

**LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY**  
**(An Autonomous Institution)**  
**DEPARTMENT OF CIVIL ENGINEERING**  
**SCHEME OF INSTRUCTIONS & EXAMINATIONS[LR-26]**  
**(w.e.f. Academic Year 2026 – 27)**  
**M.E. (Civil Engineering) I– Semester**  
**Specialization in Construction Management**

| S.No.                       | Course Code | Category | Course Title                          | Scheme of Instructions |   |     |                    | Scheme of Examination |     |                   | Credits |
|-----------------------------|-------------|----------|---------------------------------------|------------------------|---|-----|--------------------|-----------------------|-----|-------------------|---------|
|                             |             |          |                                       | L                      | T | P/D | Contact Hours/Week | Maximum Marks         |     | Duration in Hours |         |
|                             |             |          |                                       |                        |   |     |                    | CIE                   | SEE |                   |         |
| Theory Course               |             |          |                                       |                        |   |     |                    |                       |     |                   |         |
| 1                           | P26CM101    | PCC      | Construction Management               | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 2                           | P26CM102    | PCC      | Construction Project Administration   | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 3                           | P26CM103    | PCC      | Construction Equipment and Management | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 4                           | P26MB111    | MC       | Research Methodology & IPR            | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 5                           | -           | PEC      | Professional Elective–I               | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 6                           | -           | PEC      | Professional Elective–II              | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| Practical/Laboratory Course |             |          |                                       |                        |   |     |                    |                       |     |                   |         |
| 7                           | P26CM1L1    | PCC      | Construction Engineering Lab - I      | -                      | - | 2   | 2                  | 50                    | -   | 2                 | 1       |
| 8                           | P26CM1P1    | Proj     | Seminar                               | -                      | - | 2   | 2                  | 50                    | -   | 2                 | 1       |
| Total                       |             |          |                                       | 18                     | - | 4   | 22                 | 340                   | 360 | 22                | 20      |

L: Lecture (Hrs/Wk/Sem)

T: Tutorial (Hrs/Wk/Sem)

P: Practical

D: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation

SEE: Semester End Examination

MC: Mandatory Course

PCC: Program Core Courses

PEC: Professional Elective Courses

AD: Audit Course

CM: Construction Management

MB: Master of Business

**Note:**

- Each contact hour is a Clock Hour.
- The practical class can be of two and half hour (clock hours) duration as per the requirement of a Particular laboratory.

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**PROFESSIONAL ELECTIVES COURSES**

| S. No.        | Course Code | Category | Course Title                                    | Scheme of Instructions |   |      |                    | Scheme of Examination |     |                   | Credits |
|---------------|-------------|----------|-------------------------------------------------|------------------------|---|------|--------------------|-----------------------|-----|-------------------|---------|
|               |             |          |                                                 | L                      | T | P/ I | Contact Hours/Week | CIE                   | SEE | Duration in Hours |         |
| Theory Course |             |          |                                                 |                        |   |      |                    |                       |     |                   |         |
| 1             | P26CM104    | PEC 1    | Economic Decision Analysis in Construction      | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM105    |          | Legal Issues in Construction Management         | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM106    |          | Statistical Techniques                          | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
| 2             | P26CM107    | PEC 2    | Quantitative methods in Construction Management | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM108    |          | Structural Health Monitoring                    | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM109    |          | Green Building Technology                       | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
| 3             | P26CM204    | PEC 3    | Neural Fuzzy and Expert Systems                 | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM205    |          | Value Engineering in Construction               | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM206    |          | TQM techniques in Construction                  | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
| 4             | P26CM207    | PEC 4    | Human Resources Development for Construction    | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM208    |          | Advanced Concrete Technology                    | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM209    |          | Construction Safety Management                  | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |

### PROFESSIONAL ELECTIVES WITH THREE THREADS

| S.No | PE 1                                       | PE 2                                            | PE 3                              | PE 4                                         |
|------|--------------------------------------------|-------------------------------------------------|-----------------------------------|----------------------------------------------|
| 1.   | Economic Decision Analysis in Construction | Quantitative methods in Construction Management | Neural Fuzzy and Expert Systems   | Human Resources Development for Construction |
| 2.   | Legal Issues in Construction Management    | Structural Health Monitoring                    | Value Engineering in Construction | Advanced Concrete Technology                 |
| 3.   | Statistical Techniques                     | Green Building Technology                       | TQM techniques in Construction    | Construction Safety Management               |

| Course Code  | Course Title            |   |   |   |     | Core/Elective |         |
|--------------|-------------------------|---|---|---|-----|---------------|---------|
| P26CM101     | CONSTRUCTION MANAGEMENT |   |   |   |     | core          |         |
| Prerequisite | Contact Hours per Week  |   |   |   | CIE | SEE           | Credits |
|              | L                       | T | D | P |     |               |         |
| -            | 3                       | - | - |   | 40  | 60            | 03      |

**Course Objectives**

The objectives of this course are

1. To understand the fundamental principles of construction management including planning, organizing leading, and controlling.
2. To analyze the nature of managerial decision making in the construction industry and the rational model of decision making.
3. To identify challenges in decision making and learn tools & techniques to improve decision effectiveness.
4. To apply analytical methods such as benefit cost analysis, replacement analysis, and break even analysis in construction projects.
5. To develop skills in risk management and mitigation strategies specific to the construction industry.

**Course Outcomes**

After Completion o this course, the student will be able to

1. Students will be able to explain and apply the principles of construction management (planning, organizing, staffing, leading, controlling) in real projects.
2. Students will demonstrate an understanding of decision-making processes and the rational model, and 3. Students will be able to evaluate and overcome challenges in managerial decision making using appropriate tools and techniques.
4. Students will be proficient in performing benefit-cost, replacement, and break-even analyses for construction project evaluation.
5. Students will be able to design and implement risk management strategies to minimize project uncertainties and improve performance.

**UNIT- I**

Introduction to management, science & art of construction management; modern management; system approach & emergence of management thought; need, nature & purpose of construction management; major problems in the construction industry; firm organization, chain of command, division of work, organization charts, functions & responsibilities of a construction manager case studies future of construction management.

**UNIT- II**

Principles of construction management: planning, organizing, staffing, leading, controlling. Decision making in construction industry; nature of managerial decision making; the rational model of decision making; challenges to the rational model; improving decision making effectiveness with tools & techniques benefit cost analysis, replacement analysis, break even analysis; risk management in construction industry.

**UNIT- III**

Site mobilization & demobilization aspects; various resource management based on funds availability; organization & monitoring of construction work with respect to cost time schedules; coordinating, communicating & reporting techniques application of MIS to construction training of construction managers.

**UNIT- IV**

Work Study: Definition, objectives, basic procedure, method study & work measurement work study applications in Civil Engineering. Method Study: Definition, objective, procedure for selecting work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams.

**UNIT V**

Work Measurement and AI Applications-Time and Motion Studies Concept of Standard Time and Various Allowances-Time Study-Equipment Performance Rating Activity Sampling-Time-Lapse Photography Technique-Analytical Production Studies-AI Applications in Work Measurement and Productivity Analysis-Use of AI for Equipment Performance Monitoring

**Text Books**

1. Roy Pilcher (1985)“Project Cost Control in Construction”, Collins Professional& Technical Books, London.
2. Rama C.M. “Construction Management& Practice” Tata McGraw-Hill, NewDelhi,1980.

**References**

1. Tenah, K.A. (1985) “The Construction Management Process” Reston Publishing Company, Virginia, USA.
2. Construction Planning & Management by PS Gahlot & BM Dhir, New Age International Limited Publishers.
3. Construction Project Planning & Scheduling by Charles Patrick, Pearson, 2012.
4. Construction Project Management Theory & Practice–Kumar Neeraj Jha, Pearson, 2012.
5. Construction Management Fundamentals by Knutson, Schexnayder, Fiori, Mayo, Tata McGraw Hill, 2nd Edition, 2011.

| Course Code  | Course Title                        |   |   |   |     | Core / Elective |         |
|--------------|-------------------------------------|---|---|---|-----|-----------------|---------|
| P26CM102     | CONSTRUCTION PROJECT ADMINISTRATION |   |   |   |     | Core            |         |
| Prerequisite | Contact Hours per Week              |   |   |   | CIE | SEE             | Credits |
|              |                                     | T | D | P |     |                 |         |
| -            |                                     | - | - | - | 40  | 60              | 03      |

**Course Objectives**

The objectives of this course is to:

1. To understand the **organizational structure and administrative framework** of construction projects.
2. To study **modern project delivery systems and digital management tools** used in construction industry.
3. To identify **risks, safety issues and mitigation strategies** associated with construction projects.
4. To understand **construction drawings, specifications, BIM concepts and regulatory requirements**.
5. To learn **preconstruction planning, tendering procedures and project coordination techniques**.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Understand construction administration practices and **quality management in construction projects**.
2. To be able to have an idea of hierarchy, work responsibility and work progress.
3. To be able to understand risks and uncertainty related issues in constructions
4. To be able to understand the IS specifications and drawings for the Civil Engineering Construction projects.
5. To be able to understand the pre-construction operations and techniques.

**UNIT-I****Introduction to Construction Administration**

Introduction to Construction Project Administration, Organizational Structure in Construction Projects, Role of Owner, Contractor, Engineer and Construction Manager, Coordination among project participants, Control of Quality in Construction, Modern Project Delivery Systems such as Design-Bid-Build, Design-Build and EPC Contracts, Overview of digital construction management systems.

**UNIT-II****Construction Organization and Documentation**

Introduction to authority and lines of authority in construction administration, Staffing responsibilities and hierarchy in construction projects, Roles of Project Manager, Site Engineer and Quantity Surveyor, Construction documentation and contract documents, Familiarization with construction drawings and specifications, Digital documentation systems and collaboration platforms, Introduction to Building Information Modelling (BIM).

**UNIT-III****Construction Risk and Safety Management**

Reasons for risks in construction projects, Concepts of certainty, risk and uncertainty, Risk management process, Identification and nature of construction risks, Contractual allocation of risks, Types of risks in construction industry, Minimizing risks and mitigating losses, Decision making techniques such as expected value method, decision trees and sensitivity analysis, Introduction to construction safety management practices.

**UNIT-IV****Construction Specifications and Drawings**

Role of Engineers and Architects in construction documentation, Construction drawings and their interpretation, Specifications and standards in construction projects, Conflicts between drawings and specifications, CSI specification format, Allowances and tolerances in specifications, Municipal regulations and approval procedures, Introduction to BIM-based drawing coordination and clash detection.

