COEP Technological University

(Unitary Public University of Government of Maharashtra)

Wellesely Road, Shivajinagar, Pune - 411005

Department of Civil Engineering

Curriculum

(Structure, Evaluation Scheme and Course Content)

For

Post Graduate Program

Master of Technology

In

Construction Management

With Effect From

Academic Year 2025-2026

Master of Technology

Construction Management

Program Educational Objectives (PEOs)

I. Succeeding in development of career in the field of construction management and / or higher studies by acquiring knowledge in quantitative management analysis, research methodology, construction planning and techniques.

II. Analyze and optimize Civil engineering systems with social awareness and responsibility.

III. Exhibit professionalism, ethical approach, leadership, communication skills, team work in their profession and adapt to modern trends by engaging in lifelong learning.

Program Outcomes (POs)

The post-graduate students will demonstrate:

PO1. An ability to independently carry out research /investigation and development work to solve practical problems

PO2. An ability to write and present a substantial technical report/document

PO3. 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 bachelor program.

PO4. Adopt the relevant knowledge and cutting-edge technologies through lifelong learning process and acquire professional and intellectual integrity, professional code of conduct, ethics understanding of the social responsibility for sustainable development of society.

PO5. Observe and examine critically the outcomes of referred problem and make corrective measures subsequently and learn from mistakes.

Correlation between the PEOs and the POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
PEO 1	3	2	3	2	2
PEO 2	2	1	2	3	3
PEO 3	2	3	2	3	2

Master of Technology

Construction Management Curriculum Structure

List of Abbreviations

Abbreviation	Title	No of courses	Credits	% of Credits
PSMC	Program Specific Mathematics Course	1	4	5
PSBC	Programme Specific Bridge Course	1	3	3.75
PCC + LC	Programme Core Course + Laboratory Course	8	24	30
PEC	Programme Elective Course	3	9	11.25
OJT	On Job Training	1	3	3.75
OE	Open Elective	1	3	3.75
LLC	Liberal Learning Course	1	1	1.25
SLC	Self Learning Course	2	6	7.5
RM	Research Methodology	1	3	3.75
AEC	Ability Enhancement Course	1	2	2.5
Project	Project	2	22	27.5
	Total	**22**	**80**	**100**

M.Tech. Civil- Construction Management

NEP Curriculum Structure: 2025-26

Semester I

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	PSMC	CM-25001	Probability & Data Analysis	3	1	-	1	4	30	20	50	-	-
2	PSBC	CM-25002	Construction Project Planning and Management	2	-	2	1	3	30	20	50	50	50
3	PCC	CM-25003	Construction Material & Material Management	3	1	-	1	4	30	20	50		
4	PCC	CM-25004	Construction Equipment and Machinery	3	-	-	1	3	30	20	50		
5	PCC	CM-25005	Building Information Management	3	-	-	1	3	30	20	50		
6	PCC	CM-25006	Program Laboratory Course - I	-	-	4	-	2	-	-	-	50	50
7	PEC-1	CM(PE)-25001	*Program Specific Elective Course – I* 1. Application of Geoinformatics in Civil Engineering 2. Project Economics & Financial Management 3. Sustainable Construction 4. Quantitative methods in construction management 5. Functional Planning, Building Services, and Maintenance	3	-	-	1	3	30	20	50	-	-
8.	RM	SET-25001	Research Methodology	3	-	-	1	3	30	20	50	-	-
Total Credits				**25**									

Legends:

L-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits, **ISE**: In-Semester-Evaluation, **ESE**: End-Semester-Evaluation, **MSE**: Mid-Semester Evaluation, **TA**: Teacher's Assessment, **CIE**: Continuous-Internal-Evaluation

