VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF CIVIL ENGINEERING

M.Tech. Construction Technology and Management

(M.Tech – MCT)

Curriculum

(2025-2026 admitted students)

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VISION STATEMENT OF VELLORE INSITITUE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education	:	Excellence in education, grounded in ethics and Critical thinking, for improvement of life.
Cutting edge Research	:	An innovation ecosystem to extend knowledge and Solve critical problems.
Impactful People	:	Happy, accountable, caring and effective workforce and students.
Rewarding Co-creations	:	Active collaboration with national & international industries & universities for productivity and economic development.
Service to Society	:	Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

- To be internationally recognized for ground-breaking contributions, exceptional leadership, strong commitment to creative problem-solving and professional integrity.

MISSION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

- The school of Civil Engineering inspires and nurtures innovative leaders.
- Preparedness to address the complex societal –scale challenges in area of resilient infrastructure, smart and sustainable cites, water and energy security, climate change, mobility of goods and people, and environmental production.
- Pioneering the emerging skills in Civil Engineering.

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M.Tech. Construction Technology and Management

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.

2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.

3. Graduates will function in their profession with social awareness and responsibility.

4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

5. Graduates will be successful in pursuing higher studies in engineering or management.

6. Graduates will pursue career paths in teaching or research.

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M.Tech. Construction Technology and Management

PROGRAMME OUTCOMES (POs)

On completion of M.Tech Construction Technology and Management programme, graduates will be able to

PO_01	:	An ability to independently carry out research/investigation and development work to solve practical problems.
PO_02	:	An ability to write and present a substantial technical report / document
PO_03	:	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate master program.

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M.Tech. Construction Technology and Management

PROGRAMME SPECIFICOUTCOMES (PSOs)

On completion of M.Tech (Construction Technology and Management) programme, graduates will be able to

PSO_01 : Acquire knowledge of construction materials, construction management, project management, contract legal requirement and management of funds.

PSO_02 : Innovative in technology development, engineering system implementation and interact with their peers in other disciplines in industry and society.

PSO_03 : Independently carry out research / investigations to solve practical problems and write / present a substantial technical report / document.

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M.Tech. Construction Technology and Management

CREDIT STRUCTURE

Programme Credit Structure	Credits
University Core Courses	39
Professional Core Courses	24
Professional Elective Courses	14
Open Elective	3
Total Graded Credit Requirement	**80**

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M.Tech. Construction Technology and Management

DETAILED CURRICULUM

Professional Core Courses 24

Sl. No.	Course Code	Course Title	L	T	P	C
1	MAMAT503	Advanced Statistical Methods	3	0	2	4
2	MACTM501	Construction Planning, Scheduling and Control	3	0	2	4
3	MACTM502	Construction Equipment and Methods	3	1	0	4
4	MACTM503	Construction Economics and Finance	3	1	0	4
5	MACTM504	Project Formulation and Appraisal	3	1	0	4
6	MACTM505	Virtual Design for Infrastructure systems	3	0	2	4

University Core Courses 39

Sl. No.	Code	Title	L	T	P	C
1	MAENG501	Technical Report Writing	1	0	4	3
2	MASTS501	Qualitative and Quantitative Skills Practice I	3	0	0	3
3	MASTS502	Qualitative and Quantitative Skills Practice II	3	0	0	3
4	MASET697	Project Work	0	0	0	10
5	MACTM698	Internship I / Dissertation I	0	0	0	10
6	MACTM699	Internship II / Dissertation II	0	0	0	10

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M.Tech. Construction Technology and Management

Professional Elective Courses 14

Sl. No.	Code	Title	L	T	P	C
1	MACTM601	AI – Enhanced Structural health monitoring	3	0	2	4
2	MACTM602	Automation in Construction	3	1	0	4
3	MACTM603	Lean Project delivery	3	1	0	4
4	MACTM604	Supply Chain Management	3	0	0	3
5	MACTM605	Estimating, Tendering and Bidding	3	1	0	4
6	MACTM606	Safety and Quality Management in Construction	3	1	0	4
7	MACTM607	Contract and Administration Planning	3	0	0	3
8	MACTM608	Modern Construction Materials	3	0	0	3
9	MACTM609	Human Resource Management	3	0	0	3
10	MACTM610	Prefabricated and Modular Construction	3	0	0	3
11	MACTM611	Environmental Impact Assessment	3	0	0	3
12	MACTM612	Energy Efficient Building	3	0	0	3
13	MASTE602	Advanced Concrete Materials and Technology	3	0	2	4
14	MASTE610	Repair and Rehabilitation of Structures	3	0	0	3

Open Elective **03**

Sl. No	Course Code	Course Title	L	T	P	C
1	MASTS601	Competitive Coding I	3	0	0	3

MAMAT503	Advanced Statistical Methods	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Apply statistical methods and modelling techniques to analyze complex engineering data and support evidence-based decision-making.
2. Develop predictive models for engineering applications using regression, time series analysis, and machine learning approaches.
3. Design experiments and implement advanced statistical inference methods to optimize processes and assess uncertainties in engineering solutions.

Course Outcomes

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

1. Apply the sampling techniques and statistical inference methods to analyze data, estimate parameters and perform hypothesis testing for decision-making.
2. Analyze variable relationships, assess regression model accuracy and interpret statistical patterns for data-driven insights.
3. Utilize time series analysis techniques for forecasting and trend identification in engineering applications, facilitating proactive planning and resource allocation.
4. Conduct analysis of variance (ANOVA) to determine significant factors influencing engineering processes, enhancing experimental design and statistical decision-making
5. Apply Bayesian statistical inference, machine learning techniques, and decision-making models to analyze uncertainty, assess risk, and enhance predictive analytics in engineering applications.

Module: 1	Sampling Techniques and Statistical Inference	9 hours

Sampling Techniques - Simple random, Stratified, Systematic, Cluster sampling. Sampling Distribution and Central Limit Theorem. Bias and Variability in Sampling. Theory of Estimation – Method of Maximum Likelihood, Minimum Variance and Method of Moments. Testing of hypothesis – Z, t, F and Chi-square tests and Confidence Intervals for population parameters.

Module: 2	Correlation and Regression Analysis	9 hours

Pearson and Spearman correlation coefficients. Simple linear regression, polynomial regression. Regression diagnostics and goodness-of-fit tests. Multiple regression models and factor analysis.

Module: 3	Time Series Analysis and Forecasting	9 hours

Statistical forecasting methods - Moving averages, exponential smoothing and autoregressive models. Model fitting and graphical interpretation - Time series decomposition: Trend, seasonality, cyclic components. Stationarity and Differencing Technique. Error measurement and Model evaluation.

Module: 4	Experimental Design and Statistical Modelling	8 hours
Principles of design of experiments. Analysis of variance – One-way and two-way classifications, Assumptions and interpretations. Experimental Designs - Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD). Concept of 2^2 and 2^3 and factorial experiments.		
Module: 5	**Applications of Statistical Methods**	**8 hours**
Bayesian statistics - Bayesian inference, prior and posterior probabilities. Applications in uncertainty modelling and risk assessment. Machine learning applications in engineering. Regression-based ML models for predictive analysis. Supervised vs. unsupervised learning Risk analysis and decision-making models. Decision trees, fuzzy logic and Markov models.		
Module: 6	**Contemporary topics**	**2 hours**
Total Lecture hours		**45 hours**

Text Book (s)	
1	Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers", 2020, 7th Edition, John Wiley & Sons, US.
2	George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel & Greta M. Ljung, “Time Series Analysis: Forecasting and Control”, 2015, 5th Edition, John Wiley & Sons, Inc., US.
Reference Book(s)	
1	Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, “Probability and Statistics for Engineers and Scientists”, 2016, 9th Edition, Pearson Education, US
2	Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, Donald B. Rubin, “Bayesian Data Analysis”, 2013, 3rd Edition CRC Press, New York.
Mode of evaluation: CAT / Assignment / Quiz / FAT.	
Indicative Experiments	
1	Testing of Hypothesis and Confidence Intervals – Z-test for mean and proportions.
2	Testing of Hypothesis and Confidence Intervals – t, F and Chi-square tests.
3	Simple linear Regression and Correlation Analysis – Modelling, Estimating and Interpreting correlation and regression coefficients.
4	Multiple Linear Regression and Correlation Analysis – Modelling, Estimating and interpreting correlation and regression coefficients.
5	Fitting of Moving average and Exponential smoothing models – forecasting and validation.
6	Fitting of AR, ARMA and ARIMA models – forecasting and validation.

