

# **Master of Building Engineering and Management**

Detailed Syllabus for  
Two Year Post Graduate Degree Programme in  
Building Engineering and Management

***Effective from the Academic Year 2026-27***



**योजना तथा वास्तुकला विद्यालय, विजयवाडा**  
School of Planning and Architecture, Vijayawada  
An Institute of National Importance, MHRD, Govt. of INDIA.

## **FIRST SEMESTER**

|                                                          |                                 |    |
|----------------------------------------------------------|---------------------------------|----|
| <b>MBEM1101 - Project Planning and Scheduling Studio</b> | Subject Category                | SC |
|                                                          | Number of Credits               | 10 |
|                                                          | Lecture Periods per Week        | 2  |
|                                                          | Tutorials per week              | -  |
|                                                          | Studio/Lab/Workshop/Practical's | 8  |
|                                                          | Total Periods per Week          | 10 |

**Objectives:** The objective of this course is to provide students with a comprehensive understanding of construction project management principles and practices, covering the complete project life cycle from project inception to post-construction stages. The course aims to familiarize students with project stakeholders, organizational structures, and project management processes while developing knowledge in project formulation, feasibility analysis, techno-economic evaluation, and statutory clearances. It also intends to equip students with skills in construction time management through work breakdown structures, activity sequencing, resource and duration estimation, and preparation of project schedules using techniques such as CPM, PERT, Gantt charts, and network diagrams. Further, the course emphasizes monitoring and control of project schedules, application of quantitative techniques, and the use of modern computer applications and project management software for effective planning, execution, and control of construction projects.

### Unit I – Fundamentals of Construction Projects

This unit introduces the concept of a project and explains the characteristics and various types of construction projects. It covers the project life cycle and discusses the different phases involved, namely inception, planning and design, execution/construction, commissioning and handover, and post-construction maintenance. The unit also highlights the roles and responsibilities of various stakeholders in the construction industry, project team organisation, and the influence of organisational structures on project execution.

### Unit II – Introduction to Construction Project Management

This unit focuses on the fundamentals of construction project management, including its objectives and functions. It explains the various project management processes and their interactions with special emphasis on project integration management. The unit introduces the major project management knowledge areas such as scope, time, cost, quality, resource, risk, procurement, communication, and stakeholder management. The role and responsibilities of a project manager in construction projects are also discussed.

### Unit III – Project Formulation and Feasibility Studies

This unit deals with project formulation and feasibility analysis in construction projects. It includes the generation and screening of project ideas, project identification, and preliminary feasibility studies covering market, technical, financial, economic, and ecological aspects. The unit explains the preparation of pre-feasibility reports, techno-economic feasibility reports, and detailed project reports (DPR). It also discusses various project clearances and approvals required from environmental, statutory, and local authorities.

### Unit IV – Construction Time Management and Scheduling

This unit introduces the principles of construction time management and project scheduling. It covers identification of work packages, preparation of work breakdown structures (WBS), sequencing of activities, resource estimation, and duration estimation techniques. The unit also explains the preparation and analysis of project schedules using tools and techniques such as Gantt charts, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), precedence diagrams, and other networking methods.

## Unit V – Monitoring, Control and Computer Applications in Project Management

This unit explains the methods of monitoring and controlling construction projects with emphasis on schedule updating and revision. It discusses resource allocation, optimization techniques, and the relationship between time and cost in construction projects. The unit also introduces quantitative techniques and computer applications used in construction management. Further, it provides an overview of project management software, along with case studies related to project scheduling and control.

**Total: 160 class hours expected**

### Outcome:

Upon successful completion of this course, the students will be able to understand the various phases involved in the construction project life cycle and the roles and responsibilities of stakeholders and project team members in the construction industry. Students will be able to apply project management principles, processes, and knowledge areas in construction projects, and develop skills in project formulation through feasibility studies, project estimation, techno-economic analysis, and preparation of detailed project reports. They will also be capable of preparing work breakdown structures, sequencing activities, estimating resources and durations, and developing project schedules using CPM, PERT, Gantt charts, and other network techniques. Further, students will gain the ability to monitor and control project schedules, apply quantitative techniques, and utilize computer applications and project management software for effective planning and management of construction projects.

### References Books

1. Project Management Institute. (2025). *A guide to the project management body of knowledge (PMBOK® Guide)* (7th ed.). Project Management Institute.
2. Sears, S. K., Clough, R. H., Sears, G. A., & Rounds, J. L. (2015). *Construction project management: A practical guide to field construction management* (6th ed.). John Wiley & Sons.
3. Chitkara, K. K. (2014). *Construction project management: Planning, scheduling and controlling* (3rd ed.). Tata McGraw-Hill Education.
4. Newitt, J. S. (2009). *Construction scheduling: Principles and practices* (2nd ed.). Prentice Hall of India.
5. Mubarak, S. A. (2015). *Construction project scheduling and control* (3rd ed.). John Wiley & Sons.
6. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2011). *Construction planning, equipment, and methods* (8th ed.). Tata McGraw-Hill Education.

|                                                                 |                                 |    |
|-----------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1102 - Construction Management, Tools and Techniques</b> | Subject Category                | TC |
|                                                                 | Number of Credits               | 03 |
|                                                                 | Lecture Periods per Week        | 02 |
|                                                                 | Tutorial Periods per Week       | 01 |
|                                                                 | Studio/Lab/Workshop/Practical's | -  |
|                                                                 | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with a comprehensive understanding of construction management principles and practices in the context of the Indian construction industry. The course aims to develop knowledge of the roles and responsibilities of construction managers, project management functions, management styles, and strategic tools such as SWOT analysis. It further intends to equip students with skills in project planning, scheduling, and resource management for effective execution of construction projects. Students will gain an understanding of planning and scheduling techniques including bar charts, milestone charts, work breakdown structures, and network-based project management methods. The course also emphasizes project monitoring and control techniques such as crashing, resource levelling, and updating, along with construction site management practices, communication and reporting systems, application of Management Information Systems (MIS), and training requirements for construction professionals to ensure efficient and successful project delivery.

#### **Unit I – Introduction to Construction Management**

This unit introduces the construction industry in India and its contribution to economic growth and infrastructure development. It explains the importance of management in construction projects and highlights the role, responsibilities, authority, and functions of a Construction Manager. Students will understand the composition and functioning of the construction team, causes of project failures, and the application of management functions and styles in construction organizations. The unit also introduces SWOT analysis as a strategic tool for evaluating construction projects and organizations.

#### **Unit II – Project Planning Process**

This unit focuses on the fundamentals of construction project planning and the various stages involved in project development. It covers the plan development process, time planning, work scheduling, and resource planning techniques required for effective project execution. The unit emphasizes the importance of systematic planning, scheduling, and controlling in achieving project objectives related to time, cost, and quality.

#### **Unit III – Management Techniques**

This unit deals with planning and scheduling techniques used in construction management. It explains the principles, objectives, advantages, and stages of planning for construction projects. Students are introduced to various scheduling methods such as Bar Charts and Milestone Charts, along with concepts like controlling, project life cycle curve, job layout, and Work Breakdown Structure (WBS). The unit aims to develop the ability to organize and manage construction activities efficiently.

#### **Unit IV – Project Management through Networks**

This unit introduces network-based project management techniques used for planning and controlling complex construction projects. It covers the objectives, advantages, terminology, and types of project networks. Students learn the rules for drawing project networks and methods such as Fulkerson's rule for numbering events. The unit develops analytical skills for sequencing project activities and understanding dependencies between construction operations.

## **Unit V – Project Controlling and Construction Site Management**

This unit focuses on project monitoring and control techniques to ensure successful project completion within planned time and resources. Topics include project monitoring, control, crashing, resource levelling, and updating of project schedules. The unit also covers construction site management practices such as site mobilization and demobilization, management of resources based on fund availability, communication and reporting techniques, and the application of Management Information Systems (MIS) in construction. It further emphasizes the importance of training for construction managers, engineers, and supervisors for effective site administration and coordination.

**Total: 48 class hours expected**

### **Outcome:**

Upon successful completion of these units, students will gain a comprehensive understanding of construction management principles, project planning processes, and modern project management techniques used in the construction industry. They will learn the roles and responsibilities of construction managers and project teams, along with the importance of management functions and strategic analysis in construction organizations. Students will develop skills in project planning, scheduling, resource allocation, and work organization using techniques such as Bar Charts, Milestone Charts, Work Breakdown Structures (WBS), and network methods. They will also acquire the ability to prepare and analyze project networks, sequence activities, and manage project execution effectively. Further, students will understand project monitoring and control techniques including crashing, resource levelling, updating schedules, and construction site management practices involving communication, coordination, MIS applications, and efficient utilization of resources for successful completion of construction projects.

### **References Books**

1. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2018). *Construction planning, equipment, and methods* (9th ed.). McGraw Hill Education.
2. Chitkara, K. K. (2014). *Construction project management: Planning, scheduling and controlling* (3rd ed.). Tata McGraw Hill Education.
3. Punmia, B. C., & Khandelwal, K. K. (2016). *Project planning and control with PERT and CPM*. Laxmi Publications.
4. Sengupta, B., & Guha, H. (2010). *Construction management and planning*. Tata McGraw Hill Education.
5. Hendrickson, C. (2008). *Project management for construction*. Prentice Hall.
6. Jha, K. N. (2015). *Construction project management: Theory and practice* (2nd ed.). Pearson Education.
7. Uher, T. E., & Loosemore, M. (2004). *Fundamentals of building contract management* (or *Fundamentals of construction management and organisation*, depending on the edition used). UNSW Press.
8. Koontz, H., & O'Donnell, C. (2012). *Principles of management*. McGraw Hill Education.
9. Kerzner, H. (2017). *Project management: A systems approach to planning, scheduling, and controlling* (12th ed.). Wiley India.

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|----------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1103 - Quantitative Methods and Operations Research</b> | Subject Category                | TC |
|                                                                | Number of Credits               | 03 |
|                                                                | Lecture Periods per Week        | 02 |
|                                                                | Tutorial Periods per Week       | 01 |
|                                                                | Studio/Lab/Workshop/Practical's | -  |
|                                                                | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to introduce students to the principles and applications of Operations Research as a scientific and analytical approach for solving managerial and engineering problems. The course aims to develop understanding of various Operations Research models, decision-making techniques, optimization methods, and quantitative tools used in project and construction management. It also intends to equip students with skills in applying analytical techniques for time, cost, quality, resource, risk, and procurement management. Further, the course emphasizes the use of computer applications and statistical software such as SPSS and Minitab for solving complex problems and improving decision-making efficiency in the construction industry.

### Unit I – Introduction to Operations Research

This unit introduces the fundamental concepts of Operations Research (OR) and its evolution as a scientific approach for decision-making and problem-solving. It covers the history, definitions, scope, and phases involved in the OR approach along with its applications in managerial and engineering problems. Students will understand the advantages and limitations of OR studies and gain awareness of various computer software tools used for performing OR-based analysis and decision-making.

### Unit II – Operations Research Models and Decision-Making Techniques

This unit focuses on important Operations Research models and analytical tools used for solving managerial and organizational problems. Students will learn techniques such as Acceptance and Allocation Models, Analytic Hierarchy Process (AHP), Fish Bone Analysis, Control Charts, Decision Trees, and Failure Modes and Effects Analysis (FMEA). The unit also introduces Pareto Analysis and other decision-support methods that help in identifying critical factors influencing project performance and quality.

### Unit III – Quantitative Models and Analytical Techniques

This unit deals with quantitative and mathematical models used in Operations Research for optimization and forecasting. It covers forecasting methods, fuzzy set theory, game theory, inventory models, network models, replacement and sequencing models, simulation techniques, vendor rating systems, and queuing models. The unit aims to develop analytical and problem-solving skills for handling complex operational and managerial situations in engineering and construction projects by using Python, Excel Solver, and Power BI, etc.

### Unit IV – Operations Research Applications in Construction Management

This unit explains the application of Operations Research techniques in various areas of construction management and project decision-making. Students will learn how OR tools are applied in time management, cost control, quality management, resource optimization, risk management, contract administration, procurement management, and value engineering. The unit also highlights the role of OR in building performance evaluation and improving overall project efficiency and effectiveness.

### Unit V – Computer Applications and Construction Industry Applications

This unit introduces the use of computer applications and statistical software such as SPSS, Minitab, and other analytical tools for solving complex mathematical and statistical problems involved in Operations Research. Students will learn data analysis, interpretation, and decision-support techniques using software applications.

The unit also emphasizes the practical application of Operations Research methods in the construction industry through case studies and real-time project management scenarios.

**Total: 48 class hours expected Outcome:**

Upon successful completion of this course, students will be able to understand the concepts, scope, and applications of Operations Research in engineering and management decision-making. They will develop the ability to apply various OR models and analytical techniques such as AHP, decision trees, forecasting, inventory models, simulation, queuing models, and network models for solving practical problems. Students will also gain skills in applying Operations Research techniques to construction management areas including time, cost, quality, resource, risk, and procurement management. Further, they will be capable of using computer software tools such as SPSS and Minitab for data analysis, optimization, and decision support in construction and project management applications.

**Reference Books**

1. Taha, H. A. (2017). *Operations research: An introduction* (10th ed.). Pearson Education India.
2. Hillier, F. S., & Lieberman, G. J. (2015). *Introduction to operations research* (10th ed.). Tata McGraw-Hill Education.
3. Vohra, N. D. (2017). *Quantitative techniques in management* (6th ed.). Tata McGraw-Hill Education.
4. Tam, C. M. (1996). *Decision making and operations research techniques for construction management*. City University of Hong Kong Press.
5. *Quantitative techniques for decision making in construction*. (2004). Hong Kong University Press.



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|--------------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1104 - Construction Technology,<br/>and advanced building Materials</b> | Subject Category                | TC |
|                                                                                | Number of Credits               | 03 |
|                                                                                | Lecture Periods per Week        | 02 |
|                                                                                | Tutorial Periods per Week       | 01 |
|                                                                                | Studio/Lab/Workshop/Practical's | -  |
|                                                                                | Total Periods per Week          | 03 |

**Objective:** This course intends to give an overview of the modern concrete construction techniques that can be used for the construction of various types of structures, the understanding of which is essential for the construction managers. This course basically aims to identify the various parameters that govern the selection of a particular structural solution for a given building in the given set of parameters. It covers the various geo-technical aspects of soil mechanics required for designing the sub-structure for various buildings. It includes the study of various types of foundation system, their design consideration, application, construction processes and the required construction equipment. It also intends to study the various systems that can be used for construction of super structures in modern buildings and how various services are integrated in a given system.

### **Unit I – Site Investigation and Modern Concrete Technology**

This unit introduces the importance of site investigation and the various stages involved in identifying construction variables and constraints for a project. It covers soil investigation, sub-soil exploration, soil classification, soil testing methods, and determination of soil bearing capacity. Students will also study soil test reports for different projects. The unit further focuses on modern concrete technology including Ready Mix Concrete (RMC), precast and prestressed concrete systems, advanced formwork systems, reinforcement technologies, and construction chemicals along with their applications, advantages, limitations, and impacts on construction cost, quality, and time.

### **Unit II – Substructure, Superstructure and Building facades**

This unit deals with construction practices related to substructure and superstructure systems. Topics include foundation design based on soil characteristics, types of foundations, foundations in special conditions, basement construction, and waterproofing techniques. It also covers different floor slab systems, their characteristics, behaviour, and applications in building construction. The unit introduces various building facades and materials used.

### **Unit III – Large Span, High-Rise, Steel and Composite Construction**

This unit introduces modern structural systems used in large-span and high-rise buildings. Students will learn about space frames, pneumatic structures, shell structures, folded plates, and suspended membrane structures along with their applications and construction technologies. The unit also covers evolution and construction of high-rise buildings, structural systems, planning, scheduling, implementation, and special equipment used in tall building construction. Further, it introduces steel and composite construction systems, pre-engineered buildings, detailing, service integration, and cost and quantity modelling for different building systems.