**UNIT-V****Preconstruction Operations and Tender Management**

Need for preconstruction operations, Constructability analysis, Planning of equipment, materials and manpower, Issuance of bidding documents, Prequalification of bidders, Bonds and guarantees, Opening and evaluation of bids, Acceptance and documentation of bids, Advantages and limitations of preconstruction operations.

**Text Books:**

1. Construction Project Administration, Fisk, E.R. (2000), Prentice Hall International, London..
2. Construction Project Administration, Kwakye, A.A. (1997), Addison Wesley Longman, London.
3. Project Management in Construction – K.K. Chitkara, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Construction Management and Planning – B.K. Sengupta and H. Guha, Tata McGraw Hill Publishing Company Ltd., New Delhi.

**References Books:**

1. Construction Project Management – Krishan Kumar Chitkara, McGraw Hill, 2019.
2. Construction Project Management: A Practical Guide to Field Construction Management – S. Keoki Sears, Glenn A. Sears, Richard H. Clough, Wiley Publication, 2015.
3. Project Control – Integrating Cost and Schedule in Construction – W.J. Del Pico, Wiley Publication, 2013.
4. Total Construction Project Management – George Ritz and Sidney Levy, McGraw Hill, 2013.
5. Construction Project Management – Frederick Gould and Nancy Joyce, Prentice Hall, 2013.

| Course Code  | Course Title                          |   |   |   | Core / Elective |     |         |
|--------------|---------------------------------------|---|---|---|-----------------|-----|---------|
| P26CM103     | Construction Equipment and Management |   |   |   | Core            |     |         |
| Prerequisite | Contact Hours per Week                |   |   |   | CIE             | SEE | Credits |
|              | L                                     | T | D | P |                 |     |         |
| -            | 3                                     |   |   |   | 40              | 60  | 3       |

**Course Objectives**

The objectives of this course is to:

1. To understand the importance of Pre-Fabrication Construction.
2. To apply Modular Coordination using I.S. Recommendations.
3. To understand Construction Equipment's and Safety in Cranes operation.
4. To utilize Concrete Mixtures and their Characteristics Performance in Building process.
5. To understand Characteristics, Performance and Applications of Conveying Equipment.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Gain knowledge on importance of Pre-Fabrication Construction.
2. Analyze Modular Coordination using I.S. Recommendations.
3. Recognize Construction Equipment's and Safety in Cranes operation.
4. Able to use Concrete Mixtures and their Characteristics Performance in Building process.
5. Gain knowledge on Conveying Equipment's.

**UNIT-I**

Precast and Prefabricated construction - need for prefabrication, classification and scope. Advantages and disadvantages of prefabrication and design principles of prefabrication system.

**UNIT-II**

Modular coordination and its importance, I.S. Recommendations for modular planning, standardization, mass production and methods of Transportation.

**UNIT-III**

Construction equipment- hoisting equipment such as hoist winch, hoisting chains and hooks, slings. Various types of cranes - tower crane, mobile crane, and derrick crane, safety in crane operations, their characteristics performance and applications to building process.

**UNIT-IV**

Concrete mixers, truck mixers, pneumatic concrete placer and vibrators for concrete, and Scaffolding. Their characteristics performance and applications to building process.

**UNIT-V**

Conveying equipment - package conveyor, screw conveyor, bucket conveyor and different types of belts, their Characteristics, performance and applications.

**Text Books:**

1. Construction, Planning, Equipment and Methods, Peurify, R.L., McGraw-Hill Book Company, Inc, NY (2010), ..
2. Construction Equipment and its planning & applications, Mahesh Varma, Metropolitan Book Co (P) Ltd, New Delhi, India (1997).

**References Books:**

1. Construction Planning and Management, U.K. Srivastava, Galgotia Publications Pvt., Ltd, New Delhi, India (1999).
2. Construction Equipment and Management for Engineers Estimators and Owners, Granberg G.,Popescu M, Taylor and Francis Publishers, New York, 2006,
3. Construction Equipment and Job Planning, Deodhar, S.V., Khanna Publishers, New Delhi, 2001.
4. Building Construction, Planning Techniques and Method of Construction, Arora S.P. and Bindra S.P., Dhan Patrai and Sons, 2010.
5. Construction Equipment and Management, Sharma S.C., Khanna Publishers, New Delhi, 2008.

| Course Code  | Course Title                 |   |   |   | Core/Elective |     |
|--------------|------------------------------|---|---|---|---------------|-----|
| P26MB111     | RESEARCH METHODOLOGY AND IPR |   |   |   | MC            |     |
| Prerequisite | Contact Hours per Week       |   |   |   | CIE           | SEE |
|              | L                            | T | D | P |               |     |
| -            | 3                            | - | - | - | 40            | 60  |

**Course Objectives**

The objectives of this course is to:

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Define research problem, review and assess the quality of literature from various sources
2. Improve the style and format of writing a pyrotechnical paper/Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

**UNIT-I**

**Research Methodology:** Objectives and motivation of research, Types of research, Research approaches, Significance of research, Research methods versus Methodology, Research process, Criteria of good research, Problems encountered by researchers in India, Benefits to the society in general, Defining the Research problem, Selection of research problem, Necessity of defining the problem

**UNIT-II**

**Literature Survey and Report writing:** Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Need of Review, Guidelines for Review, Record of Research Review.

**Report writing:** Meaning of interpretation, Layout of research report, Types of reports, Mechanism of writing a report.

**Research Proposal Preparation:** Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

**UNIT-III**

**Research Design:** Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, Types of sample designs.

**UNIT-IV**

**Data Collection and Analysis:** Methods of data collection, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data, Importance of Parametric, Non-parametric test, Testing of variance of two normal populations, Use of Chi-square, ANOVA, F-test, z-test

**UNIT-V**

**Intellectual Property Rights:** Meaning, Nature, Classification and protection of Intellectual Property, the main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

**Text Books:**

1. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**References:**

1. Research Methodology, Methods & Techniques; C.R Kothari, New Age International Publishers, 2004
2. Research Methodology for Engineers, R.Ganesan, MJP Publishers, 2011
3. Statistical Methods: Concepts, Application and Computation, Y.P. Agarwal, Sterling Publications Pvt. Ltd., New Delhi, 2004
4. Intellectual Property Rights and the Law, G.B.Reddy, 5th Ed. 2005 Gogia Law Agency  
Indian Patents Law –Legal & Business Implications, Ajit Parulekar and Sarita D'Souza, Macmillan India Ltd, 2006

| Course Code  | Course Title                              |   |   |   | Core/Elective |     |         |
|--------------|-------------------------------------------|---|---|---|---------------|-----|---------|
| P26CM104     | ECONOMIC DECISION ANALYSIS INCONSTRUCTION |   |   |   | PEC-1         |     |         |
| Prerequisite | Contact Hours per Week                    |   |   |   | CIE           | SEE | Credits |
|              | L                                         | T | D | P |               |     |         |
| -            | 3                                         | - | - | - | 40            | 60  | 3       |

**Course Objectives**

The objectives of this course is to:

1. To cover the principles engineering economy followed by basic methods for carrying out economic studies considering the time value of money
2. To demonstrate various interest formula methods namely present, future, annual worth method, rate of return method and break-even analysis for the comparison of alternatives.
3. To understand various methods of depreciation, tax and cost analysis of construction equipment's followed by cost estimating.
4. To manage and control the inventory and cost of production.
5. To estimate the economic life of an asset with inflation effect.

**Course Outcomes**

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

1. Highlight the basic principles of economics and its concepts.
2. To prepare various interest formula for the comparison of alternatives.
3. Use updated techniques, skills and tools of industrial engineering throughout their professional careers.
4. To acquire fundamental knowledge and understanding of production and industrial engineering.
5. Able to estimate the Economic life of an Asset with Inflation effect

**UNIT-I**

Introduction to engineering economics, basic economic concepts related to construction industry- marginal cost, marginal revenue, opportunity cost contribution, time perspective, elementary economic analysis-material selection for a product, design selection, building material and process planning.

**UNIT-II**

Interest formulae and their applications- time value of money, present worth method, future worth method, annual equivalent method, rate of return method.

**UNIT-III**

Replacement and maintenance analysis, determination of economic life of an asset, depreciation-straight line method of depreciation, declining balance method of depreciation, sum of the year's digits methods depreciation, sinking funds method of depreciation etc.

**UNIT-IV**

Production and function, cost of production, inventory cost management, optimum rise of construction, input-output analysis in the construction industry.

**UNIT-V**

Inflation, procedure to adjust inflation, economic life determination without inflation effect, economic life determination with inflation effect, measurement of inflation, impact of inflation on economic evaluations, growth of multinational construction companies.

**Text Book:**

- 1.Economics for the construction industry, Shutt R.C. (1995), Longman Scientific and Technical, England.
- 2.Engineering Economics, Panneerselvam, R. (2001), Prentice Hall of India, India.