Semester II

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	OE	<tbd>	Open Elective	3	-	-	1	3	30	20	50	-	-
2	PCC	<tbd>	Construction Cost Dynamics	3	-	2	1	4	30	20	50	50	50
3	PCC	<tbd>	Construction Techniques	3	-	-	1	3	30	20	50	-	-
4	PCC	<tbd>	Professional Practices in Construction	3	-	-	1	3	30	20	50	-	-
5	PEC-2	<tbd>	*Program Specific Elective Course – II* 1. Total Quality Management and MIS in Construction 2. Conservation and Management of Heritage Structures 3. Advanced Optimisation Techniques in Construction Management 4. Soft Computing Techniques 5. Underground Opening	3	-	-	1	3	30	20	50	-	-
6	PEC-3	<tbd>	*Program Specific Elective Course – III* 1. Environmental impact assessment 2. Construction Safety and Human Resource Development in Construction 3. Infrastructure Development and Management 4. Application of Artificial Intelligence and Machine Learning in Construction Management 5. Road Safety and Road Safety Audit	3	-	-	1	3	30	20	50	-	-
7	PCC	<tbd>	Program Laboratory Course - II	-	-	4	-	2	-	-	-	50	50
8	AEC	<tbd>	Technical Communication Skills	1	-	2	1	2	50	50	-	100	
9	LLC	<tbd>	Liberal Learning Course	-	-	2	2	1	-	-	-	100	-
			Total Credits	**24**									

- ***Exit option to qualify for PG Diploma in Civil- Construction Management***:
Eight weeks domain-specific industrial internship in the month of June-July after successfully completing the first year of the program

Semester III

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	SLC	<tbd>	Massive Open Online Course –I	3	-	-	1	3	-	-	100	-	-
2	SLC	<tbd>	Massive Open Online Course –II	3	-	-	1	3	-	-	100	-	-
3	OJT	<tbd>	Internship	-	-	-	-	3	-	-	100	-	-
4	Project	<tbd>	Dissertation Phase – I	-	-	22	12	11	-	-	-	70	30
Total Credits				**20**									

Semester IV

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	Project	<tbd>	Dissertation Phase – II	-	-	22	12	11	-	-	-	70	30
Total Credits				**11**									

SEMESTER – I

Probability and Data Analysis

Course Code: CM-25001		**Credit: 4**	
Teaching Scheme: Hrs/Week		**Examination Scheme:**	
Lectures:	3	MSE:	30
Tutorial:	1	TA:	20
Self-Study:	1	ESE:	50

Course Outcomes: At the end of the course, the students demonstrate the ability to:

1. Acquire skills to perform engineering research using statistical methods and becoming capable of estimating mathematical expectations.
2. Learn the fundamental concepts of set theory and interpret probability and data distribution functions.
3. Analyze regression and correlation analysis and development of statistical models.
4. Acquire theoretical knowledge on setting hypothesis for pattern recognition.
5. Apply suitable machine learning techniques for data handling and to gain knowledge from it.

Unit 1: Introduction to Statistical Methods **[8 Hrs]**

Statistical methods, scope and limitations, Frequency distributions, Graphic representation, Measures of central tendency, Partition values, Graphical location of partition values, Measures of dispersion, skewness and kurtosis

Unit 2: Theory of Probability **[8 Hrs]**

Introduction, Mathematical tools, Axiomatic approach, Probability function, Multiplication law of probability and conditional probability, Bayes theorem, Random variable, Distribution function, Probability density function.

Unit 3: Correlation and Regression **[8 Hrs]**

Curve fitting, Principle of least squares, Karl Pearson coefficient of correlation, Probable error of correlation coefficient, Rank correlation, Regression, Correlation ratio, Intra-class correlation, Bivariate normal distribution.

Unit 4: Sampling and Statistical Inference **[8 Hrs]**

Sampling -Introduction and types, Tests of significance, Null hypothesis, Errors in sampling, Chi-square distribution, t-distribution, F-distribution, Likelihood ratio test, Mann-Whitney-Wilcoxon U-test

Unit 5: Statistical Machine Learning Techniques **[8 Hrs]**

Linear regression, Logistic regression, Decision trees, Random forest, Support vector machines (SVM), K- nearest neighbors (KNN), Neural network, Kernal function, K-means clustering, K-mode clustering, Genetic algorithm

Unit 6: Self-Study

Mean, Median, Mode, Frequency tables, Histograms, Theoretical and experimental probability, Basic probability rules including sample spaces and events, Concept of random variables, Combinations and permutations, Probability distributions, Different sampling methods, Hypothesis testing, Predictive models, Stochastic Processes, Learning Models, Supervised and unsupervised learning, Study of different statistical machine learning techniques, Study of statistical techniques using software such as MATLAB, R Programming

Tutorial

Foundations of Probability, Python: *SciPy.stats tutorial* (probability distributions, PDF, CDF, sampling), NPTEL – Probability Methods in Civil Engineering (IIT Madras), NPTEL – Linear Regression Models (IIT Madras), MATLAB: Tutorials on confidence intervals, t-test, chi-square test, ANOVA

Textbooks:

[1] D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, 5th Edition, John Wiley & Sons, Inc., NY, USA, 2011

[2] S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical statistics, Sultan Chand and Sons, 1978.