### **Unit IV – Advanced and low carbon Construction Materials**

This unit focuses on advanced and low carbon construction materials and their applications in the construction industry. It covers concrete technology including mix design, special concretes, mass concreting, maintenance, repair, and future trends. Students will study various construction materials including plastics, asphalt, bitumen, rubber, ceramics, glass, iron and steel products, non-ferrous metals, paints, varnishes, and related materials along with their properties, specifications, and uses. The unit further discusses impact of construction materials

on environment and alternative materials in construction with their benefits, specifications, applications, standards, and future trends in sustainable construction practices.

## Unit V – Specifications, Construction Planning and Material Management

This unit explains the importance of construction specifications and their relationship with drawings and construction practices. It covers types of specifications, principles and procedures of specification writing, and contractual provisions related to materials and processes. Students will study specifications from IS Codes, British Standards, and ASTM Standards. The unit also focuses on the role of construction managers in planning and executing projects using modern materials and technologies through preparation of Work Breakdown Structures (WBS), sequencing and scheduling activities, preparation of tender documents, implementation, control, and management of cost, time, quality, and resources in construction projects.

**Total: 48 class hours expected**

### Outcome:

Upon successful completion of these units, students will be able to understand and evaluate site conditions through soil investigation, sub-soil exploration, and interpretation of soil test reports for appropriate foundation and construction decisions. They will gain knowledge of modern concrete technologies, advanced formwork systems, reinforcement techniques, and construction chemicals along with their applications in improving construction quality, time, and cost efficiency. Students will develop an understanding of substructure and superstructure systems, repair and rehabilitation techniques for concrete structures, and the use of construction equipment in various building projects. They will also acquire knowledge of large-span structures, high-rise buildings, steel and composite construction systems, and their planning, scheduling, and implementation requirements. Further, students will understand the properties, specifications, applications, and sustainability aspects of modern and green construction materials, and develop the ability to prepare construction specifications, tender documents, and project plans while considering cost, quality, resource management, and construction management practices for successful project execution.

### Reference Books

1. Neville, A. M. (2012). *Properties of concrete* (5th ed.). Pearson Education India.
2. Santhakumar, A. R. (2006). *Concrete technology*. Oxford University Press.
3. Bryan, T. (2005). *Construction technology: Analysis and choice* (2nd ed.). John Wiley & Sons.
4. Chudley, R., & Greeno, R. (2006). *Advanced construction technology* (4th ed.). Pearson Prentice Hall.
5. Chudley, R., & Greeno, R. (2008). *Building construction handbook* (7th ed.). Elsevier/Heinemann. (Commonly cited in place of "Construction Technology"; verify title if using a specific edition.)
6. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2011). *Construction planning, equipment, and methods* (8th ed.). Tata McGraw-Hill Education.
7. Wahl, I. (2009). *Building anatomy: An illustrated guide to how structures work*. Tata McGraw-Hill Education.
8. Sandaker, B. N. (2008). *On span and space: Exploring structures in architecture*. Routledge.
9. Brown, M. M. (2003). *The architecture of steel*. University of Pittsburgh Press.
10. *Architecture and construction in steel*. (1993). Taylor & Francis. (Author/editor should be verified.)
11. *Planning and control of high-rise building construction*. (2010). Concordia University. (Author should be verified.)
12. Brannigan, F. L. (2007). *Fire fighting operations in high-rise and standpipe-equipped buildings*. PennWell Books. (Verify edition if applicable.)
13. Sears, S. K., Sears, G. A., & Clough, R. H. (2008). *Construction project management: A practical guide to field construction management*. John Wiley & Sons.
14. Kalin, M. (2011). *Construction specifications writing: Principles and procedures* (6th ed.). John Wiley & Sons.
15. Spiegel, R., & Meadows, D. (2010). *Green building materials: A guide to product selection and specification* (3rd ed.). John Wiley & Sons

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|----------------------------------------------|---------------------------------|----|
| <b>MBEM1105 - Advanced Building Services</b> | Subject Category                | TC |
|                                              | Number of Credits               | 03 |
|                                              | Lecture Periods per Week        | 02 |
|                                              | Tutorial Periods per Week       | 01 |
|                                              | Studio/Lab/Workshop/Practical's | -  |
|                                              | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with comprehensive knowledge of building services and civil infrastructure systems required for modern buildings and urban developments. The course aims to develop an understanding of water supply, sanitation, storm water drainage, electrical systems, illumination, firefighting, HVAC, vertical transportation, security systems, and building automation systems. It also intends to familiarize students with the planning, design considerations, construction practices, energy-efficient solutions, and relevant codes and standards associated with these services. Further, the course emphasizes the coordination and management of infrastructure services through project management techniques for efficient, safe, and sustainable building performance.

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### **Unit I – Water Supply, Sanitation and Storm Water Drainage Services**

This unit introduces the planning, design, and construction aspects of water supply, sanitation, and storm water drainage systems for buildings and urban infrastructure. It covers sources of water supply, calculation of water demand, water quality and purification methods, water distribution systems, and domestic hot and cold water supply systems. Students will learn about materials and fixtures used in plumbing systems, sewage quantity estimation, sewer design, sewage treatment plants, and storm water drainage layouts. The unit also emphasizes design considerations and construction practices for water and sanitation systems at domestic, institutional, and city levels.

### **Unit II – Electrical Services and Illumination**

This unit focuses on electrical services used in buildings and infrastructure projects. Topics include principles of electricity, power distribution systems, substations, standby power systems, cables, bus bars, switches, sockets, distribution boards, transformers, DG sets, and electrical safety measures. The unit also introduces illumination engineering, laws of lighting, lighting design considerations for daylighting and artificial lighting, and types of interior and exterior lighting systems. Students will gain exposure to lighting design software and methods for designing efficient and safe electrical and lighting installations.

### **Unit III – Fire Fighting and HVAC Services**

This unit deals with fire safety systems and Heating, Ventilation, and Air Conditioning (HVAC) services in buildings. Students will study the causes and spread of fire, fire detection and firefighting equipment, smoke control systems, fire-resistant design, and fire escape planning for high-rise buildings. The HVAC portion covers principles of air conditioning, occupant comfort, sizing and selection of HVAC systems, all-air and all-water systems, energy requirements, performance evaluation mechanisms, and applicable codes and standards. The unit emphasizes integration of safety and environmental comfort in building services design.

### **Unit IV – Vertical Transportation, Security and Building Automation Systems**

This unit introduces vertical transportation systems such as elevators, escalators, and walkways along with their specifications, design considerations, selection criteria, and energy requirements. It also covers building security systems, planning and design strategies for secure buildings, and installation of various security devices. Further, the unit focuses on Building Automation Systems (BAS) and Building Management Systems (BMS), including their components, functioning, and applications in controlling and optimizing building services. The concept of intelligent buildings and innovative energy-efficient solutions for building services are also discussed.

## Unit V – Civil Infrastructure Services and Project Coordination

This unit focuses on the planning, design, construction, and maintenance of civil infrastructure services associated with different types of buildings and external development works. Students will understand the coordination of architectural, structural, and building service systems through project management techniques. The unit emphasizes integration and management of various infrastructure services to ensure efficient project execution, resource utilization, and sustainable building performance.

**Total: 48 class hours expected**

### Outcome:

Upon successful completion of this course, students will be able to understand and design basic water supply, sanitation, storm water drainage, electrical, illumination, fire fighting, and HVAC systems for various types of buildings. They will gain knowledge of vertical transportation systems, security systems, and building automation technologies used in intelligent buildings. Students will develop the ability to select appropriate materials, equipment, layouts, and energy-efficient solutions for building services while considering safety, comfort, operational efficiency, and sustainability. Further, they will be capable of coordinating civil infrastructure services with architectural and structural systems and applying project management techniques for planning, execution, and maintenance of building service systems and external development works.

### Reference Books

1. Hall, F., & Greeno, R. (2015). *Building services handbook* (8th ed.). Butterworth-Heinemann.
2. Grondzik, W. T., Kwok, A. G., Stein, B., & Reynolds, J. S. (2014). *Mechanical and electrical equipment for buildings* (12th ed.). John Wiley & Sons.
3. Janis, R. R., & Tao, W. K. Y. (2009). *Mechanical and electrical systems in buildings* (4th ed.). Pearson Prentice Hall.
4. Moss, K. J. (2002). *Energy management in buildings*. Taylor & Francis.
5. Indian Buildings Congress. (2009). *Practical handbook on energy conservation in buildings*. Indian Buildings Congress.
6. Rangwala, S. C. (2017). *Water supply and sanitary engineering* (32nd ed.). Charotar Publishing House.
7. Bureau of Energy Efficiency. (2017). *Energy conservation building code 2017*. Government of India.
8. Grondzik, W. T. (2010). *Air-conditioning system design manual* (2nd ed.). Butterworth-Heinemann.
9. *Air conditioning systems: Performance, environment and energy factors*. (2012). Nova Science Publishers. (Author/editor should be verified.)
10. *Development trends in building services engineering*. (2005). City University of Hong Kong Press. (Author/editor should be verified.)
11. Norman, T. L. (2010). *Integrated security systems design* (2nd ed.). Butterworth-Heinemann.
12. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.
13. Sinopoli, J. M. (2009). *Smart buildings systems for architects, owners and builders*. Butterworth-Heinemann.
14. National Fire Protection Association. (Latest ed.). *National Fire Protection Association standards*. National Fire Protection Association.
15. Bureau of Indian Standards. (2016). *National Building Code of India 2016*. Bureau of Indian Standards.
16. Bureau of Indian Standards. (Latest ed.). *Relevant Indian Standard codes*. Bureau of Indian Standards.

## Electives-1

|                                                                |                                 |    |
|----------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1106 - Automation and Mechanization in Construction</b> | Subject Category                | TC |
|                                                                | Number of Credits               | 03 |
|                                                                | Lecture Periods per Week        | 02 |
|                                                                | Tutorial Periods per Week       | 01 |
|                                                                | Studio/Lab/Workshop/Practical's | -  |
|                                                                | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with comprehensive knowledge of construction equipment, machinery, and mechanization techniques used in modern construction projects. The course aims to develop an understanding of equipment economics, ownership and operating costs, replacement policies, and equipment selection methods. It also intends to familiarize students with various types of construction equipment used for earthwork, concreting, lifting, piling, and water pumping operations along with their productivity and operational characteristics. Further, the course emphasizes equipment management, maintenance, safety practices, productivity optimization, and the impact of mechanization on project cost, time, quality, and resource management. The course also introduces students to modern advancements such as automation and robotics in the construction industry.

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### Unit I – Introduction to Construction Equipment and Equipment Economics

This unit introduces the evolution and development of construction equipment and machinery used in the construction industry. It covers the importance of mechanization in improving construction productivity, quality, and efficiency. Students will learn about ownership and operating costs of construction equipment, economic life analysis, depreciation, replacement policies, and financial considerations involved in equipment management. The unit also discusses decision-making aspects related to equipment selection and utilization in construction projects.

### Unit II – Earthwork and Concreting Equipment

This unit focuses on equipment used for earthwork and concreting operations in construction projects. Topics include excavators, bulldozers, loaders, graders, compactors, scrapers, batching plants, transit mixers, concrete pumps, vibrators, and finishing equipment. Students will understand the working principles, applications, selection criteria, productivity considerations, and operational requirements of these machines. The unit also highlights the role of equipment in improving construction speed, quality, and resource utilization.

### Unit III – Lifting, Piling and Water Pumping Equipment

This unit deals with lifting equipment such as cranes, hoists, elevators, and material handling systems used in construction projects. It also covers piling equipment used for deep foundation works and equipment for pumping and dewatering operations. Students will learn about equipment specifications, operational methods, safety requirements, and applicability for different types of projects. The unit emphasizes efficient equipment utilization for high-rise, infrastructure, and foundation construction works.

### Unit IV – Equipment Productivity, Optimization and Management

This unit explains methods for estimating and optimizing the productivity of construction equipment. Students will learn techniques for equipment planning, selection, balancing, scheduling, and performance evaluation. Topics include buy, lease, or rent decisions, maintenance management, preventive maintenance practices, equipment safety measures, and operational efficiency. The unit also discusses the influence of equipment usage on project cost, time, quality, and resource management performance.

## Unit V – Construction Equipment in Project Management and Modern Technologies

This unit focuses on the impact of construction equipment and machinery on project management functions such as planning, scheduling, monitoring, and control. Students will understand the role of mechanization in improving project performance and decision-making. The unit further introduces modern advancements such as automation, robotics, and intelligent equipment systems in the construction industry. Emerging trends in construction technology and their applications in improving productivity, safety, and sustainability are also discussed.

### Outcome

Upon successful completion of this course, students will be able to understand the evolution, classification, and applications of construction equipment and machinery used in different construction activities. They will gain the ability to evaluate equipment economics including ownership costs, operating costs, replacement policies, and buy, lease, or rent decisions. Students will develop skills in selecting appropriate equipment for earthwork, concreting, lifting, piling, and pumping operations based on project requirements and productivity considerations. They will also understand methods for estimating and optimizing equipment productivity, implementing maintenance and safety practices, and analyzing the impact of mechanization on project performance related to cost, time, quality, and resources. Further, students will gain awareness of automation, robotics, and emerging technologies in the construction industry and their role in modern construction management.

### Reference Books

1. Sharma, S. C. (2013). *Construction equipment and its management*. Khanna Publishers.
2. Patel, S. K. (2005). *Construction equipment management*. Galgotia Publications.
3. Oberlender, G. D. (2006). *Heavy construction equipment and methods*. McGraw-Hill Education.
4. Wang, J. (2015). *Construction machinery*. CRC Press.
5. Darko, A. (2021). *Introduction to construction equipment and methods*. Routledge.
6. Varma, M. (2014). *Construction equipment operation and maintenance*. Oxford University Press.
7. *Automation and robotics in construction*. (2018). Springer.
8. *Robotics and automation in construction*. (2016). McGraw Hill Education.
9. *Principles of construction equipment systems*. (2010). Pearson Education India.
10. *Fleet management and equipment maintenance*. (2002). ASCE Press.
11. *Construction productivity: Measurement and improvement*. (2014). Routledge.
12. *Building construction machinery*. (2011). Universal Publishing Corporation.

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|-----------------------------------|---------------------------------|----|
| <b>MBEM1107 – Risk Management</b> | Subject Category                | TC |
|                                   | Number of Credits               | 03 |
|                                   | Lecture Periods per Week        | 02 |
|                                   | Tutorial Periods per Week       | 01 |
|                                   | Studio/Lab/Workshop/Practical's | -  |
|                                   | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with a comprehensive understanding of risk management principles, probability concepts, and decision analysis techniques used in engineering and construction projects. The course aims to develop knowledge of risk identification, assessment, analysis, communication, and management methodologies for effective project planning and control. It also intends to familiarize students with tools such as decision trees, probability analysis, sensitivity analysis, risk registers, and risk management plans. Further, the course emphasizes the application of risk management techniques in construction projects through practical case studies and real-world project scenarios.

### **Unit I – Introduction to Risk Management and Probability Concepts**

This unit introduces the fundamentals of risk management and its importance in engineering, construction, and project management. It covers the concepts of uncertainty, risk, and probability along with basic probability laws and distributions used in risk assessment. Students will understand the nature of risks, sources of risks, and the role of probability in decision-making and project analysis.

### **Unit II – Decision Analysis and Risk Assessment Techniques**

This unit focuses on the basics of decision analysis and various techniques used for identifying and evaluating risks. Topics include decision-making under certainty, uncertainty, and risk, decision trees, expected value concepts, sensitivity analysis, and qualitative and quantitative risk assessment methods. The unit develops analytical skills required for evaluating alternatives and making informed project decisions.

### **Unit III – Risk Analysis Concepts, Methodology and Applications**

This unit explains the concepts and methodologies used in risk analysis for engineering and construction projects. It covers risk identification, risk classification, risk measurement, and risk evaluation techniques. Students will study methods such as probability analysis, simulation techniques, and risk modelling approaches along with practical applications of risk analysis in project planning, cost, time, quality, safety, and resource management.