7	Performing One-way ANOVA – CRD - Modelling, Estimation and interpretation of Coefficients.			
8	Performing Two-way ANOVA – RBD & LSD - Modelling, Estimation and interpretation of Coefficients. RBD and LSD.			
9	Markov Chain Monte Carlo (MCMC) methods to estimate parameters in a Bayesian model.			
10	Fitting of Regression - based ML models for predictive analysis.			
Total Laboratory hours				**30 hours**
Text Book(s)				
1.	Maria Dolores Ugarte, Ana F. Militino, and Alan T. Arnholt, “Probability and Statistics with R”, 2015, 2nd Edition, Chapman and Hall/CRC, UK			
2.	George Athanasopoulos and Rob J. Hyndman, Forecasting: Principles and Practice, 2021, 3rd Edition, OTexts, Australia			
Reference Book(s)				
1	Wayne A. Woodward, Henry L. Gray, and Alan C Elliott, “Applied Time Series Analysis with R”, 2016, 2nd Edition, CRC Press, US			
2	Brian J. Reich & Sujit K. Ghosh, Bayesian Statistical Methods, 2019, 1st Edition, Chapman and Hall/CRC, US			
Mode of evaluation: Assessment / FAT / Oral Examination				
Recommended by Board of Studies		28-05-2025		
Approved by Academic Council		No. 78	**Date**	12-06-2025

MACTM501	Construction Planning, Scheduling and Control	L	T	P	C
		3	0	2	4

Pre-requisite	NIL	Syllabus version
		1.0

Course Objectives

1. To use appropriate scheduling techniques for different project requirements.
2. To perform monitoring and control functions for real-time projects.
3. To manage delays and risks in construction projects and prepare comprehensive reports.

Course Outcomes

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

1. Utilize appropriate scheduling techniques for different construction projects.
2. Perform monitoring and controlling functions for real-time projects.
3. Allocate and schedule resources for construction project activities.
4. Prepare and present various types of project information reports.
5. Manage delays and schedule risks in construction projects.

Module: 1	Construction Project Planning	8 hours

Project Management – Project Vs Process – Construction Project Lifecycle – Construction Project Organization – Estimating Project Duration – Work Breakdown Structure (WBS) – Scheduling Levels – Tools for Time Management – Bar/Gantt charts – Network Diagrams – Critical Path Method – Network Analysis – Calculation of Floats.

Module: 2	Construction Scheduling	9 hours

Precedence Diagram Method (PDM) – Scheduling with Uncertain Durations – Three-time estimates – PERT – Linear Scheduling Method.

Module: 3	Schedule Compression and Resource Scheduling	9 hours

Schedule Compression – Time - Cost Trade off – Project Crashing – Planning for Resources – Resource Scheduling – Resource Allocation – Resource Smoothening – Resource Levelling.

Module: 4	Project Monitoring and Control	9 hours

Project Monitoring – Baseline Schedule – Project Updating – Progress Reports – Project Control – Project S Curves – Earned Value Analysis – Project Management Information Systems – Project Reporting.

Module: 5	Managing Delays and Schedule Risks	8 hours

Delay Claims – Types of Delays – Project Documentation – Methods of Delay Analysis – Schedule Risk Management – Types of Risks in Construction Projects – Schedule Risks – Good Scheduling Practices for Risk Assessment – Expected Value – Risk Adjustment.

Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
Text Book(s)		
1.	Mubarak, S., Construction Project Scheduling and Control, 2019, 4th Edition, Wiley, New Jersey, USA.	
2.	Jha, K.N., Construction Project Management – Theory and Practice, 2020, 2nd Edition, Pearson, New Delhi, India.	
Reference Books		
1.	Hinze, J.W., Construction Planning and Scheduling, 2011, 4th Edition, Pearson, London, UK.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Indicative Experiments		
1.	Formulating project enterprise structure	
2.	Creating project calendar	
3.	Defining precedence relations and calculating critical path	
4.	Resource allocation and leveling	
5.	Project Controlling – Earned Value Analysis	
6.	Creating baselines, project updating and tracking	
7.	Scheduling a horizontal linear project	
8.	Scheduling a vertical linear project	
9.	Performing schedule delay analysis	
10.	Project reporting and presentation	
Total Laboratory Hours		**30 hours**
Mode of assessment: Assessment / FAT / Oral examination		
Recommended by Board of Studies	28-05-2025	
Approved by Academic Council	No. 78	**Date** 12-06-2025

MACTM502	Construction Equipment and Methods	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the various techniques to be implemented in substructure construction.
2. To know the launching of girders, material handling and erection of components in superstructure construction.
3. To study the various types of roads; its construction procedure and equipment employed in road construction.
4. To know the various types of equipment and its usage in construction activity and maintenance of equipments.

Course Outcomes

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

1. Identify the suitable techniques to construct the substructure based on site condition
2. Identify the suitable techniques and equipments for any type of superstructure construction.
3. Identify the techniques to implement in construction of road, embankment, and retaining wall in different terrain.
4. Categorize and identify the suitable equipment used in various earthwork activities with safety aspect.
5. Prepare a suitable plan with equipments for erection of new plants like concrete batching, hot bituminous mixing plant and crushing plant.

Module: 1	Sub Structure Construction	9 hours

Techniques of Box jacking – Pipe Jacking – under water construction of diaphragm walls and Basement - Tunnelling techniques – Piling techniques – Dewatering and standby Plant equipment for underground open excavation – case studies.

Module: 2	Superstructure Construction	8 hours

Launching girders, bridge decks, offshore platforms – Material handling – erecting lightweight components on tall structures – Erection of articulated structures – Fabrication and erection of steel trusses and frames.

Module: 3	Highway Construction Practice	8 hours

Embankment Construction – Ground improvement techniques – Retaining and Breast walls on hill road. Bituminous Constructions – Concrete road construction: Test – Construction equipments – Method of construction of joints in concrete pavements.

Module: 4	Earthwork Equipment and equipment management	9 hours

Fundamentals of Earthwork operations – Earth Moving operations –Types of Earthworks Equipment – Tractors – Motor Graders – Scrapers – Front end Loaders- Earth Movers – capacity calculations. Factors affecting selection of equipment and methods – Planning – Equipment Management in Projects – Maintenance Management – Safety Management.

Module: 5	**Cranes, Rigs and Screening Equipment**	**9 hours**
Crane - Mobile, Tower, Crawler and Truck mounted - Piling Rigs - Forklifts and related equipment – Portable Material Bins – Conveyors – Equipment used in Demolition – Chain Pulley Blocks. Crushers – Feeders – Screening Equipment – Batching and Mixing Equipment – Truck mixer - Pumping Equipment – Placing Boom – shotcrete pump – concrete paver.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
Tutorial		
Tutorial problem in Module 1: 3 Hrs Tutorial problem in Module 2: 3 Hrs Tutorial problem in Module 3: 3 Hrs Tutorial problem in Module 4: 3 Hrs Tutorial problem in Module 5: 3 Hrs		
Total Tutorial hours		**15 hours**

Text Book(s)	
1.	Sharma, S.C., Construction Equipment & Management, 2019, Khanna Publishing House, India.
2.	Rajoria, K.B., and Srivastava, H.K., Case Studies in Construction Project Management, 2024, 1st Edition, Khanna Publishing House, India.
Reference Books	
1.	Jha, K.N., Construction Project Management – Theory and Practice, 2020, 2nd Edition, Pearson, New Delhi, India.
2.	Punmia, B.C., Jain, A.K., and Jain, A.K., Building Construction, 2023, 11th Edition, Laxmi Publications, New Delhi, India.