[3] Alpaydin, Introduction to Machine Learning, MIT Press.

[4] Masashi Sugiyama**,** Introduction to Statistical Machine Learning, Elsevier, USA, 2016

Reference Books:

[1] S. M. Ross, Introduction to Probabiltity Models,8th edition. Academic Press, 2004

[2] Mitchell, Machine Learning, McGraw Hill.

[3] Glen Cowan, Statistical Data Analysis, Clarendon Press , Oxford, 1998

[4] S. Dowdy, S. Wearden, and D. Chilko, Statistics for Research, Wiley, 2nd ed, 2004.

Web Resources:

[1] Probability and Statistics by Prof. Somesh Kumar, IIT Kharagpur (NPTEL) https://onlinecourses.nptel.ac.in/noc21_ma74/preview

[2] Introduction to Statistics by Prof. Sameen Naqvi, IIT Hyderabad (NPTEL) https://onlinecourses.nptel.ac.in/noc24_ma30/preview

[3] Statistical Inference by Prof. Niladri Chatterjee, IIT Delhi (NPTEL) https://onlinecourses.nptel.ac.in/noc20_ma19/preview

[4] Introduction to Machine Learning by Prof. Balaraman Ravindran, IIT Madras (NPTEL) https://onlinecourses.nptel.ac.in/noc22_cs29/preview

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	2
CO2	3	2	3	2	3
CO3	3	2	3	2	2
CO4	3	3	3	2	3
CO5	3	2	3	3	2

1 – Slightly; 2 – Moderately; 3 - Substantially

Construction Project Planning and Management

Course Code:CM-25002	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 2	MSE: 30
Self-Study: 1	TA 20
Practical: 2	ESE: 50

Course Outcomes: Students will be able to:

1. Evaluate time–cost trade-offs of construction resources for effective project delivery.
2. Investigate and analyze practical applications of construction management in real projects.
3. Analyse modern project planning and management practices for complex projects.
4. Design and create optimized construction project schedules.
5. Apply advanced project management techniques using software tools to analyze and control projects.

Unit 1: **[7 Hrs]**

Project Management -Basic forms of organization. Work breakdown structure, estimating duration of an activity, Construction scheduling using Gantt chart, milestone chart

Unit 2: **[7 Hrs]**

Scheduling methods (AOA and AON),CPM, PERT, Precedence network (PNA), GERT, Ladder, Line of Balance technique

Unit 3: **[7 Hrs]**

Updating of schedule, time-cost trade-offs. Resource-constrained scheduling and resource levelling. Applications of CPM/PERT, Site layout, and mobilization,

Unit 4: **[7 Hrs]**

Statistical concepts: Charts, Work Study- time and motion study

Self-Study:

Management approaches in construction: traditional vs. modern scientific management; principles of management; success and failure factors; management theories; role of planning department; construction project life cycle.

References:

[1] Sengupta and Guha, Construction Management and Planning, Tata McGraw-Hill Publication.

[2] K Nagrajan, Project Management, New Age International Limited.

[3] Barrie & Paulson, Professional Construction Management, McGraw-Hill Institute Edition.

[4] Roy, Pilcher Construction Management

[5] Jha, Construction Project Management, Theory and Practice, Pearson

[6] Chitkara, Construction Project Management – Planning, Scheduling, and Controlling

[7] Harris and McCaffer, Modern Construction Management

[8] Pilcher R. (1966). Principles of Construction Management. McGraw-Hill Publishing Co. Ltd

[9] O'Brien, Plotnick, CPM in Construction Management, McGraw-Hill

[10] Harris, F., McCaffer, R., Baldwin, A., & Edum-Fotwe, F. (2021). Modern construction management. John Wiley & Sons.

[11] Fewings, P., & Henjewele, C. (2019). Construction project management: an integrated approach. Routledge.
[12] Mubarak, S. A. (2015). Construction project scheduling and control. John Wiley & Sons.
[13] Jha, K. N. (2015). Construction Project Management. 2nd Edition. Pearson Publishers.
[14] Goetsch, D. L. (2014). Project management for construction. Pearson Higher Ed.
[15] Baldwin, A., & Bordoli, D. (2014). Handbook for construction planning and scheduling. John Wiley & Sons.
[16] Whyte, A. (2014). Integrated design and cost management for civil engineers. CRC Press.
[17] Ottosson, H. (2012). Practical project management for building and construction. CRC Press.
[18] Schexnayder, C. J., & Mayo, R. E. (2008). Construction management fundamentals. McGraw-Hill Professional.