### **Unit IV – Risk Communication and Risk Management Planning**

This unit deals with communication and documentation processes involved in risk management. Topics include risk communication strategies, stakeholder involvement, risk registers, risk charters, and preparation of risk management plans. Students will learn methods for documenting, monitoring, controlling, and reporting risks effectively throughout the project life cycle. The unit emphasizes coordination and communication for successful implementation of risk management practices.

### **Unit V – Case Studies and Applications of Risk Management in Construction**

This unit focuses on practical applications and case studies related to risk management in construction and infrastructure projects. Students will study real-life project scenarios involving financial, technical, environmental, contractual, and operational risks. The unit highlights the preparation and implementation of risk management plans, lessons learned from project failures and successes, and the role of risk management in improving project performance, safety, quality, and sustainability.

### **Outcome**

Upon successful completion of this course, students will be able to understand the concepts of risk, uncertainty, probability, and decision analysis in project management. They will develop the ability to identify, classify, assess, and analyze risks using qualitative and quantitative techniques. Students will gain skills in preparing risk registers, risk charters, and risk management plans, and effectively communicate project risks among stakeholders. They will also be capable of applying risk management methodologies and analytical tools to construction and infrastructure projects for improving project performance, safety, quality, cost control, and decision-making efficiency.

## Reference Books

1. Turner, J. R. (2009). *Risk management in projects*. Gower Publishing.
2. Chapman, C., & Ward, S. (2011). *How to manage project opportunity and risk: Why uncertainty management can be a much better approach than risk management* (3rd ed.). John Wiley & Sons.
3. Schuyler, J. R. (2001). *Risk and decision analysis in projects* (2nd ed.). Project Management Institute.
4. Goodwin, P., & Wright, G. (2014). *Decision analysis for management judgment* (5th ed.). John Wiley & Sons.
5. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). *Probability and statistics for engineers and scientists* (9th ed.). Pearson Education.
6. Hull, J. C. (2015). *Risk management and financial institutions* (4th ed.). Pearson Education.
7. Rejda, G. E., & McNamara, M. J. (2013). *Principles of risk management and insurance* (12th ed.). Pearson Education.
8. Project Management Institute. (2009). *Practice standard for project risk management*. Project Management Institute.
9. Vose, D. (2008). *Risk analysis: A quantitative guide* (3rd ed.). John Wiley & Sons.
10. Fenton, N., & Neil, M. (2012). *Risk assessment and decision analysis with Bayesian networks*. CRC Press.
11. Brauer, R. L. (2018). *Safety and health for engineers* (3rd ed.). Cengage Learning.
12. Smith, N. J., Merna, T., & Jobling, P. (2014). *Managing risk in construction projects* (3rd ed.). Blackwell Publishing.
13. Meyer, T., & Reniers, G. (2013). *Engineering risk management*. De Gruyter.
14. Hubbard, D. W. (2009). *The failure of risk management: Why it's broken and how to fix it*. John Wiley & Sons.



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|------------------------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1108 - Inter departmental/Inter-Institutional Elective (Online/Physical Mode)</b> | Subject Category                | TC |
|                                                                                          | Number of Credits               | 03 |
|                                                                                          | Lecture Periods per Week        | 02 |
|                                                                                          | Tutorial Periods per Week       | 01 |
|                                                                                          | Studio/Lab/Workshop/Practical's | -  |
|                                                                                          | Total Periods per Week          | 03 |

**Objective:** The underlying fundamental of this elective is for the student to identify and pursue any unique course of study related to STEM (Science, Technology, Engineering, and Management) in physical or online mode. The student can select a course that may be directly or indirectly relevant to the building or its related infrastructure works. The objective of this course is to enhance the exposure of students in an unrestricted manner and to aid their learning through varied methods. The course enables students to acquire skills to develop their ideas into physical form and encourages startups. This elective intends to achieve the concept of multidisciplinary and cross-collaboration to the other areas of specialization.

### Course Content

The course may be linked to the built environment, construction, architecture, planning, project management, or related to the topic of research. Encouraging a multi-disciplinary approach through the subject as well as its contents, the coursework should include a theoretical understanding of the subject, learning through case studies and real-world projects, and future methods of application in the industry/ research. The use of analytical tools and techniques is encouraged.

Upon completion of this course, the student should be able to

- Learn foundational concepts of the topic
- Establish a link between the learnings and their projects/ research
- Apply the skills in their research/ projects/ future career
- Share the insights with fellow classmates
- Earn a certificate from the online learning platform or certificate from other Department of studies.

### References

1. National Programme on Technology Enhanced Learning (NPTEL) initiated by Ministry of Education.
2. Courses offered by IIT, IIM, ISSER, NIT's, SPA's, NITTTR and other reputed Universities/Institution
3. Courses offered by reputed National and International Universities.

## **SECOND SEMESTER**

|                                                                             |                                 |    |
|-----------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1201- Construction Project Cost Planning, Control and Monitoring</b> | Subject Category                | SC |
|                                                                             | Number of Credits               | 10 |
|                                                                             | Lecture Periods per Week        | 2  |
|                                                                             | Tutorial Periods per Week       | -  |
|                                                                             | Studio/Lab/Workshop/Practical's | 8  |
|                                                                             | Total Periods per Week          | 10 |

**Objective:** The objective of this course is to provide students with comprehensive knowledge of cost management, contract management, value engineering, risk management, and project feasibility analysis in construction projects. The course aims to develop skills in quantity surveying, estimation, rate analysis, and cost control techniques for effective financial management of projects. It also intends to familiarize students with various national and international contract systems, tendering procedures, bidding strategies, contract administration, and dispute resolution mechanisms. Further, the course emphasizes the application of value engineering, life cycle costing, claim management, arbitration practices, and cost-benefit analysis for improving project efficiency, minimizing risks, and ensuring successful project delivery.

### Unit I – Cost Management

This unit focuses on the principles and practices of cost management in construction projects. Students will learn methods of preparing preliminary estimates such as plinth area estimates and calculating areas, volumes, and heights of building projects. The unit covers detailed quantity surveying, preparation of work packages, specification deviation statements, analysis of rates, cost indexing, and additional item rate calculations. It also introduces item nomenclature for civil and MEP works and emphasizes accurate estimation and cost control techniques required for effective financial management of construction projects.

### Unit II – Contract Management

This unit introduces various types of construction contracts and their application in project execution and administration. Students will study conventional and modern contract forms such as CPWD, MES, FIDIC, AIA, NEC, and JCT contracts along with international contract practices and comparative analysis. The unit covers contract estimation, bidding models and strategies, bidder qualification, suitability of contracts for different projects, and the roles and responsibilities of stakeholders. It also focuses on tendering procedures, Indian Contract Act 1872, contract administration, delay protocols, change order analysis, professional ethics, and determination of special conditions of contract for construction projects.

### Unit III – Value Engineering in Projects

This unit deals with the application of value engineering techniques for improving project performance and achieving cost optimization without affecting functionality and quality. Students will learn function analysis, life cycle costing techniques, and value engineering approaches in architectural planning and building design. The unit also covers selection of sustainable and green materials, optimization of finishes, and evaluation of alternative MEP systems for improving efficiency, reducing operational costs, and enhancing project value.

### Unit IV – Risk and Scope Management

This unit focuses on risk management, scope management, and dispute resolution practices in construction projects. Topics include claim management, compensation procedures, resolving contractual disputes, and methods of dispute resolution such as negotiation, mediation, arbitration, and conciliation. Students will study the provisions of the Arbitration and Conciliation Act 1996 and analyse case studies related to arbitration and dispute management. The unit emphasizes effective management of project risks and contractual issues to minimize conflicts and delays.

## Unit V – Cost Benefit Analysis of Projects

This unit introduces the concepts and applications of cost-benefit analysis in construction and infrastructure projects. Students will learn methods for evaluating project feasibility based on economic, financial, and operational considerations. The unit focuses on the applicability of cost-benefit analysis for investment decisions, project appraisal, and feasibility studies. It also highlights techniques for comparing project alternatives and assessing the long-term economic viability and benefits of construction projects.

**Total: 160 class hours expected**

### Outcome:

Upon successful completion of this course, students will be able to prepare estimates, perform quantity surveying, analyse rates, and apply cost management techniques for construction projects. They will gain the ability to understand and evaluate different contract systems, bidding procedures, contract conditions, and contract administration practices used in the construction industry. Students will develop skills in applying value engineering and life cycle costing techniques for optimizing project cost, quality, and performance. They will also understand risk management, claim management, dispute resolution methods, and arbitration procedures related to construction contracts. Further, students will be capable of conducting cost-benefit analysis and feasibility studies for evaluating the economic viability and effectiveness of construction and infrastructure projects.

### Reference Books

1. Project Management Institute. (2008). *A guide to the project management body of knowledge (PMBOK® Guide)* (4th ed.). Project Management Institute.
2. Sears, S. K., Clough, R. H., Sears, G. A., & Rounds, J. L. (2008). *Construction project management: A practical guide to field construction management* (5th ed.). John Wiley & Sons.
3. Chitkara, K. K. (2014). *Construction project management: Planning, scheduling and controlling* (3rd ed.). Tata McGraw-Hill Education.
4. McCarthy, J. F. (2010). *Construction project management: A managerial approach*. Pareto Building Books.
5. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2011). *Construction planning, equipment, and methods* (8th ed.). Tata McGraw-Hill Education.
6. Potts, K. F. (2008). *Construction cost management: Learning from case studies*. Taylor & Francis.
7. Ostwald, P. F. (2001). *Construction cost analysis and estimating*. Prentice Hall.
8. Schwalbe, K. (2015). *An introduction to project management* (5th ed.). Cengage Learning.

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|-------------------------------------------|---------------------------------|----|
| <b>MBEM1202 - Project Cost Management</b> | Subject Category                | TC |
|                                           | Number of Credits               | 03 |
|                                           | Lecture Periods per Week        | 02 |
|                                           | Tutorial Periods per Week       | 01 |
|                                           | Studio/Lab/Workshop/Practical's | -  |
|                                           | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with comprehensive knowledge of construction cost management, value engineering, financial management, and project accounting practices used in the construction industry. The course aims to develop skills in cost estimation, rate analysis, life cycle costing, cost optimization, and project cost control techniques for effective financial planning and management of construction projects. It also intends to familiarize students with value engineering principles, project valuation methods, scope and change management practices, and project closure procedures. Further, the course emphasizes management accounting, financial accounting, fund flow analysis, cash flow management, and price forecasting techniques for informed decision-making and efficient financial administration in construction projects.

### **Unit I – Construction Cost Management and Estimation**

This unit introduces the principles and processes involved in construction cost management throughout the project life cycle. It covers cost determination, cost planning, cost monitoring, and cost control techniques along with the impact of risks on project costs. Students will learn life cycle cost analysis, time–cost relationship assessment, and modern estimation practices including parametric, elemental, and preliminary cost estimation methods. The unit also includes preparation of detailed estimates, schedule of rates, bills of quantities (BOQ), analysis of material, labour, and equipment costs, cost indices, contingencies, and justification documentation used in present-day construction projects.

### **Unit II – Value Engineering and Project Change Management**

This unit focuses on value engineering techniques for improving project efficiency, functionality, and economic performance while maintaining quality standards. Students will study valuation methods for land and building projects including income capitalization and market analysis approaches. The unit also covers principles of scope management, change management, performance reporting, and risk response strategies in construction projects. Emphasis is given to project closing procedures, administrative closure, contract close-out processes, and sustainable value optimization practices adopted in modern construction management.

### **Unit III – Cost Analysis, Optimization and Project Cost Control**

This unit deals with detailed cost analysis and optimization techniques used in construction projects. Topics include direct and indirect cost analysis, activity cost slopes, and optimization of project cost and duration using network-based techniques such as crashing and schedule compression. The unit also introduces modern approaches to cost control, cost coding systems, classification methods, and digital cost monitoring practices used in the construction industry. Applications of cost optimization and control in real-time construction projects are emphasized.

### **Unit IV – Management Accounting and Construction Financial Systems**

This unit introduces management accounting concepts and their application in construction project management. Students will study the nature, scope, and objectives of management accounting along with fundamentals of cost accounting and financial accounting. The unit explains accounting procedures, financial reporting systems, budgeting practices, and limitations of traditional accounting methods. Emphasis is placed

on the role of accounting systems in project decision-making, financial planning, and organizational control in construction enterprises.

### **Unit V – Fund Flow, Cash Flow and Price Forecasting Techniques**

This unit focuses on financial flow analysis and forecasting methods relevant to construction project management. Topics include fund flow analysis, preparation and interpretation of fund flow and cash flow statements, advantages and limitations of fund flow analysis, and cash management practices. The unit also introduces price forecasting methods such as average method, moving average method, weighted average method, and exponential smoothing techniques. Students will understand the application of financial forecasting tools for budgeting, financial planning, and economic decision-making in modern construction projects.

**Total: 48 class hours expected**

#### **Outcome:**

Upon successful completion of this course, students will be able to apply cost management processes, prepare estimates, analyse rates, and develop bills of quantities for construction projects. They will gain the ability to perform life cycle cost analysis, evaluate project costs and schedules, and implement cost optimization and cost control techniques in construction management. Students will understand value engineering principles, project valuation methods, scope and change management processes, and project close-out procedures. They will also develop knowledge of management accounting, cost accounting, financial accounting systems, and accounting procedures used in construction organizations. Further, students will be capable of preparing and analysing fund flow and cash flow statements and applying forecasting techniques for financial planning, budgeting, and economic decision-making in construction projects.

#### **Reference Books**

1. Potts, K. F., & Ankrah, N. (2014). *Construction cost management: Learning from case studies* (2nd ed.). Taylor & Francis.
2. O'Brien, J. J., & Plotnick, F. L. (2009). *Construction cost estimating for project control* (2nd ed.). McGraw-Hill Education.
3. Towey, D. (2012). *Construction quantity surveying: A practical guide for the contractor's QS*. Wiley-Blackwell.
4. Chakraborti, M. (2010). *Building estimation, costing and valuation*. Professional Publications.
5. Dutta, B. N. (2016). *Estimating and costing in civil engineering: Theory and practice* (28th ed.). UBS Publishers.
6. Callahan, K. R., Stetz, G. S., & Brooks, L. M. (2007). *Project management accounting: Budgeting, tracking, and reporting costs and profitability*. John Wiley & Sons.
7. Arora, M. N. (2013). *Management accounting*. Himalaya Publishing House.
8. Arora, M. N. (2012). *Cost accounting: Principles and practice*. Vikas Publishing House.
9. Pandey, I. M. (2015). *Financial management* (11th ed.). Vikas Publishing House.
10. Blank, L., & Tarquin, A. (2012). *Engineering economy* (7th ed.). McGraw-Hill Education.
11. Younker, D. L. (2003). *Value engineering: Analysis and methodology*. CRC Press.
12. Jha, K. N. (2015). *Construction project management: Theory and practice* (2nd ed.). Pearson Education India.
13. Chandra, P. (2011). *Projects: Planning, analysis, selection, financing, implementation, and review* (7th ed.). Tata McGraw-Hill Education.

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|----------------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1203 - Construction<br/>Occupational Health and Safety Administration</b> | Subject Category                | TC |
|                                                                                  | Number of Credits               | 03 |
|                                                                                  | Lecture Periods per Week        | 02 |
|                                                                                  | Tutorial Periods per Week       | 01 |
|                                                                                  | Studio/Lab/Workshop/Practical's | -  |
|                                                                                  | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of construction site management, occupational health and safety practices, environmental management, and legal regulations related to the construction industry. The course aims to develop understanding of construction hazards, accident prevention, safety management systems, equipment safety, and industrial safety laws. It also emphasizes safety audits, risk control techniques, and modern safety management approaches for improving safety performance and sustainable construction practices.

### **Unit I – Construction Site Management and Environmental Safety**

This unit introduces the principles and practices of construction site management with emphasis on safe and efficient project execution. It covers organization of site operations, temporary site infrastructure, site logistics, documentation procedures, and coordination of construction activities. Students will learn health, safety, and environmental (HSE) management systems, safety responsibilities of project stakeholders, occupational health and hygiene practices, and environmental management measures in construction projects. The unit also includes sustainable site management practices, waste management, pollution control, and implementation of Environmental, Social, and Governance (ESG) considerations in modern construction projects.