**Reference:**

- 1.Anthony J Tarquin, Leland T Blank, Engineering Economy-A Behavioral Approach, McGraw-Hill, 1976.
4. R L Peurifoy, Solutions to Problems in Estimating Construction Costs, McGrawHill, ©1975
- 2.Blank, L.T., and Tarquin,a.J (1988) Engineering Economy,4th Edn. Mc-Graw Hill Book Co.
- 3.Collier C and GlaGola C (1998) "Engineering Economics & Cost Analysis", 3nd Edn. Addison Wesley Education Publishers.
- 4.Patel, B M (2000) "Project management-strategic Financial Planning, Evaluation and Control", Vikas Publishing House Pvt. Ltd. New Delhi.
- 5.Shrivastava,U.K., (2000)"Construction Planning and Management",2ndEdn. Galgotia Publications Pvt. Ltd. New Delhi.
- 6.Steiner, H.M. (1996) "Engineering Economic principles", 2nd Edn. Mc-Graw Hill Book

| Course Code  | Course Title                            |   |   |   | Core / Elective |     |         |
|--------------|-----------------------------------------|---|---|---|-----------------|-----|---------|
| P26CM105     | Legal Issues in Construction Management |   |   |   | PEC-I           |     |         |
| Prerequisite | Contact Hours per Week                  |   |   |   | CIE             | SEE | Credits |
|              | L                                       | T | D | P |                 |     |         |
| -            | 3                                       |   |   |   | 40              | 60  | 03      |

**Course Objectives**

The objectives of this course is to:

1. To study the various types of construction contracts and their legal aspects and provisions
2. To study the tenders, legal requirements, labor and human rights regulations
3. To understand the duties and responsibilities of construction administration
4. To study the disputes and liabilities in construction
5. To understand the dispute resolution in construction & conciliation Act 1996

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Student shall able to know basics on construction related contracts.
2. Students shall be able to carry out the tendering process
3. Overview of construction management, administration and present
4. Status of construction industry. Students shall be aware of labor law related legislations
5. Students shall be able to know dispute resolution mechanism

**UNIT-I**

**Introduction to Construction Law:** Need for legal issues in Construction in the Indian Judicial System – Context of Construction Industry, Principles of a Contract, Indian Contract Act 1872 – Provisions for Construction Industry, Essentials of a Valid Contract, Types of Contracts, Alternate Contract Methods, Concept of Completion of a Contract, IT Law 2000 and its Influence on construction Contracts

**UNIT-II**

**Construction Tendering Process:** Introduction to Construction Process, Need for tendering, process of Tendering in Construction, Importance of Specifications and Estimates in Construction, Concept of completion of the contract, Sub-Contracts and requirements, Tendering Models and Strategies, Prequalification of Bidders, Documents forming a BID and a Contract, Agreements and Bonds in Tendering Process

**UNIT-III**

**Construction Administration:** Duties and Responsibilities – Project Manager, Owner, Engineers and Contractors, Important Site Documents, Process of Building Permissions, Provision for Scheduling delays and accelerations, Environmental Provisions for Construction Contracts.

**UNIT-IV**

**Disputes and Liabilities in Construction:** Major sources of disputes in construction, Delays – Types, Claims and solutions, Labor Laws in India, Worker Compensation and Insurance laws, Construction Liabilities and Litigations, Disputes in Land Development,

**UNIT-V**

**Dispute Resolution in Construction:** Dispute Resolution in Construction, Judicial Process in Dispute Resolution, Alternate Dispute resolution methods, Arbitration and Conciliation Act 1996, Importance of Arbitration in Construction, Arbitration Process, Arbitration Clause in Contracts

**Text Book:**

1. Gajaria G.T., *Laws Relating to Building and Engineering Contracts in India*, 1 January 2000
2. Joseph T. Bockrath, *Contracts and the Legal Environment for Engineers and Architects*, McGraw Hill, 2000

**Reference:**

1. Jimmie Hinze, *Construction Contracts*, McGraw Hill, 2001.
2. Kwaku, A., Tenah, P.E. Jose M. Guevara, P.E., *Fundamentals of Construction Management and Organisation*, Printice Hall, 1985. M.M. Tripathi Private Ltd., Bombay, 1982.
3. Patil. B.S, *Civil Engineering Contracts and Estimates*, Universities Press (India) Private Limited, 2006.
4. Indian Contract Act 1892
5. Indian Arbitration and Conciliation Act, 1996

| Course Code  | Course Title           |   |   |   | Core/Elective |     |         |
|--------------|------------------------|---|---|---|---------------|-----|---------|
| P26CM106     | STATISTICAL TECHNIQUES |   |   |   | PEC-1         |     |         |
| Prerequisite | Contact Hours per Week |   |   |   | CIE           | SEE | Credits |
|              | L                      | T | D | P |               |     |         |
| -            | 3                      | - | - | - | 40            | 60  | 3       |

**Course Objectives**

The objectives of this course is to:

1. To introduce fundamental knowledge of sampling technique
2. To describe basic techniques of statistical distributions
3. To express essential statistical procedure of regression & correlation methods
4. To study the multivariate data distributions methods
5. To impart knowledge on exact sampling distributions and the tests of significance

**Course Outcomes:**

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

1. Students who successfully complete this course will be able to:
2. Use sampling techniques for conducting various surveys related to transportation engineering
3. Decide best fit and develop the regression equations for the given variables
4. Applications of sampling distributions in Highway and Traffic Engineering problems.
5. Applications of sampling distributions to construction Engineering problems

**UNIT-I**

**Introduction:** Frequency distribution; Measures of central tendency; Measures of dispersion; Standard error, Moments (about mean, arbitrary numbers and origin); Skewness; Kurtosis; Sampling-Definitions and Applications; Simple random sampling; Stratified sampling; Systematic sampling; Sample size determination; Applications in Highway and Traffic Engineering

**UNIT-II**

**Statistical Distribution;** Probability, Bayes' Theorem; Binomial, Poisson, Exponential and Normal distributions; Fitting of distributions; Mean and variance; Chi-square test of goodness- of-fit; Applications in Highway and traffic Engineering. Mathematical expectation.

**UNIT-III**

**Regression and Correlation:** Linear regression and correlation; Multiple correlation; Multiple correlation coefficient; Standard error of estimate; Analysis of variance; Curvilinear regression; Applications in Transportation Engineering.

**UNIT-IV**

**Multi Variate Data Distributions;** Types of data; Basic vectors and matrices; Simple estimate of centroid, Standard deviation Variance and covariance; Correlation matrices; Principal component analysis; Time series analysis. Estimation- Point Estimation, Interval Estimation, Box Plot, Maximum likelihood estimation, Biased & Non-Biased Estimation.

**UNIT - V**

**Exact Sampling Distributions and Tests of Significance;** Chi-square distribution; students t- distribution; Snedecors F- distribution. Large sample and small sample tests; Tests for single mean. Means of two samples, Proportions, two variances, two observed correlation coefficients, paired T-tests, Applications. Intervals for mean, variance and regression coefficients, Applications in Highway and Traffic Engineering Problems.

**Text Book:**

1. Basic Statistics - Simpson and Kafks; Oxford and IBH Calcutta,1969.
2. Fundamentals of Mathematical Statistics - Gupta, S.C. and Kapoor, K.V. Sultanchand Multivariate Data Analysis – Cootey W.W & Cochens P.R; John Wiley & Sons, 2014.

**Reference:**

1. Multivariate Data Analysis – Cootey W.W & Cochens P.R; John Wiley & Sons
2. Fundamentals of Statistics: D.V.Elhance and Veena Elhance
3. Statistical Analysis: Dr.Rahul Sawlikar and Dr.R.P.Ingole, Payal Prakashan,Nagpur ISBN- 978-81-922554-3-9
4. Statistics: R.S.N.Pillai and V.Bagavathi,S.Chand and Company, New Delhi
5. Standard Problems and Formulae of Statistics: Dr.Rahul Sawlikar, Dr.S.B. Kishor, Das Ganu Prakashan,Nagpur ISBN- 978-93-81660-24-9

| Course Code  | Course Title                                    |   |   |   | Core/Elective |     |         |
|--------------|-------------------------------------------------|---|---|---|---------------|-----|---------|
| P24CM107     | QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT |   |   |   | PEC-2         |     |         |
| Prerequisite | Contact Hours per Week                          |   |   |   | CIE           | SEE | Credits |
|              | L                                               | T | D | P |               |     |         |
| -            | 3                                               | - | - | - | 40            | 60  | 3       |

**Course Objectives**

The objectives of this course is to:

1. To study the various quantitative methods applied to the elements of management.
2. To gain knowledge of formulation of optimization models using various methods.
3. To understand transportation model utility in construction industry
4. To modify and improve network flow problems to optimize the resources.
5. To study the modifications and improvements on CPM/PERT techniques.

**Course Outcomes**

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

1. Able to understand transportation model utility and its application in construction industry
2. Understand modification of network flow problems to optimize the usage of resources.
3. Understand the concept of simulation, decision theory, sequencing and queuing theory.
4. Understand modification of network flow problems to optimize the usage of resources.
5. Understand the concept of simulation, decision theory, sequencing and queuing theory

**UNIT-I**

Introduction, phases of operations research (or), models and scope of or in construction management, concept of probability and statistics - classical methods such as monte-carlo and lagrangian multiplier methods.

**UNIT-II**

Standard formulation of linear programming, graphical solutions of linear programming, simplex method, linear programming and their computer solutions, characteristics of linear optimization problems.

**UNIT-III**

Transportation problems: introduction, terminology, minimization and maximization problems– formulation of mathematical models – methods of solution of transportation models using north west corner and least cost method and vogel's approximation method. Assignment problems, formulation and solution of assignment problems.

**UNIT-IV**

Dynamic programming: introduction, terminology, need for dynamic programming, characteristics of dynamic programming, application of dynamic programming in construction industry - waiting line models.

**UNIT-V**

Decision theory, game theory, simulation and its applications to construction, Modifications and improvements on CPM/PERT techniques.

**Text Book:**

1. Quantitative Methods in Construction Management. Adrian, J. American Elsevier Publishing Co., Inc., Amsterdam, Netherlands, 1973.
2. Project Management with CPM and PERT and precedence diagramming. oder, J.J., Phillips, C.R., and Davis, E.W.”  
C.B.S. Publishers & Distributors, New Delhi, 1986.

**Reference:**

1. Quantitative Construction Management, Stark, R.M., and Mayer, J.H. John Wiley and Sons, NY, 1983.
2. Management Techniques Applied to the Construction Industry , R Oxley, J Poskitt, Blackwell Science, 1996
3. “Hand Book of Engineering Management”, Andrew,D., Szilagg, 2nd Edition, 2001
4. Construction Project Management, Richard H. Clough, Glenn A. Sears, 2nd Edition, Wiley, 1979.

| Course Code  | Course Title                 |   |   |   |     | Core/Elective |         |
|--------------|------------------------------|---|---|---|-----|---------------|---------|
| P26CM108     | STRUCTURAL HEALTH MONITORING |   |   |   |     | PEC-2         |         |
| Prerequisite | Contact Hours per Week       |   |   |   | CIE | SEE           | Credits |
|              | L                            | T | D | P |     |               |         |
| -            | 3                            | - | - | - | 40  | 60            | 3       |

**Course Objectives**

The objectives of this course is to:

1. Learn the fundamentals of structural health monitoring.
2. Study the various vibration-based techniques for structural health monitoring.
3. Learn the structural health monitoring using fiber-optic and piezoelectric sensors.
4. Study the structural health monitoring using electrical resistance and electromagnetic techniques.
5. Study the experimental modal analysis using LDV

**Course Outcomes:**

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

1. Understand the fundamentals of maintenance and repair strategies.
2. Diagnose for serviceability and durability aspects of concrete.
3. Know the materials and techniques used for repair of structures.
4. Decide the appropriate repair, strengthening, rehabilitation and retrofitting technique required for a case study building.
5. Use an appropriate health monitoring technique and demolition technique.