Suggested List of Assignments in the Laboratory:

Assignment 1: Theories, Principles and Functions of Management
Assignment 2: Examples of PERT, CPM
Assignment 3: Time-cost trade off, Resource leveling, and smoothing
Assignment 4: Precedence network

The lab assignments shall be performed by using project management software such as MSP/ PRIMAVERA:
Project Planning Assignments: The students shall be assigned one project and perform the following-

- **Project Plan Creation:** Develop a comprehensive project plan that includes defining project scope, setting clear goals, and identifying key deliverables.
- **Work Breakdown Structure (WBS):** Break down the overall project into smaller, manageable tasks and sub-tasks to create a detailed WBS.
- **Project Schedule & Timeline:** Map out the project timeline, establishing milestones, sequencing activities, and setting realistic schedules.
- **Preparation of Resource Plan and time Plan of the project:** Identify and allocate the required resources—manpower, materials, equipment, and budget—and develop a detailed time plan to ensure efficient execution of all project activities.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	3
CO2	3	2	3	2	3
CO3	3	2	3	3	2
CO4	3	2	3	2	3
CO5	3	2	3	3	2

1 – Slightly; 2 – Moderately; 3 - SubstantiallyZZZ

Construction Materials and Materials Management

Course Code: CM-25003		**Credit: 4**	
Teaching Scheme: Hrs/Week		**Examination Scheme:**	
Lectures:	3 Hrs/ week	MSE: 30	CIE: 100
Tutorial:	1	TA 20	
Self-Study:	1	ESE: 50	

Course Outcomes: At the end of the course, the students demonstrate the ability to:

1. Select appropriate materials for various structural and non-structural applications.
2. Analyse the material management techniques for optimizing and handling processes.
3. Assess vendor performance based on quality, cost, and delivery.
4. Develop and evaluate strategies for cost reduction and value improvement.
5. Execute quality control measures using modern testing and assessment methods.

Unit 1: Special Construction Materials [8 Hrs]

Special Construction Materials, Material selection criteria, their properties, mode of transport and receipt, Testing at site, inspection procedures.

Unit 2: Material Management [8 Hrs]

Monitoring effectiveness of MM, Inventory management, procurement Management Store Management, Vendor management & ERP systems.

Unit 3: Vendor Analysis [8 Hrs]

Vendor Selection Process, Evaluation Techniques, Relationship Management, Risk & Compliance Management, ERP systems

Unit 4: Value Analysis [8 Hrs]

Function, Job plan, Tools & Techniques, Implementation & Challenges, Applications in Construction.

Unit 5: Classification and Codification of materials [8 Hrs]

Material coding systems, Barcoding, RFID, and BIM integration.

Self-Study

LCA, waste reduction, industrial by-products, green materials, LEED/IGBC certifications.

Textbooks:

[1] Construction Materials, Methods and Techniques: Building for a Sustainable Future, William P. Spence & Eva Kultermann.
[2] Construction Materials Management Process**,** George Stukhart.
[3] Value Management of Construction Projects, John Kelly, Steven Male, and Graham.
[4] Green Building Materials, Construction and Sustainability, Dr. Ramya Muthusamy, Dr. Thang Prakash Sengodan.

Reference Books:

[1] Ghose, Materials of Construction' by, Tata- McGraw Hill Publication.
[2] Gopalkrishnan, Handbook of Materials management, Prentice Hall Publication.
[3] A.K. Dutta, Materials Management.
[4] Dean S. Ammer, Materials Management and Purchasing, Taraporevala Publications.
[5] B.K. Roy Chowdhury, Management of Materials, S. Chand & Sons.
[6] Deb, Materials Management.
[7] Lee and Dobler, Purchasing and Material Management, McGraw Hill Publications.
[8] P. Gopalakrishnan and Sundaresan, Materials Management An integrated Approach, Prentice Hall of India.
[9] K.S. Menon Purchasing and Inventory Control, Wheeler Publishing.
[10] Magee and Boodman, Production, Planning & Inventory Control.