### **Unit II – Construction Hazards, Accident Prevention and Safety Management**

This unit focuses on safety problems and hazard management in construction projects. Topics include identification of construction hazards, causes and types of accidents, accident investigation procedures, accident cost analysis, and methods of accident prevention. Students will study safety management systems, risk assessment techniques, behavioural safety practices, emergency response planning, and digital safety monitoring methods. The unit also emphasizes legal, financial, and organizational implications of accidents and the importance of developing effective safety programs in construction industries.

### **Unit III – Safety in Construction Equipment and Specialized Construction Activities**

This unit deals with safety measures related to construction equipment, machinery, and specialized construction operations. Students will study safety practices for vehicles, cranes, hoists, lifts, scaffolding, ladders, working platforms, electrical installations, blasting operations, and fire protection systems. The unit also covers safety management in high-risk construction activities such as high-rise buildings, bridges, dams, tunnels, and road construction projects. Emphasis is given to safe storage, handling, transportation of construction materials, and the use of modern technologies such as IoT-based monitoring and smart safety equipment for improving site safety performance.

### **Unit IV – Industrial Safety Laws, Labour Regulations and Safety Performance Evaluation**

This unit introduces legal and regulatory frameworks related to industrial and construction safety. It covers safety provisions under the Factories Act, labour laws, Building and Other Construction Workers (BOCW) Act, and relevant Indian and international safety standards. Students will learn methods for measuring safety performance, conducting safety audits, safety inspections, and maintaining safety documentation. The unit also explains workers' insurance systems, experience modification rating (EMR), compensation mechanisms, and the role of compliance management in improving workplace safety and reducing liabilities.

## Unit V – Construction Safety Programs and Hazard Control Techniques

This unit focuses on the development and implementation of effective safety programs in construction organizations. Students will study the elements of comprehensive safety management systems, safety training methods, toolbox talks, and safety communication practices. The unit introduces hazard identification and risk control techniques such as HAZOP, FMEA, and FMECA for analysing and minimizing project risks. It also covers modern safety management approaches including safety culture development, Behaviour-Based Safety (BBS), digital safety management systems, BIM-based safety planning, and real-time monitoring techniques used in contemporary construction projects.

**Total: 48 class hours expected**

### Outcome:

Upon successful completion of this course, students will be able to understand construction site safety management procedures, identify hazards and accident causes, and apply safety and risk control measures in construction projects. They will gain knowledge of safety practices related to construction equipment, specialized construction activities, and relevant industrial safety laws and regulations. Students will also be capable of implementing effective safety programs, conducting safety audits, and applying hazard identification and control techniques for improving safety and productivity in construction projects.

### Reference Books

1. Singh, D. (2018). *Construction safety management and engineering*. Cengage Learning India.
2. Goetsch, D. L. (2011). *Construction safety and health* (2nd ed.). Pearson Education.
3. Deshmukh, P. (2005). *Industrial safety management*. Tata McGraw-Hill Education.
4. Reese, C. D. (2015). *Occupational health and safety management: A practical approach* (3rd ed.). CRC Press.
5. Singh, H. (2012). *Construction hazard and safety handbook*. CBS Publishers.
6. Deshmukh, P. (2014). *Safety, health and environmental management in construction*. Tata McGraw-Hill Education.
7. National Safety Council. (2009). *Accident prevention manual for business and industry: Engineering and technology* (13th ed.). National Safety Council.
8. Deshmukh, P. (2010). *Industrial safety, health and environment management systems*. Khanna Publishers.
9. Institution of Chemical Engineers.
10. Stamatis, D. H. (2003). *Failure mode and effect analysis: FMEA from theory to execution* (2nd ed.). ASQ Quality Press.
11. Universal Law Publishing. (Latest ed.). *The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996, and Central Rules*. Universal Law Publishing.
12. Bureau of Indian Standards. (2016). *National Building Code of India 2016*. Bureau of Indian Standards.
13. Frank, R. (2010). *OSHA construction safety handbook*. McGraw-Hill Education.



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|---------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1204 - Construction Contracts, Specifications and Legal Issues</b> | Subject Category                | TC |
|                                                                           | Number of Credits               | 03 |
|                                                                           | Lecture Periods per Week        | 02 |
|                                                                           | Tutorial Periods per Week       | 01 |
|                                                                           | Studio/Lab/Workshop/Practical's | -  |
|                                                                           | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of construction laws, contract principles, tendering procedures, specifications, and legal documentation used in the construction industry. The course also aims to develop understanding of disputes, claims, liabilities, labour laws, and dispute resolution methods including arbitration and conciliation.

#### **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, 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 Specifications**

Importance of Specifications and Estimates in Construction, Methods of Specification writing, classification of specifications, specifications of typical items, standard specifications, typical space for building works, implications of variations and incomplete specifications, impact on building costs.

#### **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

**Total: 48 Periods**

#### **Outcome:**

Upon successful completion of this course, students will be able to understand construction laws, contract procedures, tendering practices, and specification writing in construction projects. They will gain the ability to identify disputes, delays, claims, and liabilities, and apply dispute resolution methods such as arbitration and conciliation for effective construction contract management.

#### **Reference Books**

1. Bailey, J. (2011). *Construction law* (Vols. 1–3). Informa Law from Routledge.
2. Clough, R. H., Sears, G. A., Sears, S. K., & Segner, R. O. (2015). *Construction contracting: A practical guide to company management* (8th ed.). Wiley India.
3. Pollock, F., & Mulla, D. F. (2017). *The Indian Contract Act, 1872* (15th ed.). LexisNexis Butterworths.
4. Patil, B. S. (2012). *Engineering contracts and specifications*. Universities Press.
5. Chakraborti, M. (2010). *Estimating, costing and valuation*. Professional Publications.
6. Bunni, N. G. (2005). *The FIDIC forms of contract* (3rd ed.). Blackwell Publishing.
7. Markanda, P. C. (2016). *Law relating to arbitration and conciliation* (5th ed.). LexisNexis.

8. Hewitt, A. (2011). *Construction claims and responses: Effective writing and presentation*. Wiley-Blackwell.
9. Singh, A. (2016). *Construction law in India*. Wolters Kluwer India.
10. Dutta, B. N. (2013). *Tendering and estimating in civil engineering*. UBS Publishers.
11. Mamoria, C. B., & Mamoria, S. (2014). *Labour laws for managers*. Excel Books.
12. Baxi, U., & Galanter, M. (2004). *Alternative dispute resolution*. Universal Law Publishing.
13. Bureau of Indian Standards. (2016). *National Building Code of India 2016*. Bureau of Indian Standards.
14. Universal Law Publishing. (Latest ed.). *The Information Technology Act, 2000*. Universal Law Publishing.

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|-------------------------------------------------|---------------------------------|----|
| <b>MBEM1205 – Digital tools in Construction</b> | Subject Category                | TC |
|                                                 | Number of Credits               | 03 |
|                                                 | Lecture Periods per Week        | 02 |
|                                                 | Tutorial Periods per Week       | 01 |
|                                                 | Studio/Lab/Workshop/Practical's | -  |
|                                                 | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of modern digital technologies and intelligent systems used in the construction industry. The course aims to develop understanding of Building Information Modelling (BIM), project planning softwares, Geographical Information Systems (GIS), Remote Sensing, Human–Computer Interaction (HCI), and Artificial Intelligence (AI) and Machine Learning (ML) applications in construction management. It also emphasizes the use of digital tools for project planning, visualization, decision-making, automation, and efficient management of construction projects.

#### **Unit I – Digital tools for Project Planning and Scheduling**

This unit focuses on the use of project management software tools for planning, scheduling, monitoring, and controlling construction projects. Students will learn project scheduling techniques, work breakdown structures (WBS), resource allocation, baseline preparation, tracking project progress, cost control, and reporting systems. The unit emphasizes practical applications of digital scheduling tools in construction project management

#### **Unit II – Introduction to Building Information Modelling (BIM)**

This unit introduces the concepts, principles, and applications of Building Information Modelling (BIM) in the construction industry. It covers BIM workflows, levels of development, 3D/4D/5D modelling, clash detection, collaboration platforms, and integration of architectural, structural, and MEP systems. Students will understand the role of BIM in project planning, visualization, quantity estimation, scheduling, facility management, and sustainable construction practices.

#### **Unit III – Geo Information Systems and Remote Sensing Applications**

This unit introduces Geographical Information Systems (GIS) and Remote Sensing technologies used in planning, analysis, and management of construction and infrastructure projects. Topics include spatial data collection, mapping, satellite imagery, terrain analysis, site selection, urban planning, environmental monitoring, and infrastructure management. Students will understand the applications of GIS and Remote Sensing in construction planning, land use analysis, and smart city development.

#### **Unit IV – Digital Twin technology in Construction**

This unit introduces the concept, definition, and framework of Digital Twin technology and its evolution in engineering, construction, and infrastructure sectors. It covers the components, characteristics, and architecture of Digital Twin systems along with their significance in improving project planning, operation, maintenance, and lifecycle management. Students will also study the challenges associated with implementation such as data integration, interoperability, cybersecurity, scalability, and real-time synchronization.

#### **Unit V – Artificial Intelligence (AI) and Machine Learning(ML) in Construction**

This unit introduces Artificial Intelligence (AI) and Machine Learning (ML) concepts and their applications in the construction industry. Topics include predictive analytics, automation, smart decision-making systems, risk prediction, quality control, safety monitoring, construction robotics, and data-driven project management. Students will understand the role of AI and ML in improving project efficiency, optimization, sustainability, and intelligent construction management practices.

#### **Outcome:**

Upon successful completion of this course, students will be able to understand and apply BIM concepts and project management software for planning, scheduling, monitoring, and coordination of construction projects. They will gain knowledge of GIS and Remote Sensing applications for spatial analysis, site planning, and infrastructure management. Students will also understand Human–Computer Interaction principles and emerging technologies such as AI and Machine Learning for automation, predictive analysis, intelligent decision-making, and improved efficiency in construction and infrastructure projects.

### Reference Books

1. Kymmell, W. (2008). *Building information modeling: Planning and managing construction projects with 4D CAD and simulations*. McGraw-Hill Education.
2. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2018). *BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers* (3rd ed.). John Wiley & Sons.
3. Harris, P. E. (2019). *Project planning and control using Primavera P6* (Version 18 ed.). Eastwood Harris Pty Ltd.
4. Gill, R. (2008). *Dynamic scheduling with Microsoft Project 2007: The book by and for professionals*. J. Ross Publishing.
5. Pyron, T. (2016). *Project management with Microsoft Project*. Microsoft Press.
6. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic information systems and science* (4th ed.). John Wiley & Sons.
7. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). *Remote sensing and image interpretation* (7th ed.). John Wiley & Sons.
8. Chang, K. T. (2018). *Introduction to geographic information systems* (9th ed.). McGraw-Hill Education.
9. Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-computer interaction* (3rd ed.). Pearson Education.
10. Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., Elmquist, N., & Diakopoulos, N. (2016). *Designing the user interface: Strategies for effective human-computer interaction* (6th ed.). Pearson.
11. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson Education.
12. Raschka, S. (2016). *Python machine learning*. O'Reilly Media.
13. Bolpagni, M., Gavina, R., & Ribeiro, F. L. (Eds.). (2021). *Industry 4.0 for the built environment: Methodologies, technologies and skills*. Springer.
14. Ahmed, V., Tezel, A., & Aziz, Z. (Eds.). (2020). *Machine learning and data science in the construction industry*. CRC Press.

## Elective-2

|                                        |                                 |    |
|----------------------------------------|---------------------------------|----|
| <b>MBEM1206 - Research Methodology</b> | Subject Category                | TC |
|                                        | Number of Credits               | 03 |
|                                        | Lecture Periods per Week        | 02 |
|                                        | Tutorial Periods per Week       | 01 |
|                                        | Studio/Lab/Workshop/Practical's | -  |
|                                        | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with a fundamental understanding of research methodology, research design, and scientific approaches used in academic and professional research. The course aims to develop knowledge of research processes, hypothesis formulation, sampling techniques, data collection methods, and quantitative analysis. It also intends to familiarize students with report writing, referencing methods, and the use of computer applications and statistical tools for research and data analysis.

### Unit I – Introduction to Research Methodology

This unit introduces the fundamentals of research, including its definition, aims, objectives, and significance in academic and professional fields. It covers various types of research such as descriptive, analytical, applied, fundamental, quantitative, qualitative, conceptual, and empirical research. Students will understand the importance of systematic investigation and scientific approaches in research activities.

### Unit II – Research Process and Research Design

This unit focuses on the stages involved in the research process, including problem formulation, literature survey, development of hypotheses, preparation of research design, data collection, analysis, interpretation, and report preparation. It also introduces concepts related to research design such as dependent and independent variables, extraneous variables, control variables, and research hypotheses. Different types of research designs including exploratory, descriptive, diagnostic, and experimental designs are discussed.

### Unit III – Hypothesis Testing and Sampling Techniques

This unit deals with hypothesis formulation and testing procedures used in research studies. Topics include null and alternative hypotheses, level of significance, types of errors, and hypothesis testing methods. The unit also introduces sampling techniques, criteria for sample selection, probability sampling, and non-probability sampling methods along with their characteristics, advantages, and applications in research.

### Unit IV – Data Collection, Processing and Analysis

This unit focuses on methods of primary data collection such as observation, structured and unstructured interviews, questionnaires, and schedules. Students will learn the applications, advantages, and limitations of different data collection methods. The unit also covers data editing, coding, classification, tabulation, and basic quantitative techniques used for organizing and analyzing research data.

### Unit V – Report Writing and Computer Applications in Research

This unit introduces the principles and structure of research report and thesis preparation. Topics include preparation of prefatory sections, main body, supplementary sections, referencing, bibliography, and academic writing standards. The unit also covers the use of computer applications and software tools for data analysis, documentation, presentation, and quantitative analysis in research studies

## Outcome

Upon successful completion of this course, students will be able to understand various types of research and apply systematic research methodologies for problem identification and analysis. They will gain the ability to formulate research hypotheses, design research studies, select appropriate sampling methods, and collect

and analyze data using qualitative and quantitative techniques. Students will also develop skills in preparing research reports and theses with proper referencing and effectively use computer applications and analytical tools for research documentation and data analysis.

### Reference Books

1. Kothari, C. R., & Garg, G. (2019). *Research methodology: Methods and techniques* (4th ed.). New Age International Publishers.
2. Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners* (5th ed.). Sage Publications.
3. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
4. Cooper, D. R., & Schindler, P. S. (2014). *Business research methods* (12th ed.). McGraw-Hill Education.
5. Kumar, R. (2014). *Research methodology: A step-by-step guide for beginners* (4th ed.). Sage Publications.
6. Gupta, S. C. (2017). *Fundamentals of applied statistics* (4th rev. ed.). Sultan Chand & Sons.
7. Vohra, N. D. (2017). *Quantitative techniques in management* (6th ed.). McGraw-Hill Education.
8. Singh, Y. K. (2006). *Fundamentals of research methodology and statistics*. New Age International Publishers.
9. Booth, W. C., Colomb, G. G., Williams, J. M., Bizup, J., & Fitzgerald, W. T. (2016). *The craft of research* (4th ed.). University of Chicago Press.
10. Lester, J. D., & Lester, J. D., Jr. (2014). *Writing research papers: A complete guide* (15th ed.). Pearson Education.
11. Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS* (7th ed.). McGraw-Hill Education.
12. Leedy, P. D., & Ormrod, J. E. (2015). *Practical research: Planning and design* (11th ed.). Pearson Education.
13. Creswell, J. W., & Poth, C. N. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage Publications.
14. Cochran, W. G. (2007). *Sampling techniques* (3rd ed.). Wiley India.
15. Anderson, J., Durston, B. H., & Poole, M. (2006). *Thesis and assignment writing* (4th ed.). Wiley India.

|                                                                      |                                 |    |
|----------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1207 - Construction Quality Assurance and Quality Control</b> | Subject Category                | TC |
|                                                                      | Number of Credits               | 03 |
|                                                                      | Lecture Periods per Week        | 02 |
|                                                                      | Tutorial Periods per Week       | 01 |
|                                                                      | Studio/Lab/Workshop/Practical's | -  |
|                                                                      | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with comprehensive knowledge of quality management principles, statistical quality control techniques, and quality assurance practices used in the construction industry. The course aims to develop understanding of quality standards, testing procedures, quality assessment methods, and acceptance criteria for construction materials and processes. It also intends to familiarize students with on-site quality management practices, inspection systems, advanced testing methods, and modern quality management tools including automation and computer applications for achieving quality improvement and continuous performance enhancement in construction projects.