Mode of Evaluation: CAT / Assignment / Quiz / FAT			
Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM503	Construction Economics and Finance	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To discuss the concepts of engineering economics and identify alternatives for effective decision-making.
2. To compare alternative proposals using appropriate economic evaluation methods and evaluate alternative investments and effectively manage available funds.
3. To describe the fundamentals of managerial accounting and their application in decision-making.

Course Outcomes

At the end of the course, the student will be able to:

1. Quantify alternative options to support the decision-making process in construction economics.
2. Compare different alternatives using appropriate economic analysis techniques.
3. Systematically evaluate the costs and benefits associated with various construction projects.
4. Manage project financing, including aspects related to international funding and foreign currency exchange.
5. Apply principles of management accounting and prepare financial statements, including cash flow statements.

Module: 1	Construction Economics	8 hours

Basic concepts of Cash flow diagrams, Equivalency - Single payment in the future - Present payment compared to uniform series payments - Future payment compared to uniform series payments - Arithmetic gradient, Geometric gradient - Comparison of alternatives

Module: 2	Equipment Economics	9 hours

Construction equipment – buy, rent and lease options- operating cost, ownership cost, depreciation cost- salvage value-rate of return- replacement cost- service life- case studies

Module: 3	Evaluating alternative investments	9 hours

Real Estate - Investment Property, Depreciation – Equipment Replace Analysis - Tax before and after depreciation – Value Added Tax (VAT) – Goods and Service Tax (GST) - Inflation.

Module: 4	Funds Management	9 hours

Project Finance – Sources of finance - Long-term and short-term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management - International foreign currency management.

Module: 5	**Fundamentals of Management Accounting**	**8 hours**
Management accounting, Financial accounting principles - basic concepts, Financial statements – Accounting ratios - Funds flow statement – Cash flow statement.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
	Tutorial	
	Tutorial Class Module 1: 3 hours Tutorial Class Module 2: 3 hours Tutorial Class Module 3: 3 hours Tutorial Class Module 4: 3 hours Tutorial Class Module 5: 3 hours	
Total Tutorial hours		**15 hours**

Text Book(s)	
1.	Bose, D. C., Fundamentals of Financial management, 2011, 2nd edition, PHI Learning Pvt. Ltd, New Delhi.
2.	Collier C and Glagola C, Engineering Economics & Cost Analysis, 1998, 3rd Edition, Addison Wesley Longman, US.
Reference Books	
1.	Steven J. Peterson, Construction Accounting & Financial Management, 2019, 4th edition, Pearson, UK.
2.	Karl E. Case , Ray C. Fair and Sharon E. Oster, Principles of Economics, 2017, 12th edition Pearson, UK.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Seminar / Group discussion.

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM504	Project Formulation and Appraisal	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand project formulation and conduct detailed feasibility studies.
2. To analyse the time value of money and estimate project costs using both discounting and non-discounting criteria techniques.
3. To perform project risk analysis and suggest measures for effective risk management.
4. To explore opportunities to encourage private sector participation.

Course Outcomes

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

1. Discuss the types and phases of capital budgeting and conduct detailed project feasibility studies.
2. Compute the time value of money and explain the impact of compounding frequency on the effective interest rate.
3. Assess investment evaluations using both discounting and non-discounting criteria techniques.
4. Apply various project risk analysis techniques and describe the strategies used for effective risk management.
5. Discuss the implications of different infrastructure development models.

Module: 1	Project Formulation	8 hours

Capital investments – Importance -Types – phases - Project evaluation an overview - Generation and Screening of Project Ideas - Project feasibility study– market, technical, financial, economic and ecological – Market and Demand analysis - Demand Forecasting Methods- Uncertainties in Demand Forecasting.

Module: 2	Time Value of Money	9 hours

Time Value of Money – Future value of single amount, Present value of single amount, Future value of an annuity, Present value of an annuity -Simple Interest - Compound interest - project cash flows - Basic Principles of Cash Flow Estimation - Cash Flows for a Replacement Project.

Module: 3	Project Costing	9 hours

Investment Criteria - Discounting Criteria - Net present value (NPV), Benefit cost ratio (BCR), Internal Rate of Return (IRR) - Non-Discounting criteria - Pay Back Period, Accounting Rate of Return (ARR), Urgency - Investment analysis in practice.

Module: 4	Project Risk Analysis	9 hours

Sources, Measures, and Perspectives on Risk - Sensitivity Analysis - Scenario Analysis - Break-even Analysis - Hillier Model - Simulation Analysis - Decision Tree Analysis - Managing Risk - Project Selection Under Risk - Risk Analysis in Practice.

Module: 5	**Infrastructure Projects and Public-Private Partnerships**	**8 hours**
Characteristics of Infrastructure Projects - Public-Private Partnership – Structures of PPP - BOT, BOOT, BOLT - Key Project Parties-Project Contracts-Technology Transfer and Foreign Collaboration - Case Studies - Managing Risks in Private Infrastructure Projects - Measures of Savings in Infrastructure Costs		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
	Tutorial	
Tutorial problem in Module 1: 3 Hrs Tutorial problem in Module 2: 3 Hrs Tutorial problem in Module 3: 3 Hrs Tutorial problem in Module 4: 3 Hrs Tutorial problem in Module 5: 3 Hrs		
Total Tutorial hours		**15 hours**

Text Book(s)	
1.	Prasanna Chandra, Projects - Planning Analysis Selection Implementation & Review, 2017, Eighth Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2.	Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 2017, 12th Edition, Wiley, US.
Reference Books	
1.	W. Behrens and P.M. Hawranek, United Nations Industrial Development Organization (UNIDO) Manual for the preparation of Industrial Feasibility Studies, (IDSI Reproduction), 1991, United Nations Industrial Development Organization, Vienna.
2.	Mohamed Hegab, Public Private Partnerships for Highway Projects: Project Selection and Decision Analysis, 2014, Create space Independent Publisher, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Seminar / Group discussion.

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM505	Virtual Design for Infrastructure Systems	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide foundational knowledge of virtual design, Building Information Modelling (BIM) and industry standards for managing information
2. To explore digital construction concepts collaborative environments and its application across the infrastructure lifecycle.
3. To evaluate the principles and practical applications of Digital Twins in managing infrastructure performance and resilience.

Course Outcomes

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

1. Understand the components, stakeholders, and lifecycle phases in virtual design and construction.
2. Apply the principles and framework of ISO 19650 for information management in infrastructure projects.
3. Select digital tools and modelling practices for virtual construction planning and coordination.
4. Analyze the integration of IoT, data analytics, and information models for Digital Twin applications in infrastructure.
5. Evaluate real-world use cases of Digital Twin implementations and their impact on infrastructure management.

Module: 1	BIM and Virtual Design in Construction	8 hours

Introduction to Building Information Modelling (BIM) – Evolution from Computer Aided Design (CAD) to BIM – BIM Dimensions (3D to 7D) – Stakeholders and roles – BIM Uses across Infrastructure lifecycle – Benefits and challenges of BIM – Overview of virtual design tools – Introduction to Common Data Environment (CDE).

Module: 2	BIM Standards, Processes and ISO 19650	9 hours

Information Management principles – ISO 19650 series overview – Information Delivery Cycle – Employer's Information Requirements (EIR) – BIM Execution Plan (BEP) – Project Information Model (PIM) and Asset Information Model (AIM) – Level of Detail (LOD) and Level of Information (LOI) – Collaboration and coordination workflows – Legal and contractual aspects.

Module: 3	Tools, Data Interoperability and Digital Construction	9 hours

Overview of BIM authoring and coordination tools – Interoperability and Industry Foundation Class (IFC) standards – 4D construction simulation – 5D cost estimation – Model checking and clash detection – Integration with scheduling tools – Construction automation and site digitization – Reality capture and Scan to BIM.