Web Resources:

[1] NPTEL – Building Materials and Construction
https://nptel.ac.in/courses/105/102/105102088/

[2] Procurement and Sourcing
https://www.edx.org/

[3] Business Analysis & Process Improvement
https://www.coursera.org/learn/process-analysis

[4] Smart Logistics and RFID
https://www.edx.org/course/the-future-of-logistics

[5] NPTEL – Sustainable Materials and Green Buildings
https://nptel.ac.in/courses/105/104/105104181/

Suggested List of Assignments in Tutorial:

[1] Perform on-site testing and inspection of selected special construction materials (e.g., high-performance concrete, Fiber-reinforced composites). Document material properties and evaluate compliance with standards.

[2] Simulate inventory management and procurement processes using software tools or spreadsheets. Track material inflows/outflows and analyze procurement efficiency.

[3] Conduct a mock vendor evaluation using given data sets. Apply evaluation techniques (e.g., scoring models) and prepare a vendor selection report.

[4] Select a construction activity or material and perform a value analysis exercise. Identify functions, evaluate alternatives, and propose cost-effective solutions.

[5] Develop a material coding system for a sample project. Create barcodes or RFID tags and demonstrate integration with a BIM model or inventory system.

[6] Perform a Life Cycle Assessment (LCA) of a selected construction material using LCA software/tools. Analyze waste reduction strategies and evaluate green certifications (LEED/IGBC).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	3
CO2	3	2	3	2	3
CO3	3	2	3	2	2
CO4	3	2	3	3	2
CO5	3	2	3	3	3

1 – Slightly; 2 – Moderately; 3 – Substantially

Construction Equipment and Machinery

Course Code:CM-25004	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
	ESE: 50

Course Outcomes: Students will be able to:

1. Classify and select suitable construction equipment for different projects.
2. Analyse equipment productivity and performance efficiency.
3. Evaluate equipment life cycle and replacement policies.
4. Develop cost models for owning and operating equipment.
5. Apply numerical methods to support equipment-related decisions.

Unit 1: Economics of Construction Equipment [9 Hrs]

Identification, planning, and equipment management in projects. Various costs associated with equipment. Rent and Leave Consideration, Numerical Problems on Cost Calculations, Depreciation Methods, and Replacement Analysis.

Unit 2: Earthmoving and Compaction Equipment [8 Hrs]

Types of earthmoving equipment. Productivity and Selection Factors for Earthmoving Equipment. Compaction equipment – rollers, rammers, vibratory equipment.

Unit 3: Drilling, Blasting, and Material Handling Equipment [8 Hrs]

Equipment for drilling and blasting operations. Cranes, hoists, conveyors, pumps, bins, and batching plants. Equipment for hauling, pouring, and transporting materials. Screening and crushing equipment

Unit 4: Concrete and Road Construction Equipment [7 Hrs]

Equipment for batching, mixing, placing, and compaction of concrete. Road construction equipment – asphalt plants, pavers, compactors. Bridge construction and tunneling equipment.

Unit 5: Equipment Selection, Equipment Productivity and Performance Analysis [8 Hrs]

Technical and economic factors influencing equipment selection. Case studies on equipment usage and economics. Productivity of construction projects. Methods of measuring the productivity of different equipment. Case studies on productivity improvements.

Unit 6: Self-Study

Emerging trends: automation, remote-controlled equipment, Artificial Intelligence (AI), Internet of Things (IoT), sustainable equipment, safety features, and ergonomics.

Textbooks:

1. Robert L. Purifoy and Clifford J. Schexnayder, Construction Planning, Equipment and Methods, McGraw-Hill Publication, Sixth Edition, 2002.
2. Singh Bhopinder, Construction Equipment Management, Pearson Education and IBH Publishing Co. Ltd, New Delhi, Second Edition.
3. Varma M., Construction Equipment and its Planning and Application, Metropolitan Book Co., Reprint Edition.
4. Sharma S.C. and Bansal S.K., Construction Machinery and Equipment Management, Khanna Publishers, New Delhi.

Reference Books:

[1] CECR's (Construction Engineering Construction Reviews) manuals on machinery management.
[2] Frank Harris and Ronald McCaffer, Management of Construction Equipment, Macmillan Publication.
[3] Nunnally, S.W., Construction Methods and Management, Pearson, 8th Edition.
[4] Jagman Singh, Heavy Construction Planning, Equipment and Methods, Oxford & IBH Publishing.

