Highway, Railway & Pedestrian bridges; Flyovers, Viaducts & Aqueducts; Culverts & Box Girder Bridge; Bailey Bridge; Foundations and substructures, superstructure construction methods, launching techniques, prestressed concrete bridges, bridge erection equipment and safety practices.

Module 2: Industrial Structures

Industrial buildings and plant structures, steel industrial sheds, chimneys, silos, bunkers, cooling towers, storage tanks, fabrication and erection techniques, industrial safety and quality control.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain construction methods of highway, railway, and pedestrian bridge systems.

CO2: Analyze bridge substructures, superstructures, and launching techniques.

CO3: Evaluate prestressed concrete bridge construction practices & safety requirements.

CO4: Interpret design and construction features of industrial structural systems.

CO5: Apply fabrication and erection techniques for steel industrial structures effectively.

CO6: Assess industrial safety & quality control practices for structural construction activities.

References

1. Construction of Bridges by N. Krishna Raju
2. Design and Construction of Steel Structures by S. S. Bhavikatti
3. IRC Codes and Indian Roads Congress publications
4. Relevant Bureau of Indian Standards Codes

Advanced Quantity Surveying (CEM-207)

L-3, T-1, Credit-4

Prerequisites: Estimation and Costing, Basics of Construction Management, Knowledge of Building Drawings and Specifications

Module 1: Advanced Quantity Take-off & Estimation

Detailed quantity take-off methods, quantity surveying for multistorey buildings, highways and infrastructure projects, bar bending schedules, earthwork estimation.

Module 2: Rate Analysis & Market Intelligence

Resource-Based Analysis: Calculation of labour constants, material wastage factors, and equipment hourly costs; Price Escalation: Mathematical modelling for price adjustments in long-term contracts; Indirect Costs: Allocation of site overheads, head office overheads, and profit margins.

Module 3: Contract Administration & Management

FIDIC and Standard Forms: Study of Red, Yellow, and Silver books; Indian Standard contracts (CPWD/MES); Variations and Claims: Documentation of extra items, price variations, and extension of time (EOT); Interim Payments: Preparation of Running Account (RA) bills and final bill certification.

Module 4: Cost Control & Value Engineering

Project Cash Flow Analysis; Cost optimization techniques; Life Cycle Costing (LCC): Evaluating long-term maintenance and operational costs vs. initial capital expenditure.

Course Outcomes (COs)

After completing this course, students will be able to:

CO1: Explain advanced quantity estimation methods for buildings and infrastructure projects.

CO2: Prepare bar bending schedules and earthwork estimates using standard procedures.

CO3: Analyze resource-based rate calculations and price escalation mechanisms effectively.

CO4: Interpret contract administration procedures using FIDIC and Indian standard contracts.

CO5: Develop interim payment documentation and claim management strategies for projects.

CO6: Evaluate project costs using cash flow and life cycle costing techniques.

Reference Books

1. Estimating and Costing in Civil Engineering – B.N. Dutta, UBS Publishers.
2. Construction Cost Engineering Handbook – Keith Potts & Nii Ankrah, Routledge.
3. Construction Project Management – K.K. Chitkara, McGraw-Hill.
4. Relevant IS Codes

Construction Economics and Finance (CEM-208)

L-3, T-1, Credit-4

Prerequisite: Engineering Economics.

Module 1: Cost Estimation Techniques

Preliminary estimates, detailed Bill of Quantities (BOQ), unit rate analysis, RS Means method, and parametric estimating.

Module 2: Time Value of Money

Present/future value, Net Present Value (NPV), Internal Rate of Return (IRR), Benefit–Cost Ratio (B/C ratio), depreciation methods – Straight Line Method (SLM), Written Down Value Method (WDV), annuity calculations.

Module 3: Value Engineering

Function analysis, FAST diagramming, life-cycle costing, VE job plan, case studies.

Module 4: Project Financing Models

PublicPrivate Partnership, Hybrid Annuity Model (HAM), ESCROW Account and mechanisms, debt-equity ratio, working capital management, Different funding agencies

Module 5: Risk and Inflation Analysis

Escalation indices by regulatory bodies, sensitivity analysisfinancial risk analysis, insurance&financial derivatives.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain cost estimation methods for construction & infrastructure development projects.

CO2: Analyze investment decisions using time value of money concepts.