### **Unit I – Fundamentals and Evolution of Quality Management**

This unit introduces the concepts and evolution of quality management in engineering and construction industries. It covers the development of quality practices from Quality Inspection, Quality Control (QC), Quality Assurance (QA), Quality Management (QM), Total Quality Management (TQM), and ISO Certification systems. Students will study the importance of quality in construction projects and understand the principles and philosophies proposed by renowned quality gurus such as Philip B. Crosby, W. Edwards Deming, Joseph Juran, and Kaoru Ishikawa. The unit also discusses modern quality management practices and continuous improvement concepts used in construction organizations.

### **Unit II – Statistical Quality Control and Quantitative Techniques**

This unit focuses on statistical methods and quantitative techniques used in quality management and construction quality assessment. Topics include population and sampling techniques, measures of central tendency and variability, statistical process control, control charts, acceptance sampling, and prescribed tolerances as per standards. Students will learn the application of statistical tools for monitoring quality performance, identifying process variations, and improving decision-making in construction projects. The unit also introduces computer-based statistical analysis and automation tools used in quality management.

### **Unit III – Quality Control and Quality Assurance in Construction Materials**

This unit deals with quality control and quality assurance practices related to construction materials and construction processes. Students will study common quality issues associated with concrete and steel construction and methods for ensuring compliance with relevant IS codes and standards. The unit covers frequency of material testing, sampling procedures, testing methods, and reporting practices for commonly used materials such as cement, sand, aggregates, bricks, steel, and concrete. It also explains acceptance and rejection criteria for materials and the importance of laboratory and field testing in ensuring construction quality.

### **Unit IV – On-Site Quality Management and Assessment Techniques**

This unit focuses on practical quality management practices implemented at construction sites. Topics include setting quality standards for various stages of construction, preparation of quality checklists, inspection procedures, quality documentation, and quality audit systems. Students will learn on-site quality assessment techniques, use of testing equipment for construction materials, and introduction to advanced non-destructive testing methods and quality monitoring technologies. The unit also covers post-handover quality control, defect identification, maintenance considerations, and customer satisfaction approaches in construction projects.

### **Unit V – Modern Quality Management Systems and Computer Applications**

This unit introduces modern quality management systems, automation technologies, and computer applications used for quality monitoring and control in construction projects. Students will study the use of software tools, digital documentation systems, Building Information Modelling (BIM)-based quality management, and automated inspection systems. The unit also covers integration of quality management with project planning, scheduling, safety, sustainability, and performance management. Emerging trends such as AI-based quality assessment, smart quality monitoring systems, and data-driven quality management practices in the construction industry are also discussed.

**Total: 48 class hours expected s**

#### **Outcome:**

Upon successful completion of this course, students will be able to understand quality management concepts and apply quality control and quality assurance practices in construction projects. They will gain the ability to conduct material testing, perform on-site quality inspections, prepare quality documentation, and use modern testing methods and digital tools for effective quality monitoring and improvement in construction management.

#### **Reference Books**

1. Kothari, C. R., & Garg, G. (2019). *Research methodology: Methods and techniques* (4th ed.). New Age International Publishers.
2. Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners* (5th ed.). Sage Publications.
3. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
4. Cooper, D. R., & Schindler, P. S. (2014). *Business research methods* (12th ed.). McGraw-Hill Education.
5. Kumar, R. (2014). *Research methodology: A step-by-step guide for beginners* (4th ed.). Sage Publications.
6. Gupta, S. C. (2017). *Statistical methods*. Sultan Chand & Sons.
7. Vohra, N. D. (2017). *Quantitative techniques in management* (6th ed.). McGraw-Hill Education.
8. Singh, Y. K. (2006). *Fundamentals of research methodology and statistics*. New Age International Publishers.
9. Booth, W. C., Colomb, G. G., Williams, J. M., Bizup, J., & Fitzgerald, W. T. (2016). *The craft of research* (4th ed.). The University of Chicago Press.
10. Lester, J. D., & Lester, J. D., Jr. (2014). *Writing research papers: A complete guide* (15th ed.). Pearson Education.
11. Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS* (7th ed.). McGraw-Hill Education.
12. Leedy, P. D., & Ormrod, J. E. (2015). *Practical research: Planning and design* (11th ed.). Pearson Education.
13. Creswell, J. W., & Poth, C. N. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage Publications.
14. Cochran, W. G. (2007). *Sampling techniques* (3rd ed.). Wiley India.
15. Anderson, J., Durston, B. H., & Poole, M. (2006). *Thesis and assignment writing* (4th ed.). Wiley India.



|                                                     |                                 |    |
|-----------------------------------------------------|---------------------------------|----|
| <b>MBEM1208 - Construction Materials Management</b> | Subject Category                | TC |
|                                                     | Number of Credits               | 03 |
|                                                     | Lecture Periods per Week        | 02 |
|                                                     | Tutorial Periods per Week       | 01 |
|                                                     | Studio/Lab/Workshop/Practical's | -  |
|                                                     | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of materials management systems, procurement procedures, inventory control techniques, and material handling practices used in construction and industrial projects. The course aims to develop understanding of vendor analysis, tendering procedures, stock management, forecasting methods, and inventory optimization techniques. It also intends to familiarize students with quality control practices and the application of Operations Research techniques, MIS, and BIM technologies for efficient and integrated materials management.

### **Unit I – Introduction to Materials Management**

This unit introduces the concepts and importance of Integrated Materials Management Systems in construction and industrial projects. It covers the objectives, functions, and significance of materials management in achieving cost efficiency, timely availability of materials, and effective resource utilization. Students will learn methods of classification and codification of materials for systematic storage, tracking, and control within construction organizations.

### **Unit II – Procurement and Tendering Procedures**

This unit focuses on procurement management and tendering procedures related to material purchasing. Topics include identification of procurement sources, vendor analysis and evaluation, preparation and scrutiny of material indents, tender documentation, bid evaluation, and awarding of contracts. The unit also covers issues related to foreign procurement, governmental purchasing procedures, and ethical practices in procurement management.

### **Unit III – Inventory Control and Store Management**

This unit deals with store management, stock verification, store accounting, and disposal of scrap materials. Students will study inventory management concepts including safety stock, stock-out situations, inventory control systems, and forecasting techniques. The unit also introduces inventory analysis methods such as ABC, XYZ, VED, GOLF, FSN, HML classifications, and Economic Order Quantity (EOQ) analysis for effective inventory planning and optimization.

### **Unit IV – Material Handling, Transportation and Quality Management**

This unit focuses on material handling and transportation systems used in construction and industrial operations. Students will learn about material handling equipment, storage systems, transportation methods, and safety considerations in handling construction materials. The unit also covers quality control and quality assurance procedures related to materials management, including inspection, testing, documentation, and maintaining quality standards during procurement, storage, and usage of materials.

### **Unit V – Modern Techniques and Digital Applications in Materials Management**

This unit introduces the application of Operations Research (OR) techniques and modern digital technologies in materials management systems. Topics include optimization techniques, decision-making models, Management Information Systems (MIS), and Building Information Modelling (BIM) applications for material planning, tracking, and control. The unit emphasizes automation, digital inventory systems, data analysis, and integration of smart technologies for improving efficiency, transparency, and sustainability in materials management practices.

**Total: 48 class hours expected**

**Outcome:**

Upon successful completion of this course, students will be able to understand the principles and functions of materials management and apply procurement and tendering procedures for material purchasing and vendor selection. They will gain the ability to manage inventory systems, perform stock analysis, forecasting, and EOQ calculations for effective inventory control. Students will also understand material handling systems, quality control procedures, and the use of OR techniques, MIS, and BIM applications for improving efficiency and decision-making in materials management systems.

**Reference Books**

1. Doyle, A. (2011). *Materials management in sustainable construction engineering*. Wiley-Blackwell.
2. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2011). *Construction planning, equipment, and methods* (8th ed.). Tata McGraw-Hill Education.
3. Gransberg, D. D., Popescu, C. M., & Ryan, R. C. (2006). *Construction equipment management for engineers, estimators, and owners*. CRC Press.
4. Piasecki, D. J. (2009). *Inventory management explained: A focus on forecasting, lot sizing, safety stock, and ordering systems* (2nd ed.). Ops Publishing.
5. Aggarwal, S. C. (2011). *Inventory management: Principles and practices*. Excel Books.
6. Gopalakrishnan, P., & Sundaresan, M. (2008). *Materials management: An integrated approach*. Prentice Hall of India. (Commonly cited in place of "Procedures, Text and Cases".)
7. Datta, A. K. (2010). *Stores management and stock control*. Vikas Publishing House.
8. Dobler, D. W., & Burt, D. N. (2013). *Purchasing and supply management* (6th ed.). McGraw-Hill Education.
9. Taha, H. A. (2017). *Operations research: An introduction* (10th ed.). Pearson Education.
10. Chary, S. N. (2019). *Production and operations management* (6th ed.). Tata McGraw-Hill Education.
11. Chopra, S., & Meindl, P. (2016). *Supply chain management: Strategy, planning, and operation* (6th ed.). Pearson Education.
12. Richards, G. (2017). *Warehouse management: A complete guide to improving efficiency and minimizing costs in the modern warehouse* (3rd ed.). Kogan Page.

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|-----------------------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM1209– Inter departmental/Inter-Institutional Elective (Online/Physical Mode)</b> | Subject Category                | TC |
|                                                                                         | Number of Credits               | 03 |
|                                                                                         | Lecture Periods per Week        | 02 |
|                                                                                         | Tutorial Periods per Week       | 01 |
|                                                                                         | Studio/Lab/Workshop/Practical's | -  |
|                                                                                         | Total Periods per Week          | 03 |

**Objective:** The underlying fundamental of this elective is for the student to identify and pursue any unique course of study related to STEM (Science, Technology, Engineering, and Management) in physical or online mode. Students can select a course that may be directly or indirectly relevant to the building or its related infrastructure works. The objective of this course is to enhance the exposure of students in an unrestricted manner and to aid their learning through varied methods. The course enables students to acquire skills to develop their ideas into physical form and encourages startups. This elective intends to achieve the concept of multidisciplinary and cross-collaboration to the other areas of specialization.

### Course Content

The course may be linked to the built environment, construction, architecture, planning, project management, or related to the topic of research. Encouraging a multi-disciplinary approach through the subject as well as its contents, the coursework should include a theoretical understanding of the subject, learning through case studies and real-world projects, and future methods of application in the industry/ research. The use of analytical tools and techniques is encouraged.

Upon completion of this course, the student should be able to

- Learn foundational concepts of the topic
- Establish a link between the learnings and their projects/ research
- Apply the skills in their research/ projects/ future career
- Share the insights with fellow classmates
- Earn a certificate from the online learning platform or certificate from other Department of studies.

### References

1. National Programme on Technology Enhanced Learning (NPTEL) initiated by Ministry of Education.
2. Courses offered by IIT, IIM, ISSER, NIT's, SPA's, NITTTR and other reputed Universities/Institution
3. Courses offered by reputed National and International Universities.

## **THIRD SEMESTER**

|                                                                       |                                 |    |
|-----------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM2101 - Construction Contract Procurement Management Studio</b> | Subject Category                | SC |
|                                                                       | Number of Credits               | 10 |
|                                                                       | Lecture Periods per Week        | 2  |
|                                                                       | Tutorials per week              | -  |
|                                                                       | Studio/Lab/Workshop/Practical's | 8  |
|                                                                       | Total Periods per Week          | 10 |

**Objectives:** The objective of this course is to provide students with knowledge of construction procurement, communication, change control, and post-construction management practices used in construction projects. The course aims to develop understanding of contract administration, procurement procedures, stakeholder communication systems, project closure processes, and maintenance management. It also intends to familiarize students with joint venture practices, public-private partnerships, environmental management systems, and the application of Operations Research techniques for integrated construction project management.

### **Unit I – Construction Procurement Management**

This unit introduces the principles and processes involved in construction procurement management. It covers identification of products and services required for procurement, types of construction contracts, and procurement planning procedures. Students will study pre-qualification of contractors, preparation of contract documents, bid evaluation methods, contract award procedures, and dispute resolution mechanisms. The unit also includes comparative study of procurement guidelines and contract systems used by organizations such as the World Bank, ADB, FIDIC, CPWD, and MES, along with preparation of procurement and contract documents for construction projects.

### **Unit II – Construction Communication Management**

This unit focuses on communication management processes in construction projects. Topics include identification of project stakeholders, information requirements, communication channels, and communication systems used in project management. Students will learn methods for preparation and distribution of project information, reporting systems, documentation procedures, and communication formats for different project stages. The unit emphasizes effective coordination and stakeholder communication for successful project execution and management.

### **Unit III – Project Change Control and Project Closure**

This unit deals with project change management and project closure procedures in construction projects. Students will study processes for managing and communicating changes in project scope, design, specifications, techniques, schedules, and resources during the implementation phase. The unit also covers project monitoring and control mechanisms, administrative closure, contractual closure, and documentation procedures required for successful completion and handover of projects.

### **Unit IV – Post Construction and Maintenance Management**

This unit focuses on post-construction activities and maintenance management practices for buildings and infrastructure projects. Topics include maintenance management systems, preparation of maintenance manuals, organizational and contractual aspects of maintenance activities, and financial planning for maintenance operations. The unit also covers life cycle considerations, facility management concepts, and sustainable maintenance practices for ensuring long-term performance of constructed facilities.

### **Unit V – Joint Ventures, Environmental Management and Integrated Management Applications**

This unit introduces joint ventures, professional collaborations, and public-private partnership (PPP) models used in construction projects. Students will study Environmental Management System (EMS) standards and their application in construction activities for sustainable project development. The unit also covers the application of Operations Research (OR) techniques in procurement, communication, maintenance, and

project management processes. Emphasis is given to understanding the interaction between procurement management, communication management, and other project management knowledge areas in practical construction environments.

**Total: 160 class hours expected**

**Outcome:**

Upon successful completion of this course, students will be able to understand procurement management procedures, contract systems, bid evaluation, and contractor selection processes used in construction projects. They will gain the ability to develop communication systems, manage stakeholder information, and prepare project reports for effective project coordination. Students will also understand project change control, project closure procedures, maintenance management practices, and environmental management systems. Further, they will be capable of applying OR techniques and integrated management approaches in procurement, communication, maintenance, and overall construction project management.