Web Resources:

[1] NPTEL Online Courses on Construction Planning and Management – https://nptel.ac.in
[2] Federal Highway Administration (FHWA) – Construction Equipment Guidelines – https://www.fhwa.dot.gov
[3] Construction Industry Development Council (CIDC), India – https://cidc.in
[4] Occupational Safety and Health Administration (OSHA), USA – Construction Equipment Safety Guidelines – https://www.osha.gov
[5] International Journal of Construction Engineering and Management – https://www.sciencedirect.com/journal/journal-of-construction-engineering-and-management

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	3
CO2	3	2	3	2	3
CO3	3	2	3	2	3
CO4	3	2	3	3	2
CO5	3	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Building Information Management

Course Code:CM-25005	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab: 0	ESE: 50

Course Outcomes: Students will be able to:

1. Explain BIM concepts, standards, and maturity levels.
2. Analyze BIM processes, workflows, and collaboration.
3. Apply BIM in architecture, structure, and MEP design.
4. Evaluate BIM for planning, scheduling, cost, and sustainability.
5. Assess BIM use in facility management and emerging trends

Unit 1: BIM Fundamentals [7 Hrs]

Difference between CAD and BIM models., BIM maturity levels and their significance., National and international BIM standards, Benefits of BIM for stakeholders, Risks and challenges in BIM implementation.

Unit 2: BIM Processes and Workflows [7 Hrs

BIM lifecycle, project delivery methods using BIM, roles and responsibilities in BIM projects, information exchange and data standards (IFC, COBie), collaboration strategies, common data environment (CDE), Level of Development (LOD), BIM Execution Plan (BEP).

Unit 3: BIM for Design Disciplines [8 Hrs]

Application of BIM in architecture, structural engineering, and MEP systems, HVAC Systems, interdisciplinary coordination, clash detection principles, clash detection using Autodesk Navisworks (4D BIM), and integrated design process.

Unit 4: BIM for Construction Management [8 Hrs]

BIM in project planning and scheduling (4D BIM), Linking BIM models with project schedules, Traditional and BIM-Based Cost Estimation, Cost estimation and management using BIM (5D BIM), RA Bill preparation and validation using BIM, BIM-based Sustainability and energy analysis (6D BIM).

Unit 5: BIM for Facility and Asset Management [8 Hrs]

BIM in operations and maintenance phase, Facility Management (FM) strategies using BIM, Data requirements for FM and asset management, Life-cycle cost optimisation and predictive maintenance, BIM for renovation and retrofitting, Integration with digital twins for real-time monitoring.

Self-Study

Current global and Indian state of BIM adoption, Virtual reality (VR) and augmented reality (AR) in BIM, digital twins, 3D printing integration, prefabrication and modular construction, robotic construction, artificial intelligence in BIM applications, and the future roadmap of BIM.

Textbooks:

[1] Brad Hardin and Dave McCool, BIM and Construction Management: Proven Tools, Methods, and Workflows, Wiley, 2nd Edition.

[2] Eastman, C. M. (2008). BIM handbook : a guide to building information modeling for owners, managers, designers, engineers, and contractors. Wiley.

Reference Books:

[1] Willem Kymmell, *Building Information Modelling*, McGraw-Hill Construction, New York, 2008.

[2] BS 1192:2007, A2:2016 Collaborative production of AEC information, Code of practice.

[3] PAS 1192-2: Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling.

[4] AEC (UK) BIM Technology Protocol, Version 2.1.1, 2015.

[5] Marcus Kim, Lance Kirby, Eddy Krygiel, *Mastering Autodesk Revit for Architecture*, Wiley.

[6] Updated to align with current industry protocols, specification and documents.

[7] AEC(UK) BIM Protocol for Autodesk Revit, version 2.0 ,2012.

[8] Sham Tickoo , Exploring Autodesk Revit 2017 For Structure 2017.

[9] Sham Tickoo , Exploring Autodesk Revit 2017 for MEP 2017. Brad Hardin , Dave

[10] Mccool, BIM and Construction Management: Proven Tools, Methods and Workflows, 2ed, 2015.