**UNIT-I**

Introduction to SHM: An Overview of Structural Health Monitoring and Smart Materials

**UNIT-II**

Vibration Control for SHM: Vibration Control using SHM – Introduction to FE formulation, Constitutive Relationship, Element Stiffness Matrix for High Precision Finite Element, Element Mass Matrix for High Precision Finite Element, Developing Actuator and Sensor Influence Matrix, Estimating Sensor Voltage, Active Control of Damping, A Case study of Performance Estimation for Different Patches, SHM of Ribbon Reinforced Composite Laminate

**UNIT-III**

SHM using Piezo and Magneto strictive Layers: Delamination Sensing using Piezo Sensory Layer, Voltage Response from Piezopatch, Electrical Impedance Method basic theory, A Case Study: Results and Discussions, SHM using Magneto strictive Sensory Layer, Basics of Magnetization and Hysteresis, Delamination Sensing using Magneto strictive Sensory Layer, Constitutive relationship with composite relationship, MS Layer insymmetric Laminate, MS Layer Away from the Midplane in Asymmetric Laminate, Case Studies related to MS Layer based SHM

**UNIT-IV**

SHM using LDV: Experimental Modal Analysis using LDV – Introduction, What is LDV?, Velocity and Displacement Measurement using LDV, Case Study for Symmetric Laminate, Case Study for Cross-ply

**Text Book:**

1. Structural Health Monitoring, Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes ,JohnWiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components-Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.

**Reference:**

1. Structural Health Monitoring and Intelligent Infrastructure. Ou, H.Li and Z.D. Duan, Vol-1, Taylor and Francis Group, London, U.K, 2006.
2. Structural Health Monitoring with Wafer Active Sensors, Victor Giurgutiu, AcademicPress Inc, 2007.
3. Smart Materials and Structures, Gandhi and Thompson
4. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang.

| Course Code  | Course Title              |   |   |   |     | Core/Elective |         |
|--------------|---------------------------|---|---|---|-----|---------------|---------|
| P26CM109     | GREEN BUILDING TECHNOLOGY |   |   |   |     | PEC-2         |         |
| Prerequisite | Contact Hours per Week    |   |   |   | CIE | SEE           | Credits |
|              | L                         | T | D | P |     |               |         |
| -            | 3                         | - | - | - | 40  | 60            | 3       |

**Course Objectives**

The objectives of this course is to:

1. Exposure to the green building technologies and their significance.
2. Understand the judicious use of energy and its management.
3. Educate about the Sun-earth relationship and its effect on climate.
4. Enhance awareness of end-use energy requirements in the society.
5. Develop suitable technologies for energy management.

**Course Outcomes:**

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

1. Understand the fundamentals of energy use and energy processes in building.
2. Identify the energy requirement and its management.
3. Know the Sun-earth relationship vis-a-vis its effect on climate.
4. Be acquainted with the end-use energy requirements.
5. Be familiar with the audit procedures of energy.

**UNIT I**

Overview of the significance of energy use and energy processes in building - Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management

- Macro aspect of energy use in dwellings and its implications.

**UNIT II**

Indoor environmental requirement and management - Thermal comfort - Ventilation and air quality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.

**UNIT III**

Climate, solar radiation and their influences - Sun-earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

**UNIT IV**

End-use, energy utilization and requirements - Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building. Heat gain and thermal performance of building envelope - Steady and non-steady heat transfer through the glazed window and the wall - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer

**UNIT V**

Nuclear Medicine–Radioisotopes in medical diagnosis, Basic instrumentation- Radiation Energy management options - Energy audit and energy targeting - Technological options for energy management.

**Text Book:**

1. Natural Hazards, Bryant Edwards (2005), Cambridge University Press, U.K.
2. Disaster Management, Carter, W. Nick, 1991 Asian Development Bank, Manila.

**Reference:**

1. Disaster Mitigation Experiences and Reflections, Sahni, Pardeep et.al. (eds.) 2002, Prentice Hall of India, New Delhi
2. Natural Hazards, Bryant Edwards, Cambridge University Press, U.K (2005):
3. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004.
4. Green Building Fundamentals, Mike Montoya, Pearson, USA, 2010.
5. Green Building Design and Delivery, Charles J. Kibert, Sustainable Construction – John Wiley & Sons, New York, 2008.
6. Sustainable Construction and Design, Regina Leffers, Pearson / Prentice Hall, USA, 2009.

| Course Code  | Course Title                          |   |   |   | Core/Elective |     |
|--------------|---------------------------------------|---|---|---|---------------|-----|
| P26CM1L1     | CONSTRUCTION ENGINEERING LABORATORY-I |   |   |   | core          |     |
| Prerequisite | Contact Hours per Week                |   |   |   | CIE           | SEE |
|              | L                                     | T | D | P |               |     |
| -            | -                                     | - | - | 2 | 50            | -   |
| Credits      |                                       |   |   |   |               |     |
| 01           |                                       |   |   |   |               |     |

**Course Objectives**

The objectives of this course are

1. To understand the principles of construction management, including planning, organizing, staffing, leading, and controlling.
2. To analyze the nature of managerial decision-making in the construction industry and the rational model of decision making.
3. To identify challenges in decision making and learn tools & techniques to improve decision effectiveness.
4. To apply analytical methods such as benefit-cost analysis, replacement analysis, and break-even analysis in construction projects.
5. Assess the influence of various parameters on concrete strength

**Course Outcomes**

After Completion of this course students will be able to

1. To plan and develop project organization for executing construction projects.
2. To prepare work break down plan and estimate resources requirements.
3. Learn techniques used for planning, scheduling, and control of construction projects.
4. Students will apply techniques for real-world project and demonstrate the learning<sup>1</sup>.
5. Analyze the influence of parameters on concrete strength.

**List of Experiments:**

1. Evaluation of cement, fine & coarse aggregates.
2. Evaluation of reinforcing steel, timber, brick, and tile properties.
3. Workability variation with time for different concrete grades.
4. Experimental study of parameters affecting concrete strength
  - I. Size and shape of aggregate,
  - II. Grading of aggregate
  - III. Mixing method,
  - IV. aggregate-cement ratio.
  - V. admixtures

**Text Books:**

1. Properties of Concrete–A.M.Neville(1988).
2. Concrete–Microstructure–Properties and Materials–P.K & Paulo(1997).

**Reference Books:**

1. Design of Concrete Mix –Krishna Raju (1985).
2. Concrete Technology–M.S.Shetty.
3. Concrete Technology–Gambhir, M.L.
4. Concrete Technology–Santa kumar A.R.

| Course Code  | Course Title           |   |   |   |     | Core / Elective |         |
|--------------|------------------------|---|---|---|-----|-----------------|---------|
| P26CM1P1     | SEMINAR                |   |   |   |     | PROJ            |         |
| Prerequisite | Contact Hours per Week |   |   |   | CIE | SEE             | Credits |
|              | L                      | T | D | P |     |                 |         |
| -            | -                      | - | - | 2 | 50  | -               | 1       |

**Course Objectives**

**The objectives of this course are to impart knowledge of and problem-solving skills in**

1. Analyze a current topic of professional interest by conducting a detailed literature survey.
2. Summarize and present the selected topic effectively before an audience.
3. Acquire skills in technical report writing.
4. Improve analytical and problem-solving skills.
5. Develop communication and soft skills required in professional practice.
6. Integrate Sustainable Development Goals (SDGs) and innovative approaches into technical discussions.

**Course Outcomes**

**After Completion of this course, the student will be able to**

1. Understand current industrial and societal needs.
2. Analyze modern techniques, processes, and tools used in industry.
3. Prepare a structured technical report on an industrial or research-based topic.
4. Present technical knowledge effectively through seminar delivery.
5. Demonstrate confidence, communication skills, and professional ethics.
6. Correlate technical knowledge with SDGs and innovative engineering practices

**Integration of Sustainable Development Goals (SDGs):**

Students are encouraged to align seminar topics with relevant SDGs such as:

SDG 6: Clean Water and Sanitation

SDG 9: Industry, Innovation and Infrastructure

SDG 11: Sustainable Cities and Communities

SDG 12: Responsible Consumption and Production

SDG 13: Climate Action

**Innovation Component**

Emerging technologies related to the topic.

Use of modern tools (AI, GIS, IoT, BIM, Machine Learning, Smart Materials, etc.).

Case studies of innovative engineering solutions.

Patents / Startups / Research advancements.

Feasibility and scalability of innovative ideas.

**Course Plan – Seminar**

Each student shall identify a topic of current relevance in Civil Engineering, obtain faculty approval, conduct literature survey, prepare a detailed report, and present it in class.

Presentation Structure:

Presentation Duration: 20 minutes (PPT)

Question & Answer Session: 10 minutes

Total Duration: 30 minutes

**Mandatory Seminar Report Format**

Abstract

Introduction

Literature Review

Technical Discussion

Innovation & Emerging Trends

SDG Relevance

Case Study (if applicable)

Conclusions

References (IEEE/APA format)

**Guidelines for Awarding Marks (CIE – 50 Marks)**

| <b>S.No</b> | <b>Description</b>                   | <b>Marks</b> |
|-------------|--------------------------------------|--------------|
| 1           | Topic Selection & Relevance          | 5            |
| 2           | Literature Review                    | 10           |
| 3           | Technical Content & Analysis         | 10           |
| 4           | Innovation / Emerging Technologies   | 5            |
| 5           | SDG Integration                      | 5            |
| 6           | PPT Preparation (Clarity & Quality)  | 5            |
| 7           | Presentation Skills                  | 5            |
| 8           | Question & Answer Session            | 2            |
| 9           | Seminar Report (Format & References) | 3            |

**LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY**  
**(An Autonomous Institute)**  
**DEPARTMENT OF CIVIL ENGINEERING**  
**SCHEME OF INSTRUCTION & EXAMINATION[LR-26]**  
**(w.e.f. Academic Year 2026 – 27)**  
**M.E. (Civil Engineering) II– Semester**  
**Specialization in Construction Management**

| S. No.                      | Course Code | Category | Course Title                         | Scheme of Instructions |   |     |                    | Scheme of Examination |     |                   | Credits |
|-----------------------------|-------------|----------|--------------------------------------|------------------------|---|-----|--------------------|-----------------------|-----|-------------------|---------|
|                             |             |          |                                      | L                      | T | P/D | Contact Hours/Week | Maximum Marks         |     | Duration in Hours |         |
|                             |             |          |                                      |                        |   |     |                    | CIE                   | SEE |                   |         |
| Theory Course               |             |          |                                      |                        |   |     |                    |                       |     |                   |         |
| 1                           | P26CM201    | PCC      | Construction Planning and Scheduling | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 2                           | P26CM202    | PCC      | Project Finance                      | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 3                           | P26CM203    | PCC      | Contract Laws and Regulations        | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 4                           | -           | PEC      | Professional Elective–III            | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| 5                           | -           | PEC      | Professional Elective-IV             | 3                      | - | -   | 3                  | 40                    | 60  | 3                 | 3       |
| Practical/Laboratory Course |             |          |                                      |                        |   |     |                    |                       |     |                   |         |
| 6                           | P26CM2L1    | PCC      | Construction Engineering Lab-II      | -                      | - | 2   | 2                  | 50                    | -   | 3                 | 1       |
| 7                           | P26CM2L2    | PCC      | Computing Application Lab            | -                      | - | 2   | 2                  | 50                    | -   | 3                 | 1       |
| 8                           | P26CM2P1    | PROJ     | Mini Project                         | -                      | - | 4   | 4                  | 50                    | -   | 3                 | 2       |
| Total                       |             |          |                                      | 15                     |   | 8   | 23                 | 350                   | 300 | 24                | 19      |

**L: Lecture (Hrs/Wk/Sem)****T: Tutorial (Hrs/Wk/Sem)****P: Practical****D: Drawing (Hrs/Wk/Sem )****CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination**MC:** Mandatory Courses**PCC:** Program Core Courses**PEC:** Professional Elective Courses**AD:** Audit Courses**PROJ:** Project**CM:** Construction Management**Note:**

- Each contact hour is a Clock Hour.
- The practical class can be of two and half hour (clock hours) duration as per the requirement of a Particular laboratory.

**LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY**  
**(An Autonomous Institute)**  
**DEPARTMENT OF CIVIL ENGINEERING**  
**SCHEME OF INSTRUCTION & EXAMINATION [LR-26]**

**PROFESSIONAL ELECTIVES COURSES**

| S. No.        | Course Code | Category | Course Title                                    | Scheme of Instructions |   |      |                    | Scheme of Examination |     |                   | Credits |
|---------------|-------------|----------|-------------------------------------------------|------------------------|---|------|--------------------|-----------------------|-----|-------------------|---------|
|               |             |          |                                                 | L                      | T | P/ I | Contact Hours/Week | CIE                   | SEE | Duration in Hours |         |
| Theory Course |             |          |                                                 |                        |   |      |                    |                       |     |                   |         |
| 1             | P26CM104    | PEC 1    | Economic Decision Analysis in Construction      | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM105    |          | Legal Issues in Construction Management         | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM106    |          | Statistical Techniques                          | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
| 2             | P26CM107    | PEC 2    | Quantitative methods in Construction Management | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM108    |          | Structural Health Monitoring                    | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM109    |          | Green Building Technology                       | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
| 3             | P26CM204    | PEC 3    | Neural Fuzzy and Expert Systems                 | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM205    |          | Value Engineering in Construction               | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM206    |          | TQM techniques in Construction                  | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
| 4             | P26CM207    | PEC 4    | Human Resources Development for Construction    | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM208    |          | Advanced Concrete Technology                    | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |
|               | P26CM209    |          | Construction Safety Management                  | 3                      | - | -    | 3                  | 40                    | 60  | 3                 | 3       |

### PROFESSIONAL ELECTIVES WITH THREE THREADS

| S.No | PE 1                                       | PE 2                                            | PE 3                              | PE 4                                         |
|------|--------------------------------------------|-------------------------------------------------|-----------------------------------|----------------------------------------------|
| 1.   | Economic Decision Analysis in Construction | Quantitative methods in Construction Management | Neural Fuzzy and Expert Systems   | Human Resources Development for Construction |
| 2.   | Legal Issues in Construction Management    | Structural Health Monitoring                    | Value Engineering in Construction | Advanced Concrete Technology                 |
| 3.   | Statistical Techniques                     | Green Building Technology                       | TQM techniques in Construction    | Construction Safety Management               |

| Course Code  | Course Title                         |   |   |   | Core / Elective |     |
|--------------|--------------------------------------|---|---|---|-----------------|-----|
| P26CM201     | CONSTRUCTION PLANNING AND SCHEDULING |   |   |   | Core            |     |
| Prerequisite | Contact Hours per Week               |   |   |   | CIE             | SEE |
|              | L                                    | T | D | P |                 |     |
| --           | 3                                    | - | - | - | 40              | 60  |
|              |                                      |   |   |   |                 | 3   |

**Course Objectives**

The objectives of this course is to:

1. Understand the concept of planning and scheduling techniques in the Construction Industry
2. Understand the application of PERT/CPM
3. Discuss the various methods of time estimates and network techniques in the construction projects
4. Understand the importance of cost control in the Construction Industry
5. Evaluate the construction cost, duration and computer applications on network problems related to construction industry

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Able to gain the knowledge of project planning, scheduling and design related problems in construction projects.
2. Ability to develop the planning and scheduling and control of the projects in the construction industry.
3. Able to evaluate the construction cost, duration and quality of the construction projects.
4. Apply the computer applications on network related problems to construction industry
5. Ability to develop the working knowledge on various network techniques and software's useful in the construction industry.

**UNIT-I**

Introduction to Project Management, Project Planning, Scheduling and Controlling- Introduction to methods of planning and scheduling. Bar charts and Milestone Charts – Development of Bar charts – Shortcomings – Remedial measures – Milestone charts. PERT- Elements of Networks – Event, Activity, and Dummy Activity – Guidelines for the construction of the network – Development of PERT network – Numbering - Fulkerson's rule - Skip numbering.

**UNIT-II**

Time estimates – Optimistic, Pessimistic and Most likely time estimates – Earliest Expected time and Latest Allowable Occurrence time. Critical Path – Slack – Identification of Critical Path – Probability of Completion of projects.

**UNIT-III**

CPM – Construction of network – Earliest Possible Occurrence time and Latest Possible Occurrence time – Start and Finish times of activities – Floats – Identification of Critical Path using floats.

**UNIT-IV**

Cost Analysis – Direct and Indirect project costs – Total costs – Cost Slopes – Crashing - Cost and Time Optimization. Use of application software for project management.

**UNIT-V**

Updating – Data required for updating – Process of updating – When to update. Resource allocation – Resources – Usage profiles – Histograms – Resource Smoothing – Resource leveling

**Text Books:**

1. Sharma, M.R., Fundamentals of Construction Planning and Management, S.K. Kataria & Son, New Delhi, 2012
2. Seetharaman, S., Construction Engineering & Management, Umesh Publications, 2007.
3. Srinath, L.S., PERT & CPM Principles and Applications, Tata McGraw Hill, New Delhi.
4. Peurifoy, L., Schexnayder, C.J. and Shapira, A., Construction Planning, Equipment and Methods, McGraw Hill, New Delhi, 8th Edition, 2010

**References Books:**

1. Punamia, B.C. and Khandelwal, K.K., Project Planning and Control with PERT and CPM, Laxmi Publications, New Delhi, 2004.
2. Gahlot, P.S. and Dhir, B.M., Construction Planning & Management, New Age International (P) Ltd., New Delhi
3. Chitkara, K. K., Construction Project Management Planning, Scheduling and Controlling, Tata McGraw Hill, New Delhi.

| Course Code  | Course Title           |   |   |   |     | Core / Elective |         |
|--------------|------------------------|---|---|---|-----|-----------------|---------|
| P26CM202     | PROJECT FINANCE        |   |   |   |     | Core            |         |
| Prerequisite | Contact Hours per Week |   |   |   | CIE | SEE             | Credits |
|              | L                      | T | D | P |     |                 |         |
| --           | 3                      |   |   |   | 40  | 60              | 03      |

**Course Objectives**

The objectives of this course is to:

1. To understand the **financial management principles used in construction projects.**
2. To train students in **investment analysis and economic decision-making for infrastructure projects.**
3. To estimate and manage **working capital requirements in construction projects.**
4. To apply **capital budgeting techniques for project investment decisions.**
5. To prepare and control **various budgets used in civil engineering and construction projects.**

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Analyse the **financial feasibility of construction and infrastructure projects.**
2. Apply **capital budgeting techniques** for investment decision making.
3. Prepare and manage **project budgets and cost control systems.**
4. Perform **break-even analysis and financial risk assessment** in projects.
5. Estimate and manage **working capital requirements in construction projects.**

**UNIT-I****Introduction to Project Finance and Investment Analysis**

Introduction to project finance, types of investments in construction projects, stages in economic appraisal of projects, risk and uncertainty in investment decisions, cost of capital, time value of money, cash flow analysis, equivalence methods for comparison of alternatives, rate of return concepts and capital ratio

**UNIT-II****Capital Budgeting Techniques**

Investment analysis and capital budgeting, evaluation of capital investment decisions, payback period method, accounting rate of return method, net present value method, internal rate of return method, profitability index method, comparison of investment alternatives and financial decision making in construction projects.

**UNIT-III****Budgeting and Cost Control in Construction Projects**

Cost concepts in construction projects, break-even analysis, budgeting and budgetary control system, classification and types of budgets, fixed and flexible budgets, preparation of sales budget, production budget, cost of production budget, materials budget, labour budget, overhead cost budget, and selling and distribution overhead budgets.

**UNIT-IV****Standard Costing and Cost Variance Analysis**

Standard costing and variance analysis in construction projects, direct material variance, direct labour variance, overhead variance, job costing, batch costing and contract costing procedures, determination of economic batch quantity, cost control using network analysis techniques.

**UNIT-V****Working Capital Management in Construction Projects**

Working capital management in construction projects, estimation of working capital at project level, cash management, receivables management, inventory management, price level accounting (inflation accounting), project financial monitoring using network techniques such as PERT and CPM.