Module: 4	Digital Twins and Smart Infrastructure	9 hours
Concept of Digital Twin – Differences between BIM and Digital Twin – Digital Twin Types – Role of IoT, sensors, and data streams – Data acquisition and storage – Cyber-physical systems – Data exchange in twin systems – Cloud platforms and Application Programming Interfaces (APIs) – Key performance indicators for infrastructure assets – Applications in predictive maintenance, asset tracking, and sustainability.		
Module: 5	**Digital Twin Implementation and Use Cases**	**8 hours**
Digital Twin lifecycle – Integration with Asset Management Systems – Data governance and standards – Challenges in deployment – Digital Twin Use Cases for bridges, highways, railways, and smart cities – Global initiatives – Case studies – Future directions and research trends.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)

1.	Rafael Sacks, Ghang Lee, Luciana Burdi, Marzia Bolpagni. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, 2025, 4th Edition, Wiley, USA.
2.	Erika Parn, Rafael Sacks, Ioannis Brilakis, Lucio Soibelman, Mark Enzer. Twin Systems: Digital Twins of the Built Environment, 2024, 1st Edition, Twin Systems Publisher, UK.

Reference Books

1.	ISO 19650 Series, Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – International Organization for Standardization (ISO), 2018–2022.
2.	Mohammad Saif Wajid, Hugo Terashima-Marín, Aasim Zafar, Mohd Anas Wajid, Bharat Bhushan, Digital Twins for Smart Cities and Urban Planning: From Virtual to Reality, 2025, 1st Edition, CRC Press, USA.

Mode of Evaluation: CAT/ Assignment / Quiz / FAT / Project / Seminar.

Indicative Experiments

1.	Creating a parametric 3D model of a simple infrastructure element
2.	Developing an integrated model of an infrastructure element with architectural, structural, and MEP elements.
3.	Performing clash detection for different discipline models (e.g., architectural, structural and MEP)
4.	4D construction simulation of an infrastructure section
5.	5D construction simulation of a simple project

6.	Creating a conceptual site model of terrain, roads and buildings with GIS integration			
7.	Automating Workflow for Converting and Enriching GIS Data to BIM-Compatible Format.			
8.	Modeling a small building or infrastructure component and sync it to digital twin user interface for collaboration			
9.	Simulating sensor data (e.g., temperature, vibration) and visualize it in a digital twin dashboard.			
10.	Generating BIM model from point cloud through reality capture.			
Total Laboratory Hours				**30 hours**
Mode of assessment: Assessment / FAT / Oral examination				
Recommended by Board of Studies	28-05-2025			
Approved by Academic Council	No. 78	**Date**	12-06-2025	

MACTM601	AI-Enhanced Structural Health Monitoring	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Develop a strong understanding of core Artificial Intelligence (AI) and machine learning (ML) concepts applied to structural engineering problems.
2. Acquire hands-on skills in data acquisition, preprocessing, and ML model development for structural analysis and health monitoring.
3. Critically evaluate AI-driven design and optimisation techniques, integrating them responsibly within engineering workflows.

Course Outcomes

1. Explain fundamental AI/ML algorithms and their relevance to structural engineering.
2. Implement Python-based data pipelines for structural data (sensor, image, time-series).
3. Train, validate, and interpret supervised learning models for damage detection and structural health monitoring.
4. Apply deep learning architectures (CNNs, RNNs) to real-world structural engineering datasets.
5. Formulate optimisation problems (genetic algorithms, surrogate models) for AI-driven structural design.

Module: 1	Basics of AI	8 hours

Overview of AI/ML terminology and history - Review of numerical methods in civil engineering - Introduction to Python for engineering computations.

Module: 2	Data Acquisition & Preprocessing	8 hours

Sensor networks and IoT in structures - Image, vibration, and time-series data collection - Cleaning, normalisation, feature extraction.

Module: 3	Machine Learning for Structural Health Monitoring	7 hours

Supervised learning: regression & classification - Unsupervised methods: clustering, anomaly detection - Performance metrics and model validation.

Module: 4	Deep Learning & Advanced AI Approaches	10 hours

Convolutional Neural Networks for image-based damage detection - Recurrent architectures for time-series structural response - Transfer learning and model interpretability.

Module: 5	AI-Driven Design Optimization	10 hours

Genetic algorithms and swarm intelligence - Surrogate modelling for rapid design exploration-Case studies in topology and material optimization.

Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	M. Z. Naser, Machine Learning for Civil & Environmental Engineers: A Practical Approach to Data-driven Analysis, Explain ability, and Causality, 2023, 1st edition, Wiley India, New Delhi.
2.	J.A. Goulet, Probabilistic Machine Learning for Civil Engineers, 2020, MIT Press, USA.
Reference Books	
1.	Goodfellow, Y. Bengio and A. Courville, Deep Learning (Adaptive Computation and Machine Learning series), 2016, The MIT Press, London.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project	

Indicative Experiments		
1.	Python-based data preprocessing and feature extraction for structural sensor data.	
2.	Implementation of linear regression and validation techniques for damage prediction.	
3.	Developing and training a convolutional neural network for image-based crack detection.	
4.	Application of genetic algorithms for optimal structural design using Python.	
5.	Time-series analysis with recurrent neural networks for vibration-based health monitoring studies.	
Total Laboratory Hours		**30 hours**

Text Book(s)	
1.	S. Raschka and V. Mirjalili, Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and Tensor Flow 2, 2019, 3rd Edition, Packt Publishing Ltd., UK.
Reference Books	
1.	F. Chollet, Deep Learning with Python, 2021, 2nd Edition, Manning Publications, USA
2.	W. McKinney, Python for Data Analysis, 2017, 3rd Edition, O'Reilly Media, USA
Mode of assessment: Assessment / FAT / Oral examination.	

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM602	Automation in Construction	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the fundamentals of automation technologies and their relevance in modern construction.
2. To develop an understanding of hardware and software for automation, building automation and construction automation systems.
3. To gain insights into the role of robotics and intelligent systems in automating construction tasks for improved efficiency and safety.

Course Outcomes

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

1. Understand the principles of automation in construction.
2. Identify the suitable hardware and software needed for various automation applications.
3. Apply automation strategies for efficient building management.
4. Analyze the scope and implement suitable automation techniques in onsite and offsite construction.
5. Evaluate the need and implementation level of robotic functions in construction tasks.

Module: 1	Principles of Construction Automation	8 hours

Introduction to Construction Automation – USA Principle of Automation – Definition and Scope of Automation – Evolution of Automation in Construction – Need and Benefits – Levels of Automation – Overview of Industry 4.0 and Digital Transformation – Human-Machine Interfaces in Construction.

Module: 2	Hardware and Software for Automation	9 hours

Fundamentals of Electrical Circuits – Essential Hardware for Automation – Sensors – Actuators – Types and Applications – Controllers – Communication Hardware – High-level Devices – Low-level software – Input and Output – Configuring the Network – Protocols and Standards – Programming Methodology – Digital Communication Protocols – Low-level Control Algorithms – Optimization.

Module: 3	Building Automation Systems	9 hours

Building Automation Essentials – Lighting Design and Control Strategies – Thermal Comfort – Principles of Air-Conditioning – Automation Strategies – Internal Heat Gain – Reducing Heat Gain through Automation – Energy Management – Monitoring Building Performance – Safety and Security – Building Management System (BMS) and Facility Management Systems (FMS).

Module: 4	Construction Automation	9 hours
Construction Automation – Decision-making on Construction Automation – Examples of Automating Construction Activities – Surveying and Layout – Other Construction Tasks – Progress Monitoring – Automation in Equipment Operation – Quality Inspection and Non-destructive Testing – 3D Printing – Automation in Offsite and Modular Construction.		
Module: 5	**Robotics in Construction**	**8 hours**
Introduction to Construction Robotics – Robot-Oriented Design – Types of Construction Robots (e.g., Bricklaying, Concrete Printing, Demolition) – Automation in Hazardous Environments – Mobile Robotic Systems – Human-Robot Collaboration – Challenges and Constraints in Construction Robotics – Case Studies of Robotics Implementation – Future Trends and Ethical Considerations.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
Tutorial		
Tutorial problem in Module 1: 3 Hrs Tutorial problem in Module 2: 3 Hrs Tutorial problem in Module 3: 3 Hrs Tutorial problem in Module 4: 3 Hrs Tutorial problem in Module 5: 3 Hrs		
Total Tutorial hours		**15 hours**

Text Book(s)

1.	Raphael, B. Construction and Building Automation: From Concepts to Implementation, 2022, 1st Edition, Routledge, UK.
2.	Wang, S. Intelligent Buildings and Building Automation, 2009, 1st Edition, Taylor & Francis Group, London.