**Reference Books**

1. Project Management Institute. (2008). *A guide to the project management body of knowledge (PMBOK® Guide)* (4th ed.). Project Management Institute.
2. Sears, S. K., Clough, R. H., Sears, G. A., & Rounds, J. L. (2008). *Construction project management: A practical guide to field construction management* (5th ed.). John Wiley & Sons.
3. Chitkara, K. K. (2014). *Construction project management: Planning, scheduling and controlling* (3rd ed.). Tata McGraw-Hill Education.
4. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2011). *Construction planning, equipment, and methods* (8th ed.). Tata McGraw-Hill Education.
5. Schwalbe, K. (2015). *An introduction to project management* (5th ed.). Cengage Learning.
6. Murdoch, J., & Hughes, W. (2008). *Construction contracts: Law and management* (4th ed.). Routledge.
7. Morgan, D. B. (2008). *International construction contract management*. Ashgate Publishing.
8. Uher, T. E., & Loosemore, M. (2009). *Fundamentals of building contract management*. UNSW Press.
9. Ramaswamy, B. S. (2011). *Contracts and their management*. LexisNexis Butterworths India.
10. Phillips, C. S. (2004). *Construction contract administration*. SME Publications.
11. Emmitt, S., & Gorse, C. (2007). *Construction communication*. John Wiley & Sons.
12. Bourne, L. (2010). *Stakeholder relationship management: A maturity model for organisational implementation*. Gower Publishing.
13. Mincks, W. R., & Johnston, H. (2011). *Construction jobsite management* (3rd ed.). Cengage Learning.
14. Fisk, E. R., & Reynolds, W. D. (1998). *Construction project administration* (or equivalent reference on change orders). Tata McGraw-Hill.
15. Motawa, I. A., Anumba, C. J., Lee, S., & Peña-Mora, F. (2008). *Managing change in construction projects: A knowledge-based approach*. John Wiley & Sons.

|                                |                                 |    |
|--------------------------------|---------------------------------|----|
| <b>MBEM2102 - Dissertation</b> | Subject Category                | JC |
|                                | Number of Credits               | 03 |
|                                | Lecture Periods per Week        | 02 |
|                                | Tutorial Periods per Week       | 01 |
|                                | Studio/Lab/Workshop/Practical's | -  |
|                                | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to develop students' research, analytical, and problem-solving skills in the fields of construction management, building technology, and related areas. The course aims to provide knowledge of research methodology, literature review, hypothesis formulation, data collection, analysis, validation, and report preparation through case studies, surveys, and field-based research activities.

### Description

The state of art report prepared on the chosen topic and develop hypothesis to be tested through the research methodology designed for the purpose. A comprehensive seminar report is prepared with the identification of areas for further research and development. Students are required to test their outcome proposals through various methods, including questionnaire surveys and case studies. It is encouraged that students identify topics for the seminar work which can be further developed into a thesis work as well. Students must create an innovative insight on the specific issues.

The state of art report prepared on the chosen topic and develop hypothesis to be tested through the research methodology designed for the purpose. A comprehensive report is prepared with the identification of areas for further research and development. Students are required to test their outcome proposals through various methods, including questionnaire surveys and case studies. It is encouraged that students identify topics for the work which can be further developed into a another Project research in the next semester in Thesis for more in-depth research. Alternatively, This Project can be an independent research topic. Students must create an innovative insight on the specific issues.

Project work includes processes such as: Research area identification; hypothesis of research topic; literature sourcing and search; aim and objective definition; formulation of methodology; field study planning; survey data collection, analysis and result presentation; literature study; compilation and inference drawing; research study validation through case studies, field application and simulation models; discussion of findings of research findings; study conclusion and recommendation formulations.

The progress of the work is presented and discussed by the student periodically in the classroom environment and progress monitored continuously. The work develops the comprehension and presentation skills of the students. The students are provided guidance from the faculty to channelize their thoughts.

The suggestive list of the areas is as follows:

- o Building Engineering, Construction technology and Structural systems.
- o Energy efficient building materials & techniques.
- o Construction project management.
- o Time management.
- o Cost management.
- o Quality management.
- o Safety management.
- o Contract Administration.
- o Design co-ordination and management.
- o Construction Finance.
- o Investment Analysis and portfolio Management.
- o Real Estate management.

- o Value Engineering.
- o Risk Management.
- o Construction Equipment.
- o Impact Assessment.
- o Human resource management.
- o Quantitative techniques.
- o Energy management.
- o Building services.
- o Green Buildings.
- o Building Performance Evaluation Systems.
- o Building automation and management systems.
- o Infrastructure services.
- o Management information systems.

**Total: 48 class hours expected**

**Outcome:**

Upon successful completion of this course, students will be able to identify research problems, develop research methodologies, conduct literature reviews, and analyze data using appropriate techniques. They will gain skills in technical report writing, presentation, critical analysis, and formulation of conclusions and recommendations for solving practical problems in construction and management fields.



|                                            |                                 |    |
|--------------------------------------------|---------------------------------|----|
| <b>MBEM2103 - Construction Procurement</b> | Subject Category                | TC |
|                                            | Number of Credits               | 03 |
|                                            | Lecture Periods per Week        | 02 |
|                                            | Tutorial Periods per Week       | 01 |
|                                            | Studio/Lab/Workshop/Practical's | -  |
|                                            | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of construction procurement management, contract administration, professional service agreements, and supply chain management practices used in construction projects. The course aims to develop understanding of procurement procedures, bid evaluation, project delivery systems, dispute resolution mechanisms, and material management systems. It also intends to familiarize students with professional ethics, interdisciplinary coordination, and modern digital tools such as BIM, MIS, and e-procurement systems used in integrated construction management.

### **Unit I – Construction Procurement Management and Contract Administration**

This unit introduces the principles and processes involved in construction procurement management. It covers procurement guidelines of international organizations such as the World Bank and Asian Development Bank (ADB), procurement planning, and preparation of contract documents including Request for Proposal (RFP) and Request for Quotation (RFQ). Students will study pre-qualification of contractors, evaluation of technical and financial bids, negotiation procedures, contract award processes, and modern procurement practices such as e-procurement and digital tendering systems. The unit also introduces various forms of construction contracts including EPC, Design-Build, and Integrated Project Delivery systems.

### **Unit II – Professional Services Contracts and Project Delivery Systems**

This unit focuses on contracts related to professional consultancy and project management services in construction projects. Topics include selection of consultants, fee structures, contractual conditions, and engagement of international consultants. Students will study joint ventures, equity participation in construction organizations, performance guarantees, bank guarantees, and fiscal aspects associated with professional services. The unit also covers modern project delivery systems such as PPP (Public Private Partnership), Swiss Challenge Method, Design-Bid-Build (DBB), Design-Build (DB), and EPC models along with their applications in infrastructure and construction projects.

### **Unit III – Procurement of Materials, Equipment and Supply Chain Management**

This unit deals with procurement procedures related to construction materials, equipment, and machinery. Students will learn procurement planning, purchase procedures, vendor selection, warranties, taxation issues, inspections, testing procedures, and release of payments. The unit also introduces material management concepts including classification, storage, inventory control, supply chain management, and logistics management. Emphasis is given to modern procurement strategies, digital inventory systems, sustainable procurement practices, and integration of supply chain technologies in construction projects.

### **Unit IV – Contract Administration, Dispute Resolution and Professional Ethics**

This unit focuses on contract administration practices and dispute resolution mechanisms used in construction projects. Topics include alternate dispute resolution methods, Dispute Review Boards (DRBs), arbitration procedures, claims management, and contractual issues arising during project execution. Students will study standard consultancy agreement forms, code of professional practice, interdisciplinary coordination, and professional ethics in construction management. The unit also introduces legal compliance, risk allocation, and modern approaches to collaborative contracting and conflict management.

### **Unit V – Integrated Project Procurement and Digital Construction Management**

This unit introduces integrated approaches to procurement and project management using modern digital technologies. Students will study the role of project management organizations (PMOs), procurement of project management services, and coordination between procurement, finance, contracts, and project execution teams. The unit also covers applications of BIM, ERP, MIS, e-procurement systems, and data-driven decision-making tools in procurement and contract management. Emerging trends such as sustainable procurement, smart contracts, blockchain applications in construction contracts, and digital project governance are also discussed.

**Total: 48 class hours expected**

**Outcome:**

Upon successful completion of this course, students will be able to understand procurement processes, contract administration practices, and project delivery systems used in construction projects. They will gain the ability to evaluate bids, manage procurement of materials and professional services, and apply supply chain and inventory management techniques. Students will also understand dispute resolution mechanisms, professional ethics, and interdisciplinary coordination in construction management. Further, they will be capable of using modern digital tools and integrated management approaches for effective procurement and contract management in construction projects.

**Reference Books:**

1. Murdoch, J., & Hughes, W. (2008). *Construction contracts: Law and management* (4th ed.). Routledge.
2. Morgan, D. B. (2008). *International construction contract management*. Ashgate Publishing.
3. Ramaswamy, B. S. (2011). *Contracts and their management*. LexisNexis Butterworths India.
4. Uher, T. E., & Loosemore, M. (2009). *Fundamentals of building contract management*. UNSW Press.
5. Garrett, G. A. (2003). *Project procurement management*. FMC Press.
6. Lysons, K., & Farrington, B. (2020). *Procurement and supply chain management* (10th ed.). Pearson Education.
7. Pryke, S. (2009). *Construction supply chain management: Concepts and case studies*. Wiley-Blackwell.
8. Gopalakrishnan, P., & Sundaresan, M. (2008). *Materials management: An integrated approach*. PHI Learning.
9. Dobler, D. W., & Burt, D. N. (2013). *Purchasing and supply management* (6th ed.). McGraw-Hill Education.
10. Markanda, P. C. (2016). *Law relating to arbitration and conciliation* (5th ed.). LexisNexis.
11. Kerzner, H. (2017). *Project management: A systems approach to planning, scheduling, and controlling* (12th ed.). Wiley India.
12. Hardin, B., & McCool, D. (2015). *BIM and construction management: Proven tools, methods, and workflows* (2nd ed.). John Wiley & Sons.
13. Laudon, K. C., & Laudon, J. P. (2018). *Management information systems: Managing the digital firm* (15th ed.). Pearson Education.
14. Yescombe, E. R. (2017). *Public-private partnerships: Principles of policy and finance* (2nd ed.). Butterworth-Heinemann.
15. World Bank. (Latest ed.). *Procurement regulations for IPF borrowers*. World Bank Publications.
16. Asian Development Bank. (Latest ed.). *Procurement policy and Procurement regulations for ADB borrowers*. Asian Development Bank.

|                                              |                                 |    |
|----------------------------------------------|---------------------------------|----|
| <b>MBEM2104 - Project Finance Management</b> | Subject Category                | TC |
|                                              | Number of Credits               | 03 |
|                                              | Lecture Periods per Week        | 02 |
|                                              | Tutorial Periods per Week       | 01 |
|                                              | Studio/Lab/Workshop/Practical's | -  |
|                                              | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of financial management principles and practices related to construction and infrastructure projects. The course aims to develop understanding of financial systems, financial statements, capital budgeting techniques, investment appraisal methods, cash flow management, and financial risk analysis. It also intends to familiarize students with project financing procedures, working capital management, international financing systems, and the application of quantitative and computer-based tools for effective financial decision-making in construction projects.

### **Unit I – Fundamentals of Construction Financial Management**

This unit introduces the concepts and evolution of financial management in construction projects. It covers the role and importance of finance management during various phases of the construction project life cycle. Students will study the financial system, sources of construction finance, need for financing building and infrastructure projects, and the role of government and financial institutions in construction finance. The unit also discusses forms of business organizations such as joint ventures, consortiums, and public-private partnerships (PPP), along with relevant laws and regulations governing construction finance.

### **Unit II – Financial Statements and Financial Analysis**

This unit focuses on financial accounting systems and analysis techniques used in construction organizations. Topics include preparation and interpretation of financial statements such as balance sheets, profit and loss statements, cash flow statements, and fund flow statements. Students will learn financial ratio analysis for evaluating the financial health and performance of construction firms. The unit also covers concepts of taxation, depreciation, amortization, inflation, valuation, returns, payback period, and profitability analysis relevant to project finance management.

### **Unit III – Capital Budgeting and Investment Analysis**

This unit deals with capital budgeting and investment appraisal techniques used for financial decision-making in construction projects. Students will study concepts such as Time Value of Money (TVM), Net Present Value (NPV), Internal Rate of Return (IRR), Modified IRR, Rate of Return (ROR), Cost-Benefit Analysis, Accounting Rate of Return, Break-Even Analysis, and Discounted Cash Flow techniques. The unit emphasizes comparative evaluation of investment alternatives, project feasibility assessment, replacement analysis, and financial decision-making under risk and uncertainty.

### **Unit IV – Working Capital, Cash Flow and Financial Risk Management**

This unit focuses on working capital management, liquidity management, and cash flow planning for construction projects. Topics include estimation, preparation, monitoring, and control of cash and fund flow statements, project cash flow forecasting, and budgetary control systems. Students will also study financial risk analysis, risks and uncertainties in capital budgeting, performance budgeting, and value engineering as a tool for financial optimization. The unit highlights practical applications and case studies related to financial management in construction projects.

### **Unit V – International Construction Finance and Modern Financial Applications**

This unit introduces international financing systems and financial management practices for global construction projects. Students will study financing norms and procedures of international financial institutions, financial planning for international projects, and management of international project finances. The unit also covers application of quantitative techniques, computer applications, financial modelling tools, and digital technologies

used in construction financial management. Emerging trends in project finance, sustainable financing, infrastructure investment strategies, and modern financial decision-support systems are also discussed.

**Total: 48 class hours expected**

**Outcome:**

Upon successful completion of this course, students will be able to understand financial management concepts and analyze financial statements related to construction organizations and projects. They will gain the ability to apply capital budgeting and investment appraisal techniques such as NPV, IRR, and cost-benefit analysis for project evaluation and decision-making. Students will also understand cash flow management, working capital management, financial risk analysis, and project financing procedures. Further, they will be capable of using quantitative techniques and digital tools for effective financial planning and management of construction and infrastructure projects.

**Reference Books:**

1. Pandey, I. M. (2015). *Financial management* (11th ed.). Vikas Publishing House.
2. Chandra, P. (2011). *Projects: Planning, analysis, selection, financing, implementation, and review* (7th ed.). Tata McGraw-Hill Education.
3. Potts, K. F., & Ankrah, N. (2014). *Construction cost management: Learning from case studies* (2nd ed.). Routledge.
4. Blank, L., & Tarquin, A. (2012). *Engineering economy* (7th ed.). McGraw-Hill Education.
5. Myers, D. (2016). *Construction economics: A new approach* (4th ed.). Routledge.
6. Gitman, L. J., & Zutter, C. J. (2015). *Principles of managerial finance* (14th ed.). Pearson Education.
7. Yescombe, E. R. (2013). *Project finance*. John Wiley & Sons.
8. Arora, M. N. (2013). *Management accounting*. Himalaya Publishing House.
9. Arora, M. N. (2012). *Cost accounting: Principles and practice*. Vikas Publishing House.
10. Subramanyam, K. R., & Wild, J. J. (2014). *Financial statement analysis* (11th ed.). McGraw-Hill Education.
11. Finnerty, J. D. (2004). *Project financing: Asset-based financial engineering* (2nd ed.). John Wiley & Sons.
12. Yescombe, E. R. (2017). *Public-private partnerships: Principles of policy and finance* (2nd ed.). Butterworth-Heinemann.
13. Dell'Isola, A. J. (2007). *Value engineering: Practical applications for design, construction, maintenance and operations*. McGraw-Hill Education.
14. Vohra, N. D. (2017). *Quantitative techniques in management* (6th ed.). McGraw-Hill Education.

### Elective 3

|                                                     |                                 |    |
|-----------------------------------------------------|---------------------------------|----|
| <b>MBEM2105 - Digital Twin in Built Environment</b> | Subject Category                | TC |
|                                                     | Number of Credits               | 03 |
|                                                     | Lecture Periods per Week        | 02 |
|                                                     | Tutorial Periods per Week       | 01 |
|                                                     | Studio/Lab/Workshop/Practical's | -  |
|                                                     | Total Weeks                     | 03 |

**Objective:** The objective of this course is to provide students with knowledge of Digital Twin technology, its framework, development processes, and applications in construction and infrastructure sectors. The course aims to develop understanding of Digital Twin generation methods, analytics, simulation techniques, and integration with technologies such as BIM, IoT, AI, and cloud computing. It also intends to familiarize students with technology transfer, market analysis, and practical applications of Digital Twin systems through real-world case studies.

#### Unit I – Introduction to Digital Twin Technology

This unit introduces the concept, definition, and framework of Digital Twin technology and its evolution in engineering, construction, and infrastructure sectors. It covers the components, characteristics, and architecture of Digital Twin systems along with their significance in improving project planning, operation, maintenance, and lifecycle management. Students will also study the challenges associated with implementation such as data integration, interoperability, cybersecurity, scalability, and real-time synchronization.