**Text Books:**

1. Project Cost Control in Construction – Roy Pilcher, Collins Professional and Technical Books, London.
2. Basic Cost Engineering – K.K. Humphreys and P. Wellman, Marcel Dekker Inc., New York.
3. Construction Project Management – K.K. Chitkara, Tata McGraw Hill Education.
4. Engineering Economics – L.T. Blank and A.J. Tarquin, McGraw Hill Education.
5. Construction Management and Planning – B.K. Sengupta and H. Guha, Tata McGraw Hill.

**References Books:**

1. Engineering Economics and Cost Analysis – Collier C. and Glagola C., Addison Wesley Education Publishers.
2. Project Management: Strategic Financial Planning, Evaluation and Control – B.M. Patel, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Construction Planning and Management – U.K. Shrivastava, Galgotia Publications Pvt. Ltd., New Delhi.
4. Engineering Economic Principles – H.M. Steiner, McGraw Hill Education.

5. Construction Project Management – Frederick Gould and Nancy Joyce, Prentice Hall.

| Course Code  | Course Title                 |   |   |   |     | Core / Elective |         |
|--------------|------------------------------|---|---|---|-----|-----------------|---------|
| P26CM203     | Contract Law and Regulations |   |   |   |     | Core            |         |
| Prerequisite | Contact Hours per Week       |   |   |   | CIE | SEE             | Credits |
|              | L                            | T | D | P |     |                 |         |
| -            | 3                            | - | - |   | 40  | 60              | 03      |

**Course Objectives**

The objectives of this course is to:

1. To study the foundational principles and essential elements of construction constitute.
2. To know the prequalification process and its significance in tendering.
3. To study the key components of arbitration agreements.
4. To provide students with a comprehensive understanding of the legal frameworks and regulations that governs construction projects.
5. To provide students with a comprehensive understanding of labour laws, welfare legislation.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Understand the fundamental principles and elements of a valid contract under the Indian Contracts Act, 1872.
2. To comprehend the purpose and benefits of prequalification in the tendering process.
3. Understand the Scope and Application of Arbitration Agreements
4. Students will be able to analyze and apply the relevant laws and regulations governing land.
5. Students will be able to effectively interpret and apply labour laws and welfare legislation.

**UNIT I**

**CONSTRUCTION CONTRACTS:** Indian Contracts Act - Elements of Contracts - Types of Contracts - Features - Suitability - Design of Contract Documents - International Contract Document - Standard Contract Document - Law of Torts

**UNIT II**

**TENDERS:** Prequalification - Bidding - Accepting - Evaluation of Tender from Technical, Contractual and Commercial Points of View - Contract Formation and Interpretation - Potential Contractual Problems - World Bank Procedures and Guidelines - Transparency in Tenders Act.

**UNIT III**

**ARBITRATION:** Comparison of Actions and Laws - Agreements - Subject Matter - Violations - Appointment of Arbitrators - Conditions of Arbitration - Powers and Duties of Arbitrator - Rules of Evidence - Enforcement of Award - Costs

**UNIT IV**

**LEGAL REQUIREMENTS:** Insurance and Bonding - Laws Governing Sale, Purchase and Use of Urban and Rural Land - Land Revenue Codes - Tax Laws - Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs - Legal Requirements for Planning - Property Law - Agency Law - Local Government Laws for Approval - Statutory Regulations

**UNIT V**

**LABOUR REGULATIONS:** Social Security - Welfare Legislation - Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration - Insurance and Safety Regulations - Workmen's Compensation Act - Indian Factory Act - Factory Act - Child Labour Act - Other Labour Laws

**Text Books:**

1. Gajaria G.T., *Laws Relating to Building and Engineering Contracts in India*, M.M. Tripathi Private Ltd., Bombay, 1982
2. Jimmie Hinze, *Construction Contracts*, Second Edition, McGraw Hill, 2001
3. Joseph T. Bockrath, *Contracts and the Legal Environment for Engineers and Architects*, Sixth Edition, McGraw Hill, 2000.
4. Ewan McKendrick., *Contract Law: Text, Cases, and Materials*, Oxford University Press, 2021 (6th Edition).

**References:**

1. M. Krishnamoorthy., *Indian Contract Act, 1872*, LexisNexis, 2020 (9th Edition)
2. R. Yashod Vardhan, Satyajeet A. Desai., *Pollock and Mulla: Indian Contract and Specific Relief Acts*, LexisNexis, 2020 (14th Edition)
3. S. K. Kapur., *Law of Contract*, Central Law Agency, 2019 (12th Edition)
4. T. D. N. Rao., *Contract Law in India*, Universal Law Publishing, 2017

5. S. N. Shukla., *Contract and Specific Relief Laws*, Eastern Book Company, 2018
6. R. K. Gupta., *Law of Contracts*, Legal Edge, 2021
7. S. K. Verma, J. J. Vachhrajani., *Contract Law in India*, Allahabad Law Agency, 2020

| Course Code  | Course Title                  |   |   |   |     | Core/Elective |         |
|--------------|-------------------------------|---|---|---|-----|---------------|---------|
| P26CM204     | NEURAL FUZZY AND EXPERTSYSTEM |   |   |   |     | PEC-3         |         |
| Prerequisite | Contact Hours per Week        |   |   |   | CIE | SEE           | Credits |
|              | L                             | T | D | P |     |               |         |
| -            | 3                             | - | - | - | 40  | 60            | 3       |

**Course Objectives**

The objective of this course is to impart knowledge of:

1. Explain the concepts of neural networks, fuzzy logic, and genetic algorithms.
2. Solve problems that are appropriately solved by neural networks, fuzzy logic, and genetic algorithms.
3. Understand the structure of expert systems.
4. Get exposure to software packages in practice.
5. Understand the Applications of Artificial Neural Networks, Fuzzy logic and expert systems in civil engineering.

**Course Outcomes**

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

1. Learn the mathematical theory behind the intelligent problem-solving approaches and apply them to write the code to solve a particular design problem.
2. Carry out three design projects in the course in neural networks, fuzzy logic, and genetic algorithms.
3. Covers intelligent approaches to solving engineering problems that are appropriate for pattern matching, control, optimization, and other areas.
4. Solve the problems pertaining to artificial neural networks, fuzzy logic and expert systems using standard software packages.
5. Exposure to Mat-lab and tools pertaining to artificial neural networks, fuzzy logic using standard methods.

**UNIT-I**

Introduction: Brief introduction to the study of artificial intelligence. An Insight to the concept of natural intelligence followed by the development of artificial neural networks, fuzzy logic systems and expert systems tool Demonstration of the importance of artificial neural networks, fuzzy logic and expert systems with the help of at least two practical examples civil engineering for each study. Importance of neuro-fuzzy systems

**UNIT-II**

Neural Networks: Components of artificial neural networks - neurons, inputs, outputs, error, error propagation, hidden layers, threshold logic, weights, bias, noise, momentum, rate of learning, training and testing - Hebb's rule, Delta rule - Supervised learning - Generalized Delta rule - unsupervised learning.

Types of Neural Networks - Perceptions - feed forward back propagation networks - Hop field networks.

**UNIT-III**

Fuzzy sets: Crispness, vagueness, uncertainty, and fuzzy sets. Basic. Definitions and operations of Fuzzy sets, approximate reasoning, and membership function. Fuzzy Relations: Fuzzy relation and fuzzy composition, fuzzy aggregation procedures, Dominance Matrix, Weightages, applications of Fuzzy sets to civil engineering problems, and pattern recognition.

**UNIT-IV**

Expert systems: Structure of expert systems, Knowledge acquisition, Knowledge organization, methods of representing. Knowledge, types of inference engines, reasoning under uncertainty, various types of expert system tools, heuristics, search mechanism, expert system development and hybrid expert systems.

**UNIT-V**

Exposure to Software Packages: Neural networks (Mat lab tool kit) — fuzzy logic — expert systems (L5 object). Applications of Artificial Neural Networks, Fuzzy logic and expert systems in civil engineering — Case studies with at least one problem on each aspect of ANN, FL and Expert systems.

**Text Book:**

1. FuzzySets, Decision Making, and Expert Systems, Zimmerman, H. J., Kluwer Academic Publications, Boston, 1987.
2. Neural Networks Algorithms, Applications and Programming Freeman, J.A., and Skapura, D.M. Addison-Wesley, 1991

**Reference:**

1. Artificial Intelligence and Expert System. Elaine Rich. Juda Pearl. Heuristics.

2. Expert Systems in Construction and Structural Engineering , AdeliH., Chapman, 1988.
3. Fundamentals of Neural Networks-Architectures, Laurene Fausett, algorithms and applications, Pearson Education Inc., 2008 (reprint).
4. “Neural Networks and Learning Machines”, Simon Haykin ,Mac Millen College Pub co., New York, 2011.
5. FuzzyLogic with Engineering Applications, TimothyJ. Ross, John Wiley and sons, 2010.

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Course Title                     |   |   |   |     |     | Core/Elective |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---|---|---|-----|-----|---------------|
| P26CM205                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | VALUEENGINEERING IN CONSTRUCTION |   |   |   |     |     | PEC-3         |
| Prerequisite                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Contact Hours per Week           |   |   |   | CIE | SEE | Credits       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | L                                | T | D | P |     |     |               |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3                                | - | - | - | 40  | 60  | 3             |
| <p><b>Course Objectives</b><br/>The objective of this course is to impart knowledge of:</p> <ol style="list-style-type: none"> <li>1. Define Value engineering and its objectives</li> <li>2. Estimation of project budget using capitalized income approach</li> <li>3. Analyze a building using LCC methodology.</li> <li>4. To train the students Value engineering and total project management</li> <li>5. Understand the various functions, skills, rules &amp; Delphi technique to civil engineering projects.</li> </ol> <p><b>Course Outcomes</b><br/>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> <li>1. Establish value engineering techniques and methodology</li> <li>2. Draw value engineering job plan and work plan phases</li> <li>3. Concept of Delphi techniques and rules for brainstorming</li> <li>4. Comprehensive understanding about the various phases of Job and work plans</li> <li>5. Knack for the application of FAST and Delphi techniques for various project</li> </ol> |                                  |   |   |   |     |     |               |

**UNIT - I**

Introduction to value engineering (VE), definition, objectives of value engineering, reasons for unnecessary costs, VE techniques and methodology, interface with the other programs.

**UNIT - II**

Elements of the project budget need for cost control, meaning of capitalization, capitalization process, and capitalized income approach to construction project budgeting.

**UNIT - III**

Life cycle cost (LCC) and building costs, LCC technology and examples, LCC methodology, LCC formats and analysis and weighted evaluation – application of LCC to buildings.