Reference Books

1.	Bock, T., Linner, T. Robot – Oriented Design: Design and Management Tools for the Deployment of Automation and Robotics in Construction, 2015, 1st Edition, Cambridge University Press, UK.
2.	Warszawski, A. Industrialized and automated building systems – A managerial approach, 2019, 2nd Edition, Routledge, UK.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM603	Lean Project Delivery	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To measure productivity and identify the wastes in a construction project.
2. To employ lean principles for value generation in construction project delivery.
3. To select a suitable lean tool and implement it in different phases of the project.

Course Outcomes

At the end of the course, the student will be able to
1. Explain the core principles and philosophy of lean construction
2. Identify types of waste and value-adding processes in construction projects
3. Select appropriate lean tools for planning and productivity improvement
4. Apply lean tools for process improvement in construction project delivery
5. Implement lean in different stages of the project life cycle and measure the improvement

Module: 1	Productivity Measurement and Lean Evolution	8 hours

Need for productivity measurement systems – Construction productivity – Productivity Measurement Systems (PMS) – History of Lean – Toyota Production System – Project Management vs Lean Construction vs Lean Project Delivery – Value and Waste – Transformation-Flow-Value (TFV) theory.

Module: 2	Waste Elimination and Value Generation	9 hours

Seven Wastes in Construction – Identification and Classification of Waste – Work Sampling; Foreman delay survey – Value Stream Mapping – Continuous Flow and Pull Systems – Root Cause Analysis – Choosing by Advantages (CBA) – Creating Value for the Client – Customer Focus and Requirements Alignment.

Module: 3	Lean Tools for Planning and Productivity Improvement	9 hours

The Last Planner System (LPS) – Components of LPS: Milestone Planning – Phase Planning – Lookahead Planning – Weekly Work Planning – Percent Plan Complete (PPC) – Constraint Analysis – Collaborative Planning and Commitment-Based Scheduling – Takt Time Planning.

Module: 4	Lean Tools for Process Improvement	9 hours

A3 Problem Solving – 5 Whys and Fishbone Diagrams – 5S in Construction – Visual Management – Kanban and Pull Planning – Standard Work – Lean Metrics and Performance Indicators – Lean Safety Management – Lean in Design Phase – Integrated Project Delivery (IPD).

Module: 5	**Lean Implementation**	**8 hours**
Change Management for Lean Adoption – Building a Lean Culture – Training and Capacity Building – Big Room Approach – Case Studies of Lean Projects – Lessons Learned – Lean Maturity Assessment – Digital Lean Construction Tools – BIM and Lean Integration – Lean and Sustainability.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
Tutorial		
Tutorial problem in Module 1: 3 Hrs Tutorial problem in Module 2: 3 Hrs Tutorial problem in Module 3: 3 Hrs Tutorial problem in Module 4: 3 Hrs Tutorial problem in Module 5: 3 Hrs		
Total Tutorial hours		**15 hours**

Text Book(s)	
1.	Tzortzopoulos, P., Kagioglou, M., and Koskela, L., Lean Construction: Core Concepts and New Frontiers, 1st Edition, 2020, Routledge, London, UK.
2.	Ballard, G., and Howell, G., Lean Project Delivery, 1st Edition, 2021, Lean Construction Institute, USA.
Reference Books	
1.	Koskela, L., Theory Based Production Management: An Explanation and a Review, 2nd Edition, 2023, Lean Construction Institute, Finland.
2.	Salem, O., and Zimmer, E., Lean Construction: From Theory to Implementation, 1st Edition, 2019, CRC Press, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM604	Supply Chain Management	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the fundamentals of supply-chain-management and the role of AI in modern construction supply chains
2. To evaluate strategic procurement and supplier-relationship management using data driven methods
3. To apply advanced forecasting and inventory-optimization techniques for construction materials
4. To design and optimise logistics and distribution networks tailored to construction project needs.

Course Outcomes

1. Discuss digital supply-chain frameworks and employ AI-driven decision-support tools in construction contexts.
2. Assess and optimise procurement strategies and supplier selection via multi-criteria decision-making.
3. Implement supply chain strategies and perform demand-forecasting models.
4. Practice inventory-optimisation algorithms using real-world data.
5. Formulate and solve logistics network-design and vehicle-routing problems with both exact and heuristic methods.

Module: 1	Fundamentals of Supply-Chain Management and AI Integration	8 hours

Overview of supply-chain-management (SCM) – functions – flows and processes – importance in construction industry – Supply chain networks, Integrated supply chain planning, Decision phases in supply chain, Supply chain models and modeling systems Digital-transformation in supply chains – Environmental, Social, and Governance (ESG) planning in construction supply chains.

Module: 2	Strategic Procurement and Supplier Management	9 hours

Strategic-procurement processes – sourcing strategies – make-or-buy decisions – supply-chain-oriented contracts – Supplier-selection criteria– Supplier-evaluation models – Data Envelopment Analysis (DEA) – TOPSIS – E-procurement platforms and blockchain for provenance and transparency – Genetic Algorithm for multi-objective supplier selection – demonstration of Pareto-front generation.

Module: 3	Supply chain Planning and Performance Management	9 hours

Supply chain strategies, Supply chain drivers and obstacles, Strategic Alliances and Outsourcing – purchasing aspects of supply chain – Balanced score card approach, Performance Metrics – Planning demand and supply, Demand forecasting in supply chain – time-series analysis – exponential smoothing – ARIMA models – Machine-learning forecasting.

Module: 4	**Inventory theory models**	**9 hours**
Economic Order Quantity Models, Reorder Point Models and Multi-echelon Inventory Systems, Relevant deterministic and stochastic inventory models and Vendor managed inventory models – Implementation of forecasting and inventory algorithms in Python/R with construction.		
Module: 5	**Logistics and Distribution Network Design**	**8 hours**
Introduction to Logistics – Logistics System Design – Logistics Channels – Warehousing – Warehousing decision models – Logistics metrics, Order Management, Logistics information systems – Vehicle-routing problems (VRP) – capacitated VRP – VRP with time windows – drone and autonomous vehicle trial – Last-mile delivery challenges in Indian urban settings.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing and Managing the Supply Chain: Concepts, Strategies, and Cases, 2022, 4th Edition, McGraw-Hill Education, New York, NY, USA.
2.	Mangan, J., Lalwani, C., and Calatayud, A., Global Logistics and Supply Chain Management, 2020, 4th Edition, Wiley, Hoboken, NJ, USA.
Reference Books	
1.	Bozarth, C.B., and Handfield, R.B., Introduction to Operations and Supply Chain Management, 2019, 5th Edition, Pearson Education, Boston, MA, USA.
2.	Becker, T., Optimising and Digitising Supply Chain Processes, 2024, 1st Edition, Springer, Berlin, Germany.
3.	Chopra, S., Supply Chain Management: Strategy, Planning, and Operation (What's New in Operations Management), 2021, 7th Edition, Pearson Education, Boston, MA, USA.
4.	MacCarthy, B.L., and Ivanov, D., The Digital Supply Chain, 2022, 1st Edition, Elsevier, Amsterdam, Netherlands.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM605	Estimating, Tendering and Bidding	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the various types of estimates, analysis of rate for various items of works for a construction project to sanction the budget.
2. To attain the knowledge to prepare the specification, tender document preparation and types of contract and documents preparation.
3. To obtain the knowledge about the conditions of contract, Bidding and Bidding models.

Course Outcomes

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

1. Prepare the detailed estimate and total project cost estimate for approval of project.
2. Carryout the rate analysis using standard method for item of works involved in construction.
3. Prepare the detailed specification for various items of works with aid of detailed drawing.
4. Prepare a tender document for a budget sanctioned project. Identify the suitable construction contract method and able to prepare the contract document.
5. Draft the conditions of contract for a project and identify the suitable bidding models for projects.

Module: 1	Estimation	8 hours

Project cost estimation - Approximate Estimate and administrative approval – expenditure sanction - Detailed Estimate.