#### Unit II – Opportunities, Benefits and Applications of Digital Twin

This unit focuses on the opportunities and benefits offered by Digital Twin technology in construction and infrastructure projects. Topics include optimization of project performance, predictive maintenance, real-time monitoring, asset management, sustainability assessment, and operational efficiency. Students will explore application areas such as smart buildings, smart cities, infrastructure management, manufacturing, healthcare, transportation, and industrial systems. The unit also highlights the role of Digital Twins in decision-making and intelligent project management.

#### Unit III – Development and Generation of Digital Twins

This unit deals with the methods and processes involved in creating and implementing Digital Twin systems. Students will study data acquisition techniques, integration of IoT sensors, BIM integration, cloud computing, data modelling, visualization tools, and real-time data management. The unit also covers analytics, simulation techniques, predictive modelling, and AI-based approaches used for generating intelligent and dynamic Digital Twin environments for construction and infrastructure applications.

#### Unit IV – Technology Transfer, Innovation and Market Analysis

This unit introduces the concepts of technology transfer, innovation management, and market analysis related to Digital Twin technology. Topics include adoption strategies, commercialization of digital technologies, intellectual property considerations, and implementation challenges in industry. Students will study market trends, business opportunities, investment potential, and the role of Digital Twin technology in Industry 4.0 and smart infrastructure development. The unit also emphasizes economic feasibility and strategic planning for digital transformation in construction organizations.

#### Unit V – Digital Twin Applications and Case Studies

This unit focuses on practical applications and case studies of Digital Twin technology across various sectors. Students will analyze real-world case studies related to smart buildings, infrastructure systems, construction project management, facility management, transportation networks, and urban development. The unit

emphasizes evaluation of project performance, lessons learned, implementation strategies, and future trends in Digital Twin technology. Emerging concepts such as AI-integrated Digital Twins, autonomous systems, and sustainable digital infrastructure are also discussed.

### Outcome

Upon successful completion of this course, students will be able to understand the concepts, significance, and challenges of Digital Twin technology and its applications in construction and infrastructure projects. They will gain the ability to analyze and develop Digital Twin systems using data integration, analytics, and simulation techniques. Students will also understand market opportunities, technology transfer processes, and implementation strategies related to Digital Twin applications. Further, they will be capable of evaluating case studies and applying Digital Twin concepts for improving project performance, monitoring, maintenance, and decision-making in smart infrastructure systems.

### Reference Books

1. Fuller, A., Fan, Z., Day, C., & Barlow, C. (2021). *Digital twin: Enabling technologies, challenges and open research*. Springer.
2. Minerva, R., Lee, G. M., & Crespi, N. (2022). *Digital twin development and deployment on the cloud*. Elsevier.
3. Tao, F., & Madni, A. M. (Eds.). (2023). *Handbook of digital twins*. Springer.
4. Kumar, K., Zindani, D., & Davim, J. P. (Eds.). (2020). *Smart manufacturing and digital transformation*. CRC Press.
5. Bilal, M., & Oyedele, L. O. (2021). *Data analytics for engineering and construction project management*. Routledge.
6. Mahmud, K., Buyya, R., & Zhang, J. (Eds.). (2021). *IoT and AI technologies for sustainable living*. Wiley-Scrivener.
7. Whyte, J., & Hartmann, T. (2020). *Digital engineering for construction*. ICE Publishing. (Verify exact edition.)
8. Lee, E. A., & Seshia, S. A. (2022). *Cyber-physical systems and digital twins*. Springer.
9. Varkonyi-Koczy, A. R. (Ed.). (2021). *Artificial intelligence in smart cities and urban mobility*. Springer.
10. Sawhney, A., Riley, M., & Irizarry, J. (Eds.). (2022). *Emerging technologies in Construction 4.0*. Routledge.
11. Boje, C., Guerriero, A., Kubicki, S., & Rezgui, Y. (2023). *Facility management and digital twins*. Elsevier.
12. Ahmed, V., Tezel, A., & Aziz, Z. (Eds.). (2020). *Machine learning for the built environment*. Springer.
13. Underwood, J., & Isikdag, U. (2011). *Advanced building informatics*. Wiley-Blackwell.
14. Sinopoli, J. M. (2009). *Smart buildings systems for architects, owners and builders*. Butterworth-Heinemann.
15. Sawhney, A., Riley, M., & Irizarry, J. (Eds.). (2021). *Construction 4.0: An innovation platform for the built environment*. CRC Press.

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|--------------------------------------------------------------|---------------------------------|----|
| <b>MBEM2106 - Building Adaptation &amp; Asset Management</b> | Subject Category                | TC |
|                                                              | Number of Credits               | 03 |
|                                                              | Lecture Periods per Week        | 02 |
|                                                              | Tutorial Periods per Week       | 01 |
|                                                              | Studio/Lab/Workshop/Practical's | -  |
|                                                              | Total Weeks                     | 03 |

**Objective:** The objective of this course is to provide students with knowledge of building service life, building adaptation processes, and methods for extending the life of buildings and infrastructure systems. The course aims to develop understanding of maintenance strategies, rehabilitation techniques, adaptive reuse, and management tools used in building adaptation projects. It also intends to familiarize students with challenges associated with adaptation works and construction management approaches for effective implementation and sustainable building performance.

### **Unit I – Introduction to Building Service Life**

This unit introduces the concept of building service life and its importance in the performance and sustainability of buildings and infrastructure. It covers factors affecting the service life of buildings such as materials, environmental conditions, maintenance practices, usage patterns, and technological changes. Students will understand methods for assessing building performance, durability, deterioration mechanisms, and life cycle considerations in building management.

### **Unit II – Methods for Extension of Building Service Life**

This unit focuses on techniques and strategies used for extending the service life of buildings and infrastructure systems. Topics include preventive maintenance, repair and rehabilitation methods, retrofitting, adaptive reuse, structural strengthening, energy-efficient upgrades, and sustainable renovation practices. Students will study the role of maintenance planning, technological interventions, and material improvements in enhancing building performance and longevity.

### **Unit III – Building Adaptation Processes and Management Tools**

This unit deals with building adaptation processes and management techniques used for modifying existing buildings to meet changing functional, technological, environmental, and regulatory requirements. Students will study adaptation strategies, building assessment methods, decision-making tools, life cycle analysis, facility management systems, and digital technologies such as BIM and Digital Twin applications used in building adaptation and asset management.

### **Unit IV – Challenges in Building Adaptation and Rehabilitation Projects**

This unit focuses on the technical, financial, environmental, legal, and operational challenges associated with building adaptation and rehabilitation works. Topics include issues related to structural compatibility, heritage conservation, occupant safety, cost management, sustainability, regulatory approvals, and project coordination. Students will understand risk factors and constraints involved in executing adaptation projects in occupied and aging buildings.

### **Unit V – Construction Management Approaches for Building Adaptation Projects**

This unit introduces construction management approaches and implementation strategies for building adaptation and rehabilitation projects. Students will study project planning, scheduling, procurement, safety management, stakeholder coordination, quality control, and resource management techniques used during adaptation works. The unit also covers modern technologies, sustainable practices, and integrated project management methods for efficient execution and monitoring of building adaptation projects.

## Outcome

Upon successful completion of this course, students will be able to understand the concept of building service life and factors affecting building performance and durability. They will gain the ability to apply maintenance, rehabilitation, and adaptation techniques for extending the service life of buildings. Students will also understand management tools, challenges, and construction management practices associated with building adaptation projects and apply sustainable and efficient approaches for implementation and project control.

## Reference Books

1. Douglas, J. (2004). *Building adaptation* (2nd ed.). Routledge.
2. Chanter, B., & Swallow, P. (2007). *Building maintenance management* (2nd ed.). Wiley-Blackwell.
3. Lacasse, M. A., & Vanier, D. J. (Eds.). (2019). *Service life prediction of buildings and components*. Routledge.
4. Varghese, P. C. (2016). *Maintenance and repair of civil structures*. Standard Publishers.
5. Watt, D. (2007). *Building pathology: Principles and practice*. Wiley-Blackwell.
6. Feilden, B. M. (2003). *Conservation of historic buildings* (3rd ed.). Routledge.
7. Barrett, P., & Baldry, D. (2015). *Facilities management: Towards best practice* (3rd ed.). Wiley-Blackwell.
8. Wilkinson, S. J., James, K., & Reed, R. (2017). *Sustainable building adaptation: Innovations in decision-making*. Routledge.
9. Teicholz, P. (Ed.). (2015). *BIM for facility managers* (2nd ed.). John Wiley & Sons.
10. Jha, K. N. (2015). *Construction project management: Theory and practice* (2nd ed.). Pearson Education India.
11. Halfawy, M. R. (2011). *Asset management for infrastructure systems*. ICE Publishing.



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|----------------------------------------------------------------|---------------------------------|----|
| <b>MBEM2107 - Construction Innovation and Entrepreneurship</b> | Subject Category                | TC |
|                                                                | Number of Credits               | 03 |
|                                                                | Lecture Periods per Week        | 02 |
|                                                                | Tutorial Periods per Week       | 01 |
|                                                                | Studio/Lab/Workshop/Practical's | -  |
|                                                                | Total Weeks                     | 03 |

**Objective:** The objective of this course is to provide students with knowledge of foundation construction methods, scaffolding systems, formwork technologies, and reinforcement techniques used in modern construction projects. The course aims to develop understanding of financing agencies, industrial legislation, labour laws, taxation systems, and financial planning related to construction and industrial projects. It also intends to familiarize students with project report preparation, infrastructure financing, and procedures for acquiring project finance and statutory approvals.

### **Unit I – Foundation Engineering, Scaffolding and Formwork Systems**

This unit introduces construction methods and equipment used for foundation works, scaffolding, and formwork systems in building and infrastructure projects. Students will study various foundation construction techniques, excavation methods, piling systems, and equipment used for foundation operations. The unit also covers different types of scaffolding systems and formwork technologies including timber, metal, and plastic formwork, along with their applications, advantages, safety requirements, and selection criteria for modern construction practices.

### **Unit II – Reinforcement and Precast Construction Technology**

This unit focuses on reinforcement technologies and advanced concrete construction systems used in modern construction projects. Topics include reinforcement detailing, pre-tensioning and post-tensioning techniques, prestressed concrete systems, and precast construction technologies. Students will understand the manufacturing, transportation, erection, and quality control aspects of precast elements and study the advantages, limitations, and applications of precast and prestressed systems in industrial and infrastructure projects.

### **Unit III – Financing Agencies and Infrastructure Development**

This unit deals with financial institutions and agencies involved in infrastructure and industrial project financing. Students will study the role of financing agencies in providing financial assistance for land acquisition, infrastructure development, machinery procurement, and raw material management. The unit also covers the functions of government departments, public financial institutions, and policies supporting industrial and construction project development. Emphasis is given to funding mechanisms and infrastructure financing strategies in the construction sector.

### **Unit IV – Industrial Legislation, Labour Laws and Taxation**

This unit introduces industrial legislation, labour laws, and taxation systems applicable to construction and industrial projects. Topics include industrial laws, labour welfare regulations, contract labour laws, safety regulations, and statutory compliance requirements. Students will also study local taxation systems, excise duties, income tax provisions, GST implications, and financial compliance procedures relevant to construction and industrial operations.

### **Unit V – Project Report Preparation and Financial Planning**

This unit focuses on preparation and evaluation of project reports for construction and industrial projects. Students will study the components of a project report including land, building, utilities, materials, manpower, machinery, and resource requirements. The unit also covers provisional registration procedures, financial planning, project costing, funding arrangements, preparation of financial feasibility reports, and strategies for acquiring finance from financial institutions and investors. Emphasis is given to practical approaches for preparing comprehensive and bankable project reports.

### Outcome

Upon successful completion of this course, students will be able to understand foundation construction methods, scaffolding systems, formwork technologies, and reinforcement techniques used in construction projects. They will gain knowledge of financing agencies, industrial laws, labour regulations, and taxation systems related to industrial and construction sectors. Students will also be capable of preparing project reports, performing financial planning, evaluating funding requirements, and understanding procedures for acquiring finance and project approvals for construction and infrastructure projects.

### Reference Books

1. Punmia, B. C., Jain, A. K., & Jain, A. K. (2016). *Building construction* (11th ed.). Laxmi Publications.
2. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. L. (2011). *Construction planning, equipment, and methods* (8th ed.). Tata McGraw-Hill Education.
3. Hurd, M. K. (2011). *Formwork for concrete* (7th ed.). McGraw-Hill Education.
4. Lin, T. Y., & Burns, N. H. (2010). *Design of prestressed concrete structures* (3rd ed.). Wiley India.
5. Chandra, P. (2011). *Projects: Planning, analysis, selection, financing, implementation, and review* (7th ed.). Tata McGraw-Hill Education.
6. Kapoor, N. D. (2015). *Industrial and labour laws*. Dhanpat Rai Publications.
7. Kapoor, N. D. (2018). *Mercantile and industrial laws*. Sultan Chand & Sons.
8. Singhania, V. K., & Singhania, M. (2023). *Students' guide to income tax including GST* (latest ed.). Taxmann Publications.
9. Pandey, I. M. (2015). *Financial management* (11th ed.). Vikas Publishing House.
10. Chandra, P. (2010). *Projects: Planning, analysis, selection, financing, implementation, and review* (6th ed.). Pearson Education.
11. Bureau of Indian Standards. (2016). *National Building Code of India 2016*. Bureau of Indian Standards.

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|------------------------------------------------------------------------------------------|---------------------------------|----|
| <b>MBEM2108 - Inter departmental/Inter-Institutional Elective (Online/Physical Mode)</b> | Subject Category                | TC |
|                                                                                          | Number of Credits               | 03 |
|                                                                                          | Lecture Periods per Week        | 02 |
|                                                                                          | Tutorial Periods per Week       | 01 |
|                                                                                          | Studio/Lab/Workshop/Practical's | -  |
|                                                                                          | Total Periods per Week          | 03 |

**Objective:** The underlying fundamental of this elective is for the student to identify and pursue any unique course of study related to STEM (Science, Technology, Engineering, and Management) in physical or online mode. The student can select a course that may be directly or indirectly relevant to the building or its related infrastructure works. The objective of this course is to enhance the exposure of students in an unrestricted manner and to aid their learning through varied methods. The course enables students to acquire skills to develop their ideas into physical form and encourages startups. This elective intends to achieve the concept of multidisciplinary and cross-collaboration to the other areas of specialization.

### Course Content

The course may be linked to the built environment, construction, architecture, planning, project management, or related to the topic of research. Encouraging a multi-disciplinary approach through the subject as well as its contents, the coursework should include a theoretical understanding of the subject, learning through case studies and real-world projects, and future methods of application in the industry/ research. The use of analytical tools and techniques is encouraged.

Upon completion of this course, the student should be able to

- Learn foundational concepts of the topic
- Establish a link between the learnings and their projects/ research
- Apply the skills in their research/ projects/ future career
- Share the insights with fellow classmates
- Earn a certificate from the online learning platform or certificate from other Department of studies.

### References

1. National Programme on Technology Enhanced Learning (NPTEL) initiated by Ministry of Education.
2. Courses offered by IIT, IIM, ISSER, NIT's, SPA's, NITTTR and other reputed Universities/Institution
3. Courses offered by reputed National and International Universities.

|                                              |                                 |    |
|----------------------------------------------|---------------------------------|----|
| <b>MBEM2109 - Summer Training/Internship</b> | Subject Category                | JC |
|                                              | Number of Credits               | 01 |
|                                              | Lecture Periods per Week        | -  |
|                                              | Tutorial Periods per Week       | -  |
|                                              | Studio/Lab/Workshop/Practical's | -  |
|                                              | Total Weeks                     | 8  |

**Description:**

An internship of 8 weeks is to be carried out by the students during their summer vacations after second semester in order to understand the practical application of various project management and construction concepts studied in last two semesters. The students are supposed to submit a report of the work done by them during their training period. Refer to Annexure-1

**Total: 8 Weeks**

**Outcome:**

The students will be exposed to the industry and they will learn different types of contracts, laws that are considered in initiating and completing the projects.