CO3: Evaluate project feasibility through financial indicators and depreciation techniques.

CO4: Apply value engineering principles for cost-effective project planning and execution.

CO5: Interpret project financing models and funding mechanisms in construction management.

CO6: Assess financial risks and inflation impacts using sensitivity analysis techniques.

Reference Books

1. Construction Project Scheduling and Control by Saleh A. Mubarak (Wiley, 4th Ed.).
2. Financial Management: Theory & Practice by Prasanna Chandra (Tata McGraw Hill, 10th Ed.).
3. Construction Financial Management by S. Keoki Sears (Wiley).

Human Resource Management in Construction (CEM-209)

L-3, T-1, Credit-4

Prerequisite: Organizational Behaviour.

Module 1: Labour Laws and Regulations

Building Workers Act 1996, Contract Labour Act, Wages Code 2019, PF and ESIC compliance, and migrant worker welfare.

Module 2: HRM Planning and Recruitment

Manpower planning, skill mapping, competency frameworks, contractor labour management, e-HRMS systems.

Module 3: Training and Development

Skill certification (NSTC, MES), safety training, leadership programs, on-site apprenticeship models.

Module 4: Performance Management

KPI setting, 360-degree appraisal, incentive schemes, disciplinary procedures, grievance redressal.

Module 5: Industrial Relations and Conflict Resolution

Collective bargaining, strikes/lockouts, mediation/arbitration, team building, motivation theories (Herzberg, Vroom).

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain labour laws and workforce compliance requirements in construction industries.

CO2: Analyze manpower planning and recruitment strategies for construction organizations.

CO3: Develop workforce training and skill enhancement programs for project personnel.

CO4: Evaluate employee performance using appraisal and incentive management systems.

CO5: Interpret industrial relations practices and grievance handling procedures effectively.

CO6: Assess conflict resolution and motivational approaches for effective team management.

Reference Books

1. Human Resource Management in Construction Projects by Martin Loosemore (Taylor & Francis).
2. Construction Human Resource Management by A. Dainty (Spon Press).
3. Labour Laws for Managers by S. N. Mishra (Excel Books).

Construction Marketing and Business Development (CEM-210)

L-3, T-1, Credit-4

Module 1: Introduction to Construction Marketing

Concepts and scope of project marketing; Characteristics of construction and infrastructure markets; Marketing environment and market segmentation

Module 2: Market Analysis and Opportunity Identification

Market survey and demand forecasting; SWOT and competitor analysis; Identification of business opportunities

Module 3: Business Development Strategies

Strategic planning and growth management; Branding and corporate image; Client relationship and stakeholder management; Joint ventures and strategic alliances

Module 4: Emerging Trends in Construction Business

Digital marketing and e-business tools; Sustainable and green construction markets; International construction business trends; Entrepreneurship and innovation in construction sector.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain marketing concepts and characteristics of construction business environments.

CO2: Analyze market trends using demand forecasting and competitor assessment techniques.

CO3: Identify business opportunities through strategic market and stakeholder analysis.

CO4: Develop branding and client relationship strategies for construction organizations.

CO5: Evaluate joint ventures and strategic alliances for business growth management.

CO6: Assess emerging digital and sustainable trends in construction business development.

Sustainable Techniques in Construction Technology (CEM-211)

L-3, T-1, P-0, Credit-4

Prerequisite: Building Codes, Environmental Engineering and Sciences, Surveying and GIS.

Module 1: Green Material

Sustainable construction materials: recycled aggregates, fly ash bricks, AAC blocks, low-carbon cement, geopolymer concrete, bamboo, and natural fibre composites. Permeability, durability, and embodied carbon assessment of materials.

Module 2: Green Building Rating and Energy-Efficient Systems

LEED/IGBC/GRIHA rating systems, Solar PV panel efficiency testing, cool roof reflectivity and emissivity measurement, daylight factor measurement, building envelope U-value calculations, passive design strategies, and introduction to building energy simulation tools.

Module 3: Water Conservation Techniques

Rainwater harvesting system models, greywater treatment and reuse, dual plumbing and low-flow fixtures, leak detection techniques, water audit procedures, water balance analysis for buildings and campuses.