Module: 2	Rate Analysis	9 hours

Rate analysis - standard methods as followed by government organizations for tendering purposes - as followed by contractor organizations for bidding purposes.

Module: 3	Specifications	8 hours

Definitions, relationship with drawings, purpose, benefits, organization of specification, Drafting / writing the specifications, types of specifications.

Module: 4	Tendering Process and Contract Agreement	9 hours

Preparation of tender documents estimating, pre-qualification, bid evaluation, award of contract, project financing and contract payments, contracts close out and completion, E-tendering. Contracts, types of construction contracts, Evaluation of contract documents, need for documents, roles and functions of participants to the contract.

Module: 5	**Conditions of Contract and Bidding**	**9 hours**
Clarification by parties to contract, obligations and responsibilities of the parties, protection and indemnification, bonds and insurance, subsurface conditions, inspection of work, change of work, rejected work and deficiencies. Bidding models and bidding strategies, Owner's and contractor's estimate – Overhead charges - Internationally adopted formulae. Enlistment of contractors.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
Tutorial		
Tutorial problem in Module 1: 3 Hrs Tutorial problem in Module 2: 3 Hrs Tutorial problem in Module 3: 3 Hrs Tutorial problem in Module 4: 3 Hrs Tutorial problem in Module 5: 3 Hrs		
Total Tutorial hours		**15 hours**

Text Book(s)	
1.	B.N. Dutta, Estimating and Costing in Civil Engineering Theory and Practice Including Specifications and Valuations, 2021, 28th edition, CBS Publishers and distributors Pvt. Ltd, India.
2.	John Murdoch, Will Hughes, Ronan Champion, Construction Contracts: Law and Management, 2015, 5th edition, Routledge (Taylor and Francis Group), New York, USA.
Reference Books	
1.	Brian Greenhalgh, Introduction to construction contract management, 2016, 1st edition, Routledge (Taylor and Francis), NY and UK.

Mode of Evaluation: CAT / Assignment / Quiz / FAT.

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM606	Safety and Quality Management in Construction	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Describe effective safety management practices and understand the laws related to safety in the construction industry.
2. Identify the causes of construction-related accidents.
3. Discuss the fundamental concepts of quality and apply Six Sigma methodology and Statistical Quality Control (SQC) techniques for quality improvement.

Course Outcomes

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

1. Demonstrate appropriate safety practices during construction activities and describe the roles and responsibilities of safety personnel on site.
2. Apply safety management systems and discuss legal regulations and laws governing safety in the construction industry.
3. Identify the causes of construction-related accidents and calculate accident indices such as frequency rate, severity rate, and incident rate.
4. Explain the concepts of quality and interpret various quality standards relevant to the construction industry.
5. Apply Six Sigma methodologies and Statistical Quality Control (SQC) techniques to monitor and improve construction processes.

Module: 1	Designing for Safety	8 hours

Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices - Safety in building construction and demolition - Foundation - Structural framework and Concreting - Safety during heavy Earth moving and hoisting equipment usage - Safety in confined-space entry - Electrical safety - Fire safety – AR/VR applications in designing and monitoring the construction safety.

Module: 2	Safety Organization	9 hours

Safety Policy, Safety Record Keeping, Safety Culture - Safety Audit - Safety Training - Safety Meeting - Safety Incentives - Safety provisions - Factory Act-Laws related to the Industrial Safety - Safety standards and codes - Occupational Safety and Health Administration (OSHA) Regulations-Application of BIM for safety management systems.

Module: 3	Construction Accidents	9 hours

Injury and Accidents- Causes – Costs of Construction Injuries, Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

Module: 4	**Construction Quality Management**	**9 hours**
Introduction to quality - Importance - Types - Taguchi's concept of quality- Quality plan – Quality Management Guidelines – Quality circles - Quality policy - Quality standards / codes in design and construction (ISO: 9000) - Quality audits - Quality System Documents – Quality related training – Evaluation of Quality system.		
Module: 5	**Six Sigma and Statistical Quality Control Techniques**	**8 hours**
Six Sigma: Introduction, Success factors and methodology – Six Sigma for Projects - Statistical quality control - Tools, Control charts - Acceptance sampling, Specification and tolerances – Optimization techniques.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**
	Tutorial	
	Tutorial problem in Module 1: 3 Hrs Tutorial problem in Module 2: 3 Hrs Tutorial problem in Module 3: 3 Hrs Tutorial problem in Module 4: 3 Hrs Tutorial problem in Module 5: 3 Hrs	
Total Tutorial hours		**15 hours**

Text Book(s)	
1.	Steven McCabe, Quality Improvement Techniques in Construction: Principles and Methods, 2016, 1st Edition, Routledge, London.
2.	David L. Goetsch, Construction Safety and Health, 2012, 2nd Edition, Pearson, London.
Reference Books	
1.	Tim Howarthand David Greenwood, Construction Quality Management: Principles and Practice, 2017, 2nd Edition, Routledge, London.
2.	Phil Hughes and Ed Ferrett, Introduction to Health and Safety at Work, 2020, 7th Edition, Routledge, London.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Seminar / group discussion.

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM607	Contract and Administration Planning	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To introduce students to the fundamental concepts of contracts, administration and arbitration.
2. To develop an understanding of insurance, bonding, and tax laws.
3. To enhance students' knowledge and skills in Welfare Legislation , Labour Laws and Regulations.

Course Outcomes

By the end of the course, students will be able to:

1. Understand the fundamental principles and components of construction contracts.
2. Prepare the administration planning for projects and assign the responsibility to the line of authorities.
3. Explain the arbitration process and analyze case studies related to construction disputes.
4. Describe key concepts in insurance, bonding, and tax laws relevant to construction projects.
5. Summarize labour regulations and welfare legislation applicable to the construction industry.

Module: 1	Construction Contracts	9 hours

Types of contracts – Documents forming a contract – Contract Legal issues in contract – Standard forms of contracts – General and special conditions of contracts – Contract pricing by the client – project management consultants and the contractor – Contract correspondence and contract closure. Contract administration – Law of Torts – International contracts – Interpretation of contract in case of inconsistency, including case study.

Module: 2	Administrative Planning	9 hours

Construction Administration - Lines of Authority on Construction Projects – Comparison of strategic, tactical, and operational planning- Role of stakeholders - Delegation, authority, and responsibility - Design Build Contracts, Responsibility for Coordination of the trades.

Module: 3	Arbitration	9 hours

Comparison of Actions and Laws – Agreements – Appointment of Arbitrators – Conditions of Arbitration – Arbitration Tribunals – Powers and Duties of Arbitrator – Enforcement of Award – Arbitration and Conciliation Act 1996 – Arbitration case study.

Module: 4	Insurance, Bonding and Tax Laws	8 hours

Insurance and Bonding – Types of Bonds – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes- Claims and disputes – Dispute resolution techniques. Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

Module: 5	**Labour Regulations**	**8 hours**
Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes – Workmen's Compensation Act 1923 – Indian Factory Act 1948 – Tamil Nadu Factory Rules 1950 – Child Labour (Prohibition and Regulation) Act, 1986 - Other Labour Laws and Regulations.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	Markanda, P.C., Markanda, N., and Markanda, R., Law Relating to Arbitration and Conciliation, 2016, 9th Edition, Lexis Nexis, Haryana, India.
2.	Edward Fisk , Wayne Reynolds, Construction Project Administration, 2013, 10th Edition, Pearson, USA.
Reference Books	
1.	Brook, M., Estimating and Tendering for Construction Work, 2016, 5th Edition, Routledge, Abingdon, UK.
2.	Hinze, J., Construction Contracts, 2010, 3rd Edition, McGraw-Hill, New York, USA.
3.	Bockrath, J.T., and Plotnick, F.L., Contracts and the Legal Environment for Engineers and Architects, 2013, 7th Edition, McGraw-Hill Education, New Delhi, India.
Mode of Evaluation: CAT / Assignment / Quiz / FAT and Project	

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM608	Modern Construction Materials	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To understand the properties and applications of structural materials.
2. To gain knowledge about material behaviour, properties, and failure mechanisms.
3. To understand the applications and behaviour of smart materials and special concretes.