**UNIT - IV**

Value engineering and total project management, level of effort, team selection, value engineering job plan, and work plan phases.

**UNIT - V**

Classifying function, defining function, project level function system technique (fast) diagram, creativity and fixation, interpersonal skills, generation of ideas, brainstorming, rules for brainstorming, Delphi technique, application of Delphi technique to civil engineering projects.

**Text Book:**

1. Value Engineering: Practical Applications. Dell'Isola, Alphonse R.S. Means Company, Inc: Kingston, MA (1997). .
2. Project Management for Engineering and Construction, Oberiender, G. D. (1993).

**Reference:**

1. The Construction Management Process ,Tenah, K.A., Reston Publishing Company, Inc. Virginia(1985).
2. "Value Engineering: A Plan for Invention", Richard Park, St. Lucie Press, 1999.
3. "Value Engineering analysis and methodology", Del L. Younker, Marcel Dekker Inc, New York, 2004.
4. "Techniques of Value Analysis and Engineering", Miles, L.D., McGraw Hill second Edition, 1989.
5. "Value Engineering Mastermind: From concept to Value Engineering Certification", Anil Kumar Mukhopadhyaya, SAGE Publications, 2003

| Course Code  | Course Title                   |   |   |   |     | Core / Elective |         |
|--------------|--------------------------------|---|---|---|-----|-----------------|---------|
| P26CM206     | TQM techniques in construction |   |   |   |     | PEC-3           |         |
| Prerequisite | Contact Hours per Week         |   |   |   | CIE | SEE             | Credits |
|              | L                              | T | D | P |     |                 |         |
|              | 3                              | - | - | - | 40  | 60              | 3       |

**Course Objectives**

The objectives of this course is to:

1. Familiarize students with quality management principles in construction industry.
2. Understand quality assurance systems and ISO standards in construction projects.
3. Develop knowledge of leadership, teamwork and TQM tools for quality improvement.
4. Apply lean construction and modern quality management practices in project execution.
5. Understand the role of senior management and continuous improvement strategies in construction organizations.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Understand the concepts and principles of quality management in construction projects.
2. Apply quality assurance practices and ISO 9000 standards in construction works.
3. Analyze leadership roles, teamwork and TQM tools for quality improvement.
4. Implement lean construction principles and continuous improvement techniques.
5. Evaluate organizational quality culture and strategic quality management practices.

**UNIT-I****Fundamentals of Quality Management in Construction**

Concept of quality in construction industry, Evolution of quality management, Cost of quality, Quality planning and quality control, Road map for quality improvement in construction projects.

**UNIT-II****Quality Assurance and ISO Standards**

Quality assurance in construction, Difference between QA and QC, ISO 9000 series standards, Clauses of ISO 9001 in construction projects, Documentation and auditing procedures, Third- party certification and assessment.

**UNIT-III****Leadership and TQM Tools**

Principles of Total Quality Management, Role of leadership in quality management, Teamwork and team development stages, Quality circles in construction organizations, **TQM tools**:, Check sheets, Pareto analysis, Cause-and-effect diagram, Control charts, Flow charts.

**UNIT-IV****Lean Construction and Learning Organization**

Concept of lean production, Lean construction principles, Waste identification in construction, Just-in-time in construction, Learning organizations and continuous improvement, Application of digital tools in quality monitoring.

**UNIT-V****Strategic Quality Management in Construction**

Role of senior management in TQM., Quality culture in construction organizations, Benchmarking in construction projects, Continuous improvement techniques (Kaizen), Innovation and sustainability in construction quality management.

**Text Books:**

1. Steven McCabe – Quality Improvement Techniques in Construction, Longman, 1998.
2. K. K. Chitkara – Construction Project Management, McGraw Hill..

**References Books:**

1. Dale H. Besterfield – Total Quality Management, Pearson Education.
2. Evans & Lindsay – The Management and Control of Quality, South Western.
3. A. V. Feigenbaum – Total Quality Control, McGraw Hill.
4. Narayana V. & Sreenivasan N. S. – Quality Management – Concepts and Tasks, New Age International.

| Course Code  | Course Title                                 |   |   |   |     | Core/Elective |         |
|--------------|----------------------------------------------|---|---|---|-----|---------------|---------|
| P24CM207     | HUMAN RESOURCES DEVELOPMENT FOR CONSTRUCTION |   |   |   |     | PEC-4         |         |
| Prerequisite | Contact Hours per Week                       |   |   |   | CIE | SEE           | Credits |
|              | L                                            | T | D | P |     |               |         |
| -            | 3                                            | - | - | - | 40  | 60            | 3       |

**Course Objectives****The objective of this course is to**

1. To study the management and control of human resources in construction industry.
2. To understand the concepts of organization and management theory.
3. To study the Strategic HRM approaches and operational HRM approaches.
4. To understand the Employee relations and empowerment.
5. To train the students relationship between employers and workers organization or union.

**Course Outcomes****After completing this course, the student will be able to:**

1. Able to understand the job analysis, selection, recruitment in construction industry
2. Ability to understand and apply the management theories and human behavior theories.
3. Able to understand the human resource approaches and apply in the construction management.
4. Able to understand the changing role of trade unions and collective bargaining.
5. Ability to solve employee problems and promote industrial counseling

**UNIT-I**

The Human resource Management an Introduction: - Human resource, Nature and scope of HRM, The human resource in the environment, Human resource activities, Diversity of work and Strategies- Human resource hiring: -Job analysis, selection, recruitment, orientation, placement, socialization- Maintenance and development of the Human Resource: Work motivation and performance, Employee welfare, Compensation, Welfare schemes, Career enlargement and enrichment, Leadership and Effective communication.

**UNIT-II**

Organization and management theory: Challenges of managing people in construction, Contemporary management Theory, Production efficiency: the Classical Approach, Human Behavior theory, Manager's attitude towards people in construction, Expectations of the employment relationship.

**UNIT-III**

Strategic HRM approaches and operational HRM approaches: Models of HRM, Employee resourcing, Recruitment & Selection, Case Study Discussion, Training & Development, Appraisal Systems, Reward management, Case Study Discussion, Mentoring, Career in Construction Management.

**UNIT-IV**

Employee relations and empowerment: Employee's relations, The changing role of trade unions, The effect of unions, Collective bargaining, Case Study Discussion, The evolution of empowerment within HRM.

**UNIT-V**

Work for Analysis: -Trade Unions and Management relationships, Ethical Issues, Employee problems, Industrial Counseling. Employee empowerment- salient features- diversity and work life balance. Employee welfare -strategic Human resource development - employment legislation -legal aspects.

**Text Book:**

1. Human Resource management in construction, Langford D.A. Longman, 1995.
2. Human Resource Management in construction projects: strategic and operational approaches, Martin Loosemore, Andrew Dainty, Helen Lingard, Taylor and Francis, 2010.

**Reference:**

1. Designing and Managing Human Resource Systems, Rao, T.V and Pareek, Udai: Oxford IBH Pub. Pvt.Ltd., New Delhi , 2005.
2. Readings in HRD, Rao, T.V: Oxford IBH Pub. Pvt. Ltd., New Delhi , 2004.
3. Evaluating Management Development, Viramani, B.R and Seth, Parmila: Vision Books, New Delhi .
4. HRD in the New Economic Environment, Rao, T.V.(et.al): Tata McGraw-Hill Pub.Pvt, Ltd., New Delhi , 2003.
5. Human Resource Development and Organisational Effectiveness, Padmalita Routry Kalyani Mohanthy, Excel Books New Delhi 2009

| Course Code  | Course Title                 |   |   |   |     | Core/Elective |         |
|--------------|------------------------------|---|---|---|-----|---------------|---------|
| P24CM208     | ADVANCED CONCRETE TECHNOLOGY |   |   |   |     | PEC-4         |         |
| Prerequisite | Contact Hours per Week       |   |   |   | CIE | SEE           | Credits |
|              | L                            | T | D | P |     |               |         |
| -            | 3                            | - | - | - | 40  | 60            | 3       |

**Course Objectives**

The objective of this course is to :

1. Learn the characterization of constituents of concrete.
2. Design concrete mix by various methods as per different codes.
3. Understand the Shrinkage, Creep, Curing & Durability of Concrete.
4. Understand the various methods of mix design, I.S. Code method, British and ACI methods.
5. Study the different types of admixtures; mix design, properties and applications of special concretes.

**Course Outcomes**

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

1. Learn hydration of cement and tests on properties of cement and aggregates.
2. Comprehend the properties and testing of concrete in fresh and hardened state.
3. Understand the shrinkage and creep mechanisms, curing and durability of concrete.
4. Design concrete mixes by various methods.
5. Familiarize with the types of admixtures, and applications of special concretes.

**UNIT - I****Constituents of Concrete:**

- a) **Cement:** Types of cement and their composition, manufacture of Portland cement, hydration of cement and hydration product, structure of hydrated cement, heat of hydration, gel theories, review of tests on properties of cement.
- b) **Aggregate:** Classification of aggregates, particle shape and texture, bond and strength of aggregate and its influence on strength of concrete, porosity, absorption and moisture content and their influence, soundness of aggregate, alkali aggregate reaction, sieve analysis and grading of aggregate, review of tests on properties of aggregate.

**UNIT - II**

**Properties of Concrete:** Mixing and batching, workability, factors affecting workability, measurements of workability, various tests and procedures, segregation and bleeding, vibration of concrete, types of vibrators and their influence on composition, analysis of fresh concrete, strength of concrete, water-cement ratio, gel space ratio, effective water in the mix, mechanical properties of concrete, tests and procedure, influence of various parameters on strength of concrete, relationship between various mechanical strengths of concrete.

**UNIT - III**

**Shrinkage and Creep of Concrete:** Types of shrinkage, mechanism of shrinkage, factors affecting shrinkage, creep mechanism, factors influencing creep, rheological model, effects of creep.

**Curing of Concrete:** Methods of curing, maturity concept, and influence of temperature on strength of concrete.

**Durability of Concrete:** Permeability of concrete, chemical attack of concrete, tests on sulphate resistance, effect of frost, concreting in cold weather, hot weather concreting, and air entrained concrete.

**UNIT - IV**

**Mix Design of Concrete:** Basic considerations, process of mix design, factors in the choice of mix proportions and their influence, quality control, various methods of mix design, I.S. Code method, British and ACI methods.