Module 4: Construction Waste Management & Circular Economy

Construction and demolition (C&D) waste segregation, recycling and reuse potential assessment, lean construction simulation, life-cycle thinking in material reuse, waste quantification, reduction strategies and circular economy

Module 5: Environmental Impact Assessment (EIA) for Construction Projects

Introduction to EIA principles and regulatory framework, screening and scoping for building/infrastructure projects, identification of environmental impacts (air, water, noise, ecology, socio-economic). Preparation of Environmental Management Plan (EMP), mitigation measures, sustainability indicators, compliance monitoring, and environmental audit for construction sites.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain sustainable construction materials and their environmental performance.

CO2: Analyze green building rating systems and energy-efficient building strategies.

CO3: Evaluate water conservation techniques through audits and reuse system analysis.

CO4: Assess construction waste management practices using circular economy principles.

CO5: Interpret environmental impacts of construction projects using EIA methodologies.

CO6: Develop sustainability measures and environmental management plans for construction projects.

Reference Books

1. IGBC Green New Buildings Rating System Manual (IGBC).
2. LEED Reference Guide for Green Building Design (USGBC).
3. Sustainable Construction Technology by Raymond E. Tomeski.

Practical

Quantity Surveying (CEM-291)

L-1, T-0, P-2, Credit-2

Prerequisite: Quantity Surveying, Estimation and Costing.

Project on Bill of quantities of the following: Buildings, Roads and Small Bridges

Rate Analysis of scheduled and non-scheduled items

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain quantity estimation principles for buildings, roads, and bridge projects.

CO2: Prepare detailed bill of quantities using standard measurement procedures.

CO3: Analyze scheduled item rates using standard specifications and cost data.

CO4: Develop rate analysis for non-scheduled construction items systematically.

CO5: Evaluate material, labour, and equipment requirements for project execution.

CO6: Prepare technical project reports incorporating estimation and cost analysis methods.

Dissertation on Literature Review (CEM-281)

L-0, T-2, P-0 Credit-2

A mid-semester and end-semester seminar presentation shall be conducted on a topic selected by the student, which will subsequently be pursued as the dissertation or project internship topic.



Department of Civil Engineering
(Detailed Autonomous Syllabus)

M. Tech., 2nd Yr (3rd Semester)

Theory

Disaster Mitigation in Engineering (CE-301)

L-3, T-1, Credit-4

Prerequisite: Structural Dynamics and Seismology, Engineering Hydrology, Geotechnical and Foundation Engineering.

Module 1: Natural Hazards and Risk Assessment

Earthquake, flood, cyclone, landslide hazards; vulnerability analysis, HAZUS methodology, multi-hazard zoning maps, probabilistic seismic hazard assessment (PSHA), return period estimation and risk quantification.

Module 2: Disaster Preparedness and Emergency Planning

Disaster management cycle, National Disaster Management Authority (NDMA) guidelines, emergency response plans (ERP), risk mitigation matrix, early warning systems, community-based disaster management, evacuation modelling, and construction site-specific contingency plans.

Module 3: Disaster-Resilient Structural Consideration

Overview of seismic design as per IS 1893 and ductile detailing (IS 13920), Base isolation systems, energy dissipation devices (dampers), performance-based seismic design, flood-resistant foundations and elevated structures, wind load provisions (IS 875 Part 3) and wind tunnel testing.

Module 4: Construction Phase Disaster Management

Site safety during monsoons, temporary works stability, crane operations in high winds and site evacuation drills, business continuity planning, insurance coverage for natural perils, risk management during execution in hazard-prone areas.

Module 5: Post-Disaster Damage Assessment and Case Studies

Damage assessment protocols, rapid visual screening (RVS), Post-disaster reconnaissance and recovery planning, build-back-better principles, resilient reconstruction codes, Case studies in India

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Explain natural hazards and risk assessment techniques for infrastructure systems.

CO2: Analyze disaster preparedness using emergency planning and mitigation frameworks.

CO3: Evaluate seismic, flood, and wind-resistant structural design considerations.

CO4: Apply disaster management practices during construction in hazard-prone areas.

CO5: Assess post-disaster damage using rapid screening and recovery methods.

CO6: Develop resilient reconstruction strategies following disaster management guidelines.

Reference Books

1. Disaster Management by G.K. Ghosh (AP Publications).
2. National Disaster Management Guidelines (NDMA, Government of India).
3. Earthquake Resistant Design of Structures by S.K. Duggal (Oxford University Press).
4. NDMA Guidelines: Construction Safety in Disasters.