## **FOURTH SEMESTER**

|                          |                                 |    |
|--------------------------|---------------------------------|----|
| <b>MBEM2201 - Thesis</b> | Subject Category                | TC |
|                          | Number of Credits               | 19 |
|                          | Lecture Periods per Week        | 2  |
|                          | Tutorial Periods per Week       | -  |
|                          | Studio/Lab/Workshop/Practical's | 14 |
|                          | Total Periods per Week          | 19 |

**Objective:** The objective of the Thesis is to provide students with an opportunity to undertake independent research in the field of Building Engineering and Management. The thesis may focus on conceptual, analytical, or practical problems related to construction, infrastructure, management, sustainability, or emerging technologies. The course aims to develop students' abilities in problem identification, literature review, data collection, research methodology, analysis, interpretation, and technical reporting. It also encourages critical thinking, innovation, and application of research-based solutions to real-world issues. The complete research work is to be systematically documented and presented in the form of a formal thesis report, which may either extend the work carried out in previous semesters or explore a new area of research interest.

The subject for special study may be conceptual or practical, but pertaining to Building Engineering and Management. This should, however, offer scope to adopt a fresh approach in formulating a concept or developing a methodology effective and useful. Each student will prepare the Thesis under the guidance of a principal advisor with regular reviews by the faculty of the department. The thesis will be presented in the accepted form of a thesis report, duly supported by References, sketches, graphs, statistical data, details of the survey, if any, detailed account of experimental/analytical procedures adopted. Each student is required to defend their thesis at a Viva Voce Examination by a jury.

**Outcome:**

Student will prepare independent and original study of a special project of his own choice from the all the knowledge they have gained from the course.

|                                                                 |                                 |    |
|-----------------------------------------------------------------|---------------------------------|----|
| <b>MBEM2202 – Project Quality and Human Resource Management</b> | Subject Category                | TC |
|                                                                 | Number of Credits               | 03 |
|                                                                 | Lecture Periods per Week        | 02 |
|                                                                 | Tutorial Periods per Week       | 01 |
|                                                                 | Studio/Lab/Workshop/Practical's | -  |
|                                                                 | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of quality management systems, organizational behaviour, and human resource management practices in the construction industry. The course aims to develop understanding of quality assurance, quality control, ISO standards, TQM principles, quality management tools, and environmental management systems applicable to building projects. It also intends to familiarize students with organizational structure, leadership, communication, motivation, conflict management, and human resource practices such as training, performance appraisal, and workforce development for improving organizational and project performance.

### **Unit I Quality Management Concepts**

Quality concepts and stakeholder concerns for building and construction; Evolution of modern concept of Quality management process approach; Quality assurance & control; Quality management system and ISO 9000 : 2000 requirements; Quality system standards for construction elements; Inspections & tests; Quality management tools; Environmental Management System Standards and their application in construction; EMS - QMS relationships; Concept and philosophy of TQM; Quality circle, Quality cost; Practical aspects of quality control of building projects. Good practices and managerial responsibilities.

### **Unit II Quality Management Standards**

ISO 9000 Quality system standards (family discussion); applicability of ISO 9000 series standards world-wide, India and Indian Building sector; Elements of quality systems standards elements; Aspects of quality control & assurance of major building items like RCC, brickwork, woodwork, steelwork, flooring, finishing, internal water supply, sanitary electrical services, external services like roads, sewers et.; quality of maintenance works, checklists; Contractual implications of quality systems.

### **Unit III Quality Management Tools**

Quality Tools; SWOT analysis, Ishikawa Diagram, Pareto Analysis, Statistical Quality Control, Brainstorming, Delphi Technique; Quality cost; Quality system and Total Quality Management philosophy as applied to building sector; Human resource management for TQM; Business Process Re-engineering; Benchmarking; Partnering; Quality Circles; Quality Function Deployment; Just in Time technique; Six-Sigma; Analysis and design tools for management, including, Quality Function Deployment, Brain storming, Parametric Modelling).

### **Unit IV Organizational Behaviour**

Concepts of organisational and individual behaviour; Perception and attitudes; Communication process and information management; Motivation concepts and processes; Group behaviour and teams; Leadership; Conflict management, Stress management. Nature of organisations; Organisational development; Principles of organisation structure.

### **Unit V Human Resource Management**

Human resource policies & practices; Selection, training and assessment; Performance Appraisal; Training need assessment and dissemination of training; Post-training performance assessment.

**Total: 48 class hours expected**

**Outcome:**

Upon successful completion of this course, students will be able to understand quality management concepts, ISO standards, quality assurance systems, and TQM practices used in construction projects. They will gain the ability to apply quality management tools and techniques for improving construction quality and organizational performance. Students will also understand organizational behaviour, leadership, communication, teamwork, and conflict management principles. Further, they will be capable of applying human resource management practices including recruitment, training, performance assessment, and employee development in construction organizations.

**Reference Books:**

1. Besterfield, D. H., Besterfield-Michna, C., Besterfield, G. H., & Besterfield-Sacre, M. (2011). *Total quality management* (3rd ed.). Pearson Education.
2. Rumane, A. R. (2017). *Quality management in construction projects*. Taylor & Francis.
3. Rumane, A. R. (2012). *Construction quality management: Principles and practice*. Taylor & Francis.
4. Tricker, R. (2015). *ISO 9001:2015 for small businesses* (6th ed.). ASQ Quality Press.
5. Montgomery, D. C. (2019). *Introduction to statistical quality control* (8th ed.). Wiley India.
6. Robbins, S. P., & Judge, T. A. (2017). *Organizational behavior* (17th ed.). Pearson Education.
7. Robbins, S. P., Judge, T. A., & Vohra, N. (2015). *Organisational behaviour* (16th ed.). McGraw-Hill Education.
8. Dessler, G. (2020). *Human resource management* (16th ed.). Pearson Education.
9. Memoria, C. B., & Gankar, S. V. (2016). *Personnel management and human resources*. Himalaya Publishing House.
10. Jha, K. N. (2015). *Construction project management: Theory and practice* (2nd ed.). Pearson Education India.
11. Hammer, M., & Champy, J. (2006). *Reengineering the corporation: A manifesto for business revolution*. Harper Business.
12. Harry, M., & Schroeder, R. (2005). *Six Sigma: The breakthrough management strategy revolutionizing the world's top corporations*. Currency.
13. Sheldon, C. (2016). *Environmental management systems: A practical guide to implementation and operation*. Routledge.



#### **ELECTIVE 4**

|                                                   |                                 |    |
|---------------------------------------------------|---------------------------------|----|
| <b>MBEM2203 - Environmental Impact Assessment</b> | Subject Category                | TC |
|                                                   | Number of Credits               | 03 |
|                                                   | Lecture Periods per Week        | 02 |
|                                                   | Tutorial Periods per Week       | 01 |
|                                                   | Studio/Lab/Workshop/Practical's | -  |
|                                                   | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of Environmental Impact Assessment (EIA), environmental management principles, and sustainability practices related to construction and infrastructure projects. The course aims to develop understanding of environmental assessment methodologies, impact prediction techniques, environmental legislation, and regulatory frameworks. It also intends to familiarize students with environmental protection measures, public participation processes, and municipal solid waste management systems for sustainable development and environmental conservation.

#### **Unit I Introduction to Environment Aspects**

Definition, basic concepts and principles of EIA. Regulatory frame work in India. Environmental inventory, base line studies, over view of EIA studies.

#### **Unit II Assessment and Methodologies**

Physical, biological assessment, Socio economic and cultural environmental assessment, EIA methodologies– Adhoc, matrix, checklist approaches. Economic evaluation of impacts-cot benefits of EIA, Public participation in environmental decision making. Procedures for reviewing EIA analysis and statement.

#### **Unit III Environmental Assessment**

Introduction, process, Basic steps involved, Description of environmental setting – Base line data collection, possible impacts due to water resources projects. Impact prediction and assessment – methods of impact assessment, Matrix and check list method, Selection of proposed action. Preparation of environmental impact statement.

#### **Unit IV Legislations and Regulations**

Rationale, concerns, legislative data systems, Safe Drinking Water Act, clean water act, clean air act, noise control act, resource conservation and recovery act, comprehensive environmental response, compensation and liability act.

#### **Unit V Municipal Solid Wastes**

Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/recycle, energy recovery, treatment and disposal).

**Total: 48 class hours expected**

#### **Outcome:**

Upon successful completion of this course, students will be able to understand the principles, processes, and methodologies of Environmental Impact Assessment for construction and infrastructure projects. They will gain the ability to assess environmental, social, and economic impacts and prepare environmental impact statements and reports. Students will also understand environmental laws, regulations, and pollution control measures related to air, water, noise, and waste management. Further, they will be capable of applying

sustainable environmental management practices and solid waste management techniques in planning and execution of development projects.

**Reference Books:**

1. Morris, P., & Therivel, R. (2004). *Methods of environmental impact assessment* (2nd ed.). Routledge.
2. Davis, M. L., & Masten, S. J. (2008). *Principles of environmental engineering and science* (2nd ed.). Pearson Education.
3. Benny Joseph. (2016). *Environmental studies* (3rd ed.). Tata McGraw-Hill Education.
4. Rao, C. S. (2010). *Environmental science and engineering*. Pearson Education.
5. Tchobanoglous, G., Theisen, H., & Vigil, S. A. (2002). *Integrated solid waste management: Engineering principles and management issues*. McGraw-Hill Education.
6. Vesilind, P. A., Peirce, J. J., & Weiner, R. F. (1998). *Environmental pollution and control* (4th ed.). Butterworth-Heinemann.
7. Shastri, S. C. (2005). *Environmental legislation and management*. APH Publishing Corporation.
8. Agrawal, K. C. (2010). *Environmental management*. Excel Books.
9. Shastri, S. C. (2012). *Environmental laws in India*. LexisNexis Butterworths.
10. Ministry of Environment, Forest and Climate Change. (Latest ed.). *Environmental impact assessment notification and guidelines*. Government of India.

|                                     |                                 |    |
|-------------------------------------|---------------------------------|----|
| <b>MBEM2204 - Lean Construction</b> | Subject Category                | TC |
|                                     | Number of Credits               | 03 |
|                                     | Lecture Periods per Week        | 02 |
|                                     | Tutorial Periods per Week       | 01 |
|                                     | Studio/Lab/Workshop/Practical's | -  |
|                                     | Total Periods per Week          | 03 |

**Objective:** The objective of this course is to provide students with knowledge of Lean Philosophy, Lean Principles, and Lean Construction practices used in the construction industry. The course aims to develop understanding of lean design, lean procurement, production planning, coordination, logistics, and offsite construction techniques for improving efficiency and reducing waste. It also intends to familiarize students with lean tools and techniques such as BIM, Last Planner System, 5S, Visual Management, Just in Time, and Value Stream Mapping for enhancing project performance and continuous improvement in construction projects.

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### **Unit I – Introduction to Lean Philosophy and Lean Construction**

This unit introduces the concept and philosophy of Lean Construction and its evolution from lean manufacturing principles. It covers the definition, history, objectives, and core principles of lean thinking along with applications in various industries. Students will study lean practices in construction, process-oriented versus task-oriented approaches, transformation-flow-value concepts, and the production view of design and construction. The unit emphasizes the importance of minimizing waste and maximizing value in construction projects.

### **Unit II – Lean Principles in Design and Construction Processes**

This unit focuses on the application of lean principles and practices in the design and construction process. Topics include designing with lean principles, lean design management, collaborative planning, and designing for constructability and efficiency. Students will also study the relationship between lean and green concepts, sustainable construction practices, and the integration of lean methodologies for improving quality, productivity, and environmental performance in the built environment.

### **Unit III – Lean Culture, Procurement and Production Systems**

This unit deals with the development of lean culture in construction organizations and projects. Students will study lean procurement systems, collaborative contracting, lean production planning, coordination, logistics management, and off-site construction practices. The unit also covers applications of lean principles in real estate and infrastructure projects, emphasizing teamwork, communication, continuous improvement, and integrated project delivery approaches.

### **Unit IV – Lean Construction Tools and Techniques**

This unit introduces various lean construction tools and techniques used for improving project efficiency and reducing waste. Topics include waste reduction strategies, partnering, Target Value Design, Set-Based Design, Building Information Modelling (BIM), Pull Planning, Last Planner System, Huddle Meetings, 5S, Visual Management, Work Structuring, Continuous Improvement, Poka-Yoke, Just-in-Time (JIT), A3 Reporting, and Value Stream Mapping. Students will understand the practical application of these tools in project planning, coordination, and execution.

## Unit V – Lean Project Delivery and Implementation Strategies

This unit focuses on lean project delivery systems and implementation strategies in the construction industry. Students will study the value and benefits of lean approaches for design and construction organizations, including improved productivity, quality, cost efficiency, and stakeholder satisfaction. The unit also covers implementation challenges, drivers and barriers to lean adoption, organizational transformation, and the integration of lean concepts with emerging industry practices such as digital construction, BIM-enabled workflows, and sustainable project management systems.

**Total: 48 class hours expected**

### Outcome:

Upon successful completion of this course, students will be able to understand the philosophy, principles, and practices of Lean Construction and their applications in the construction industry. They will gain the ability to apply lean principles in design, planning, procurement, production, and project delivery processes for improving productivity and reducing waste. Students will also understand lean culture, collaborative practices, and the use of lean tools such as Last Planner System, BIM, Pull Planning, 5S, Value Stream Mapping, and Just-in-Time techniques. Further, they will be capable of implementing lean approaches for enhancing project efficiency, quality, sustainability, coordination, and continuous improvement in construction and infrastructure projects.

### Reference Books:

1. Liker, J. K. (2004). *The Toyota way: 14 management principles from the world's greatest manufacturer*. McGraw-Hill Education.
2. Forbes, L. H., & Ahmed, S. M. (2010). *Modern construction: Lean project delivery and integrated practices*. CRC Press.
3. Mossman, A., Sarhan, S., & González, V. (2020). *Construction management and lean construction*. Routledge.
4. Ballard, G., & Howell, G. (2003). *Designing for lean construction*. Lean Construction Institute.
5. Rother, M., & Shook, J. (2003). *Learning to see: Value stream mapping to create value and eliminate muda* (Version 1.4). Lean Enterprise Institute.
6. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2018). *BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers* (3rd ed.). John Wiley & Sons.
7. Salem, O., Solomon, J., Genaidy, A., & Luegring, M. (2017). *Lean Six Sigma for construction*. McGraw-Hill Education.
8. Kent, D. C., & Becerik-Gerber, B. (2017). *Integrated project delivery*. John Wiley & Sons.
9. Nahmens, I., & Ikuma, L. H. (2008). *Effects of lean construction on sustainability*. *Lean Construction Journal*, 2008, 1–12.
10. Harris, F., & McCaffer, R. (2013). *Modern construction management* (7th ed.). Wiley-Blackwell.
11. Jha, K. N. (2015). *Construction project management: Theory and practice* (2nd ed.). Pearson Education India.

**Annexure-1**

1. General Information (It is not needed here, can be kept as Annexure)

Name of student

Placement of Training

Duration of training

2. Nature of organizational enterprise (explain type of design, construction, PM activities the organizations involved)
3. Organization structure and position of Trainee
4. Chronological list of responsibilities assigned to the Trainee
5. List of the Works done during training (enclose typical work outputs)
6. Experiences and inferences drawn during Training
  1. Typical project work stages followed
  2. Time management process adopted
  3. Cost management process adopted
  4. Quality management process adopted
  5. Scope management process adopted
  6. HR management process adopted
  7. Communication systems, practices and management processes adopted
  8. Procurement management policies and processes adopted
  9. Health, safety, environment management processes adopted
  10. Risk management processes adopted

Type of consultancy (architecture, PM, construction contract followed) (enclose typical documents) Special features of the project / work (enclose documents to explain and highlight peculiarities)

11. Any other information