**UNIT - V**

**Admixtures:** Classification of admixtures, chemical and mineral admixtures, influence of various admixtures on properties of concrete, their applications.

**Fly Ash Concrete:** Mix design, properties and its applications.

**High Strength Concrete:** Mix design, properties and its applications. **Fiber Reinforced Concrete:** Mix design, properties and its applications.

**Ferro cement, lightweight concrete, high-density concrete, recycled aggregate concrete and their applications.**

**Text Book:**

1. Properties of Concrete, Neville. A.M, English Language Book Society/Longman Publications (1988).
2. Concrete – Microstructure –Properties and Material, Mehta. P.K and Paulo. J.M.M, McGraw-Hill(1997),.

**Reference:**

1. Design of Concrete Mix, Krishna Raju. N., (1985), CBS Publications.
2. Concrete Technology, Shetty, M.S., Theory & Practice, S.Chand and Co.
3. Concrete Technology, Gambhir, M.L., Tata McGraw Hill.
4. Concrete Technology, Santakumar A.R., Oxford University Press, New Delhi.

| Course Code  | Course Title                   |   |   |   | Core / Elective |         |
|--------------|--------------------------------|---|---|---|-----------------|---------|
| P26CM209     | CONSTRUCTION SAFETY MANAGEMENT |   |   |   | PEC-4           |         |
| Prerequisite | Contact Hours per Week         |   |   |   | CIE             | SEE     |
|              | L                              | T | D | P |                 |         |
| -            | 3                              | - | - | - | 40              | 60      |
|              |                                |   |   |   |                 | Credits |
|              |                                |   |   |   |                 | 3       |

**Course Objectives**

The objectives of this course is to:

1. Understand safety principles and risk management practices in construction projects.
2. Identify construction hazards and accidents prevention techniques.
3. Study safety legislation and regulatory frameworks applicable to construction.
4. Understand safety programs, workers compensation and insurance mechanisms.
5. Apply modern safety analysis methods and digital safety monitoring tools in construction.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Identify construction safety hazards and risk factors on project sites.
2. Develop and implement construction safety programs in organizations.
3. Analyze construction safety law and regulatory requirements.
4. Evaluate safety performance and workers compensation systems.
5. Apply safety analysis techniques for accident prevention and risk reduction.

**UNIT-I****Fundamentals of Construction Safety**

Safety management functions, Importance of safety in construction industry, Line versus staff authority in, safety management, Safety responsibility and accountability, Safety organization and safety administration, Safety culture in construction organizations.

**UNIT-II****Construction Hazards and Accident Prevention**

Construction safety problems, Hazards in construction projects, Accident: definition, causes and cost of accidents, Accident investigation and prevention methods, Legal and financial aspects of accidents, Safety program: need and elements, Hazard identification techniques: HAZOP, FMEA, FMECA.

**UNIT-III****Safety in Construction Operations**

Safety in construction equipment: vehicles, cranes, hoists and lifts, Safety in scaffolding, ladders and working platforms, Electrical safety in construction sites, Fire safety and handling of explosives/blasting operations, Safety in storage and handling of building materials, Personal Protective Equipment (PPE) and safety gear, First aid and emergency response on site.

**UNIT-IV****Safety Laws and Performance Measurement**

Safety legislation related to construction industry, Industrial safety regulations, Safety provisions in Factories Act and Labour laws, Safety audit and safety inspection, Measurement of safety performance, Experience Modification Rate (EMR), Workers compensation and insurance.

**UNIT-V****Safety Analysis and Modern Safety Approaches**

Case Based Reasoning (CBR) in safety management, Case indexing and retrieval in accident analysis, Accident prevention and forecasting using CBR, System safety analysis methods, Fault Tree Analysis (FTA), Failure Mode and Effects Analysis (FMEA), Digital safety monitoring and smart safety systems in construction

**Text Books:**

1. John V. Grimaldi – Safety Management, AITBS Publishers, New Delhi.
2. Jimmy W. Hinze – Construction Safety, Prentice Hall.

**References Books:**

1. K. K. Chitkara – Construction Project Administration, Addison Wesley.
2. Richard J. Coble, Jimmie Hinze & Theo C. Haupt – Construction Safety and Health Management, Prentice Hall.
3. K. N. Vaid – Construction Safety Management, NICMAR Publications.
4. K. Mohammed Imthathullah Khan et al., Safety Management in Construction Projects, IJESIT Journal.

| Course Code  | Course Title                           |   |   |   | Core / Elective |     |         |
|--------------|----------------------------------------|---|---|---|-----------------|-----|---------|
| P26CM2L1     | CONSTRUCTION ENGINEERING LABORATORY-II |   |   |   | Core            |     |         |
| Prerequisite | Contact Hours per Week                 |   |   |   | CIE             | SEE | Credits |
|              | L                                      | T | D | P |                 |     |         |
| -            | -                                      | - | - | 2 | 50              | -   | 1.0     |

**Course Objectives**

The objectives of this course is to:

1. To study the concrete mix design using various codes and evaluate the properties of concrete.
2. To evaluate the properties of concrete and correlate them with the non-destructive testing results.
3. To evaluate the effect of different parameters on non-destructive testing results.
4. Evaluate the crack propagation in a beam under single-point - two-point loading.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Design the concrete mixes using various codes and assess the properties of concrete.
2. Correlate the properties of concrete with the non-destructive testing results.
3. Appraise the effect of different parameters on non-destructive testing results.
4. Estimate the crack propagation and crack patterns in a beam.
5. Able to estimate the crack propagation and crack patterns in a beam

**List of Experiments:**

1. Concrete mix design by BIS, ACI and BS method – proportioning, batching, mixing, molding of specimens for compression, modulus of elasticity and modulus of rupture – testing of specimens as per relevant codes of practice (comparative study).
2. Development of correlation between Non-Destructive and Destructive tests using Rebound Hammer & UPV instruments.
3. Influence of following parameters on NDT readings – experimental observations.
  - a. Aggregate Cement Ratio
  - b. Cement Ratio
  - c. Excess / Deficient Cement
  - d. Excess / Deficient Water
  - e. Aggregate type.
 (Some of the above parameters may be considered depending upon time)
4. Strain and deflection measurement for a structural member under single point / two-point loading – crack propagation observation. Measurement and plotting.

**Text Books:**

1. Properties of Concrete, Neville. A.M, English Language Book Society/Longman Publications (1988).
2. Concrete – Microstructure – Properties and Material, Mehta. P.K and Paulo. J.M.M, McGraw-Hill(1997),.

**References Books:**

1. Design of Concrete Mix, Krishna Raju. N., (1985), CBS Publications.
2. Concrete Technology, Shetty, M.S., Theory & Practice, S.Chand and Co.
3. Concrete Technology, Gambhir, M.L., Tata McGraw Hill.
4. Concrete Technology, Santakumar A.R., Oxford University Press, New Delhi.

| Course Code  | Course Title              |   |   |     |     | Core / Elective |     |
|--------------|---------------------------|---|---|-----|-----|-----------------|-----|
| P26CM2L2     | COMPUTING APPLICATION LAB |   |   |     |     | Core            |     |
| Prerequisite | Contact Hours per Week    |   |   | CIE | SEE | Credits         |     |
|              |                           | T | D | P   |     |                 |     |
| -            |                           | - | - | 2   | 50  | -               | 1.0 |

**Course Objectives**

The objectives of this course is to:

1. Understand the application of Primavera software in construction project management.
2. Learn preparation of construction project schedules using Primavera.
3. Extract and analyze project planning data from Primavera.
4. Understand project planning and scheduling techniques.
5. Introduce digital project management tools used in modern construction planning.

**Course Outcomes**

After Completion of this course, the student will be able to:

1. Apply Primavera software for construction project planning.
2. Prepare construction schedules using Primavera.
3. Analyze project data and scheduling parameters.
4. Develop resource allocation and project baselines.
5. Apply digital tools for monitoring and controlling project schedules.

**List of experiments**

1. Introduction to Primavera software, its components and setting up a new project including creation and modification of project calendar.
2. Creation of Organizational Breakdown Structure (OBS) in Primavera.
3. Creation of Enterprise Project Structure (EPS).
4. Creating a new project and developing Work Breakdown Structure (WBS).
5. Creating project activities and assigning activity durations.
6. Assigning resources and cost estimation for project activities.
7. Project scheduling and identification of floats (Total Float and Free Float).
8. Identification of Critical Path for the project.
9. Generating and managing Project Baselines for schedule comparison.
10. Project tracking, resource monitoring and exporting project reports using Primavera.

**Text Books:**

1. .Billy E. Gillett – Introduction to Operations Research, McGraw Hill.
2. Feigenbaum L. – Construction Scheduling with Primavera Project Planner, Prentice Hall.

**References Books:**

1. Ming Sun & Rob Howard – Understanding IT in Construction, Spon Press.
2. Paulson B.R. – Computer Applications in Construction, McGraw Hill.
3. Tarek Hegazy – Computer-Based Construction Project Management, Pearson.
4. David A. Marchman – Construction Scheduling with Primavera.
5. Feigenbaum L. – Construction Scheduling with Primavera Project Planner.

**Online Resources**

Primavera Lab Manual <https://zbook.org/primavera-lab-manual-tumcivil>

| Course Code  | Course Title           |   |   |   |     | Core/Elective |         |
|--------------|------------------------|---|---|---|-----|---------------|---------|
| P26CM2P1     | MINI PROJECT           |   |   |   |     | Core          |         |
| Prerequisite | Contact Hours per Week |   |   |   | CIE | SEE           | Credits |
|              | L                      | T | D | P |     |               |         |
| -            | -                      | - | - | 4 | 50  | -             | 2       |

**Course Outcomes**

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

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

**Guidelines:**

1. As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter-disciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling
6. All the investigations should be clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference.

Departmental committee: Supervisor and a minimum of two faculty members

**Evaluation Guidelines:**

| Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50 |            |                                 |
|---------------------------------------------------------------------------------------|------------|---------------------------------|
| Evaluation by                                                                         | Max. Marks | Evaluation Criteria / Parameter |
| Supervisor                                                                            | 20         | Progress and Review             |
|                                                                                       | 05         | Report                          |
| Departmental Committee                                                                | 05         | Relevance of the Topic          |
|                                                                                       | 05         | PPT Preparation                 |
|                                                                                       | 05         | Presentation                    |
|                                                                                       | 05         | Question and Answers            |
|                                                                                       | 05         | Report Preparation              |