Course Outcomes

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

1. Understand the types, properties, and applications of structural and composite construction materials.
2. Analyze material behavior under various stresses and environmental conditions.
3. Identify and select advanced materials and industrial by-products used in modern construction.
4. Understand the characteristics and applications of smart materials in building systems.
5. Gain knowledge of special concretes and their performance

Module: 1	Structural Materials	8 hours

Reinforcement – Steel - Glass Fiber – Carbon Fiber - Rebar Couplers – Sections – Aluminum, Steel - Rapid wall panels – Composite, Aerated Light Weight, GFRP - Decorative Panels – PVC, Acrylic, Gypsum boards.

Module: 2	Material Behaviour	8 hours

Surface properties – Stress response - Failure theories – Fracture mechanism – Rheology – Thermal properties.

Module: 3	Advanced Materials	9 hours

Adhesives – Epoxy , Resins, Polyurethane - Admixtures - Mineral Admixtures, Chemical admixture, Waterproofing admixtures and membrane, Industrial by-products - AAC blocks – Interlocking blocks – Lightweight aggregates – Recycled aggregates – Laminates – Fibers.

Module: 4	Smart Material	9 hours

Smart and intelligent material – Neoprene – Structural plastics and composites - Polymer membrane – Geo textile and geo membrane – Properties and applications – Flooring and façade materials- Glazed brick – Photo catalytic cement – Acid etched copper – Petroleum products – Bituminous materials – Polymer foams.

Module: 5	**Special Concretes**	**9 hours**
High-Strength Concrete - High-performance concrete – Ultra High-Performance Concrete - Self-Compacting Concrete – Reactive Powder concrete – Lightweight concrete - Perforated concrete - Nano Concrete - Micro concrete – Flexible Concrete – Properties and Applications.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	Kumar Mehta, P. and Monteiro, P. J. M., Concrete: Microstructure, Properties and Materials, 2014, 4th Edition, McGraw-Hill, New Delhi, India.
2.	Neville, A. M., Properties of Concrete, 2012, Pearson, New Delhi, India.
Reference Books	
1.	Shetty, M. S., Concrete Technology, 2017, S. Chand and Company Ltd., New Delhi, India.
2.	ACI 211.1-91, Standard Practice for selecting Proportions for Normal, Heavy weight, and Mass Concrete, USA

Mode of Evaluation: CAT / Assignment / Quiz / FAT/Seminar			
Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM609	Human Resource Management	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To study various aspects of manpower planning and the organization of human resources.
2. To understand human relations within an organization, the appraisal process, and the implementation of strategies related to leadership theories and the management of work-related stress.
3. To examine motivation techniques and employee welfare measures and describe employee appraisal and assessment processes.

Course Outcomes

At the end of the course, the student will be able to:

1. Plan manpower requirements and identify the factors influencing the supply and demand of human resources.
2. Understand the operation of human resource functions, including recruitment, selection strategies, and placement.
3. Apply human relations approaches and leadership theories to address human resource challenges.
4. Analyze organizational behaviour and implement effective labour welfare measures.
5. Conduct employee appraisal and assessment processes and able to Managing New Technologies.

Module: 1	Manpower planning	8 hours

Manpower Planning process, Organizing, Staffing, directing, and controlling – Estimation, manpower requirement – Factors influencing supply and demand of human resources – Role of HR manager – Personnel Principles.

Module: 2	Organization	9 hours

Organization Hierarchical charts – Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection strategies – Placement – Training: Training of multi-skilled workforce, Assessment of training needs and methods.

Module: 3	Human Relations	9 hours

Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership – Theories - Special Human resource problems – Productivity in Industry personnel – Prevention and Management of work stress – work – life balance.

Module: 4	**Organizational Behaviour and welfare measures**	**9 hours**
Individual in organization - Motivation – Personality and creativity – Group dynamics, Team working – Communication and negotiation skills- Compensation – Safety and health – General Provident Fund (GPF) – Employee Provident Fund (EPF) – Group Insurance – Housing - Pension – Laws related to welfare measures.		
Module: 5	**Development methods**	**8 hours**
Wages and Salary, Employee benefits, Employee appraisal and assessment – Employee services – Safety and Health Management –Innovative approach to designing and managing organization – Managing New Technologies - Competency upgradation and their assessment - Performance Management.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	Stephen P. Robbins and Timothy A. Judge., Essentials of Organizational Behaviour, 2021, 15th Edition, Pearson Education Inc., USA.
2.	Gary Dessler and Biju Varrkey, Human Resource Management, 2017, 17th Edition, Pearson Education Inc., USA.
Reference Books	
1.	Andrew Dainty, Martin Loosemore, Human Resource Management in Construction: Critical Perspectives, 2012, 2nd edition, Routledge, UK
2.	David Buchanan, Andrzej Huczynski, Organizational Behaviour, 2023, 11th edition, Pearson Education, UK.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Seminar / Group discussion.

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM610	Prefabricated and Modular Construction	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To understand the principles and volumetric aspects of prefabricated and modular construction systems
2. To plan transportability and lifting requirements for off-site elements, considering factory, site and route constraints
3. To apply quality assurance and quality control frameworks, develop bespoke QA/QC schemes for modular components and utilize AI and ML techniques for optimization.
4. To schedule and sequence assembly operations, including precast and prestressed handling, stressing and post-tensioning protocols

Course Outcomes

1. Explain volumetric prefab systems and volumetric-design criteria for transport and lifting.
2. Develop transport-route and lifting-point plans that satisfy dimensional, load and regulatory requirements.
3. Design and implement QA/QC schemes in accordance with international standards and site-factory interfaces.
4. Build and train AI/ML models for constructability checks, defect detection and process optimization.
5. Prepare detailed assembly schedules and digital-twin simulations for precast and prestressed operations.

Module: 1	Introduction to Prefabrication and AI in Constructability	8 hours

Principles of volumetric vs panelized systems – Design for transportability and lifting – Factory and site interface requirements – Introduction to artificial-intelligence and machine learning in construction – Supervised-learning for design validation – Case studies of ML-driven defect detection – Genetic algorithm for layout and dimension optimization – demonstration of GA-based design-space search.

Module: 2	Transportation and Lifting Planning	9 hours

Transport-route analysis – Dimensional and weight constraints – Lifting-point design and factory rigging – Site cranage and hoisting requirements – Regulatory standards (ISO 12488, EN 1991-3) – BIM based simulation of transport and lift – Vehicle-routing optimization via Tabu Search – demonstration of Tabu Search on multi-stop delivery scheduling.

Module: 3	Quality Control and Assurance Principles	9 hours

QA/QC frameworks for off-site manufacture – ISO 9001:2015 and EN 1090 standards – Non-destructive testing methods (ultrasonic, radiography) – Statistical process control and Six Sigma – Developing QA/QC checklists and sampling plans – Supply chain-oriented contracts for quality liability – Statistical process control using Shewhart control charts – demonstration of control-limit calculation.

Module: 4	**AI and ML in Production and Constructability**	**9 hours**
Machine-vision systems for surface-defect detection – Predictive maintenance of fabrication equipment – Sensor-based monitoring of stressing operations in prestressed elements – Reinforcement layout optimization with deep-learning – Digital-twin integration for real-time quality feedback – Backpropagation algorithm in neural-network training – demonstration of model convergence and validation.		
Module: 5	**Scheduling and Sequencing Operations**	**8 hours**
Precast and prestressed element handling and care – Stressing and post-tensioning protocols – Assembly-sequence planning – Digital-twin simulation for site logistics and clash detection – Integration with off-site manufacturing production schedules – Ant Colony Optimization for assembly-sequence planning.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	Smith, R. E., Prefab Architecture: A Guide to Modular Design and Construction, 2010, 1st edition, John Wiley & Sons, UK.
2.	Lawson, R. M., Ogden, R. G. & Goodier, C. I., Design in Modular Construction, 2014, 1st edition, CRC Press, UK.
Reference Books	
1.	Abraham Warszawski, Industrialized and Automated Building Systems: A Managerial Approach, 1999, 2nd edition, Routledge (Taylor & Francis Group), UK.
2.	Jack S. Goulding & Farzad Pour Rahimian (eds.), Offsite Production and Manufacturing for Innovative Construction: People, Process and Technology, 2019, 1st edition, Routledge, UK.
3.	Abdul Razzak Rumane, Quality Management in Construction Projects, 2019, 2nd edition, Taylor & Francis Group, UK.
4.	Australian Building Codes Board, Prefabricated, Modular and Offsite Construction Handbook, 2024, Australian Building Codes Board.
5.	Precast/Prestressed Concrete Institute (PCI), PCI Design Handbook: Precast and Prestressed Concrete, 2021, 8th edition, Precast / Prestressed Concrete Institute.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM611	Environmental Impact Assessment	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives:

1. To understand the concepts of EIA and also emphasis the role of engineers in EIA and Environmental impact factors.
2. To know the legislation to be used for the enforcement of emphasized acts and the role of public participation.
3. To discuss the methods to be used in EIA and legal systems related to environmental management systems for cleaner production and sustainable development.
4. To know the impacts on different environments, draft an EIA for specific projects and understand the mitigation and monitoring methods.

