Department of Civil Engineering

(Detailed Autonomous Syllabus)

M. Tech., 1st Yr (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).

Practical

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: Schimidt 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 bySoftwares (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.