Expected Course Outcome:

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

1. Explain the philosophy and art of environmental management systems.
2. Role of government in approving the projects and the laws to be enforced.
3. Apply the mechanism of EIA for project appraisal and suggest suitable methods for handling the data collected during the EIA processes.
4. Possible impacts that could occur on physical, biological, and human resources by the project.
5. To understand the difference between theory and practice for writing an EIA report.

Module: 1	Environmental Impact Assessment (EIA)	6 hours

EIA for Environmental Engineers–Environmental Impact Statement – Environmental Appraisal–Environmental Impact Factors.

Module: 2	EIA Legislation	7 hours

Criteria and Standards for Assessing Significant Impacts – Risk Assessment – Public Participation and Involvement.

Module: 3	EIA Process and Methods	12 hours

Criteria for selecting EIA Methodology – Screening – Scoping – Predictive Models for Impact Assessment – Mitigation, Monitoring, Auditing, Evaluation of Alternatives and Decision Making – Methods of Strategic Environmental Assessment, Environmental management plan.

Module: 4	Prediction and Assessment of Impacts on Different Environments and Human Resources	15 hours

Geology – Soils, Minerals, Climate, Water Resources, Water Quality, Air Quality, Noise; Terrestrial Ecosystems – Wetlands, Aquatic Ecosystems, Threatened and Endangered Species; Demographics – Economics, Land Use, Infrastructure, Archaeological and Historic, Visual, and Safety.

Module: 5	EIA Case Studies	5 hours
Environmental Impact of Industrial Development – Management Requirements for the Preparation of EIA for industrial projects – Preparation of EIA of Land Clearing Projects – Assessment of Traffic and Transportation Impacts.		
Module: 6	**Contemporary issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)	
1.	Canter, L.W., Environmental Impact Assessment, 1996, 1st Edition, McGraw-Hill, New York, NY, USA.
2.	Morris, P., and Therivel, R. (Eds.), Methods of Environmental Impact Assessment, 2009, 3rd Edition, Routledge–Taylor & Francis Group, Abingdon, UK.
3.	Mareddy, A., Environmental Impact Assessment – Theory and Practice, 2017, B.S. Publications, Hyderabad, India.
4.	Anjaneyulu, Y., and Manickam, V., Environmental Impact Assessment Methodologies, 2020, 3rd Edition, BS Publications / BSP Books, Hyderabad, India.

Reference Book(s)	
1.	Petts, J., Handbook of Environmental Impact Assessment – Volume 1 & 2, 1999, Blackwell Science Ltd., Oxford, UK.
2.	Eccleston, C.H. (Ed.), Environmental Impact Assessment: A Guide to Best Professional Practices, 2011, CRC Press, Boca Raton, FL, USA.

Mode of evaluation: CAT / Assignment / Quiz / FAT / Seminar / group discussion.

Recommended by Board of Studies	28-05-2025		
Approved by Academic Council	No. 78	**Date**	12-06-2025

MACTM612	Energy Efficient Building	L	T	P	C
		3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Understand the Principles of Energy Efficiency in Buildings.
2. Analyze climatic data and building orientation to reduce energy consumption in buildings.
3. Evaluate the thermal performance of buildings.
4. Interpret and implement energy codes to design sustainable buildings and optimize energy saving opportunities in existing buildings.

Course Outcomes

1. Understand energy consumption, thermal comfort, and climate-responsive design principles in buildings.
2. Apply passive and active strategies to enhance energy performance in buildings.
3. Analyze building envelope performance using material properties, insulation, and solar orientation.
4. Understand theoretical methods for assessing energy performance and interpret audit data to suggest efficiency improvements in systems like HVAC and lighting.
5. Compare and apply Certification systems and ASHRAE standards in building design.

Module: 1	Principles of Energy Efficiency in Buildings	9 hours

Introduction to energy conservation and efficiency in buildings - Heat transfer mechanisms and their impact on energy usage - Energy use patterns and performance benchmarks in buildings - Microclimatic factors influencing design and occupant comfort - Thermal comfort models- adaptive comfort, PMV, and PPD - Fundamentals of orientation and building form for energy optimization.

Module: 2	Climate Responsive Design and Passive Strategies	9 hours

Climatic zone - specific design responses - cold, hot-dry, composite, humidity, and temperature - Passive cooling and heating methods - shading, ventilation, thermal mass - Site and orientation - based energy strategies - Designing with natural energy flows for improved performance - Integrating early - stage renewable energy principles - Basics of simulation tools for passive design analysis.

Module: 3	Building Envelope Systems and Retrofit Technologies	8 hours

Role of walls, roofs, and openings in building thermal performance - Advanced materials - insulation types, glazing, and thermal breaks - Fenestration design for daylighting and thermal control - Overview of energy - efficient HVAC systems and zonal control - Retrofit strategies for envelope and mechanical systems - Transitioning buildings toward net - zero goals through retrofits.

Module: 4	Lighting, Renewable Energy, and Smart Systems	8 hours
Efficient lighting systems and daylight-responsive design - Integration of renewable energy-PV systems and solar thermal - Energy storage and net metering considerations - Smart technologies for building automation and energy monitoring - Intelligent control systems for lighting, HVAC, and overall energy use - Case applications of smart energy systems in modern buildings.		
Module: 5	**Codes, Ratings, Audits, and Implementation Practices**	**9 hours**
Fundamentals of energy auditing and assessment methods - Overview of energy codes and standards (ECBC, ASHRAE, NBC) - Certification systems- LEED, GRIHA, BEE Star Ratings - Economic and environmental impact of energy - efficient practices - Real-world projects- case studies of efficient and smart buildings - Addressing implementation barriers and practical strategies.		
Module: 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**45 hours**

Text Book(s)	
1.	Hu, M., Net Zero Energy Building: Predicted and Unintended Consequences, 2019, 1st Edition, Routledge, Abingdon, UK.
2.	Keeping, M., and Shiers, D., Sustainable Building Design: Principles and Practice, 2017, 1st Edition, Wiley-Blackwell, Hoboken, NJ, USA.
Reference Books	
1.	Lechner, N., Heating, Cooling, Lighting: Sustainable Design Methods for Architects, 2021, 5th Edition, Wiley, Hoboken, NJ, USA.
2.	Jayamaha, L., Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance, 2006, 1st Edition, McGraw-Hill, New York, NY, USA.
3.	Kwok, A.G., and Grondzik, W.T., The Green Studio Handbook: Environmental Strategies for Schematic Design, 2018, 3rd Edition, Routledge, Abingdon, UK.
4.	Bureau of Energy Efficiency (BEE), Energy Conservation Building Code (ECBC), 2017, Ministry of Power, Government of India, New Delhi, India.
5.	ASHRAE, ASHRAE Handbook – HVAC Systems and Equipment, 2024, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Atlanta, GA, USA.
6.	International Living Future Institute (ILFI), Whole Building Life Cycle Assessment: Reference and Guidance, 2020, International Living Future Institute, Seattle, WA, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT/ Group discussion			
Recommended by Board of Studies	28-05-2025		
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