Web Resources:

[1] Official Autodesk Revit Knowledge Network – https://knowledge.autodesk.com/

[2] National BIM Standard – US (NBIMS-US) – https://www.nationalbimstandard.org/

[3] buildingSMART International – https://www.buildingsmart.org/

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	-	2	3	-	-
CO2	3	-	3	-	2
CO3	3	-	3	-	-
CO4	3	-	3	3	3
CO5	-	-	3	3	-

1 – Slightly; 2 – Moderately; 3 - Substantially

Construction Management Lab -I

Course Code: CM-25006 **Credit: 2**

Teaching Scheme: Hrs/Week **Examination Scheme:**

Lectures: 0 Lab ISE: 50 (CIE)

Practical: 4 Lab ESE: 50

Course Outcomes: Students will be able to:

1. Develop 3D models integrating architectural and structural components.
2. Integrate project schedules with models to visualize construction sequences.
3. Prepare cost estimates, BOQs, and cash flow linked with project data.
4. Document and report construction practices through project work and field visits.

A. Assignments & Tasks

1. **3D Modelling (Revit Architecture / Tekla Structures):**
   - Model architectural model of the project.
   - Ensure correct use of levels, grids, families, and parametric elements.
   - Export the 3D model in IFC/compatible formats.
2. **4D Simulation (Scheduling Integration):**
   - Develop a detailed Work Breakdown Structure (WBS).
3. **5D Cost Estimation & BOQ Preparation:**
   - Extract quantities from BIM model.
   - Prepare Bill of Quantities (BOQ)
   - Integrate cost data with 3D/4D model for 5D BIM.

B. Materials Quality Evaluation Experiments

C. Field Visit

Students will undertake field visits to active construction projects and prepare a comprehensive report highlighting construction processes, project management practices, safety, quality control, and resource management from a construction management perspective.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	3	2
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	2	3
CO5	2	3	2	2	2

1 – Slightly; 2 – Moderately; 3 - Substantially

Applications of Geoinformatics in Civil Engineering

Course Code: CM(PE)-25001		**Credit:**	3
Teaching Scheme		**Examination Scheme**	
Lectures:	3 Hrs	MSE:	30
Self-Study:	1 Hrs	TA:	20
Tutorial:	0	ESE:	50

Course Outcomes: Students will be able to:

1. Apply the fundamental principles of remote sensing, sensor characteristics, and data acquisition techniques to interpret various satellite images and geospatial datasets.
2. Analyze multispectral satellite imagery using band combinations, image interpretation elements, and ground truth data to extract meaningful land features and patterns.
3. Apply and evaluate digital image processing techniques—such as radiometric correction, geometric correction, contrast enhancement, and PCA—to improve image quality for geospatial applications.
4. Analyze GIS data models, projections, and spatial analysis tools, and evaluate their suitability for solving real-world geospatial and civil engineering problems.
5. Apply GPS surveying methods and develop integrated Geoinformatics solutions combining RS–GIS–GPS tools for civil engineering applications such as mapping, monitoring, and infrastructure planning.

Unit 1: Basics of Geoinformatics and Remote Sensing [4 Hrs]

Introduction to Geoinformatics (RS- GIS-GPS), Fundamental of Remote Sensing History, Type of Remote Sensing, Remote Sensing platforms and sensors, Data acquisition through various platforms, Cameras and sensor parameters.

Unit 2: Satellite Data and Image Analysis [8 Hrs]

Elements of satellite images, Concept of bands, pixel, digital number, metadata, Multispectral Remote Sensing, False color composite, Interpretation of multispectral image, Combination of sensors, Image interpretation parameters, Ground truths.

Unit 3: Digital Image Processing [6 Hrs]

Atmospheric, radiometric, geometric corrections, Histograms, Density slicing, Contrast stretching, Principle component analysis, Basics of digital image processing techniques

Unit 4: Geographic Information Systems (GIS) [8 Hrs]

Introduction to GIS, Components of GIS, Hardware and software, GIS functionality, Data capture, management, analysis and visualization, Projections and georeferencing, Concepts of projections, Types of projections and their applications, Topological data model, TIN, spaghetti, polygon structure data models, Digitization processes

Unit 5: Global Positioning System (GPS) and Applications of Geoinformatics [10 Hrs]

Introduction to GPS, Fundamental concepts, Coordinates and reference systems, Components of GPS system, GPS for land navigation and survey reconnaissance, Static / Differential Positioning, Dynamic / Kinematic Positioning, GPS equipment, National GPS applications. Applications of geoinformatics in civil engineering.

Unit 6: Self-Study

Case studies on Geoinformatics applications in civil engineering, Exploration of open-source software (QGIS, Google Earth Engine), Review of recent developments (drones, LiDAR, cloud-based platforms), Study of national initiatives (NRSC, ISRO Bhuvan portals)

Textbooks:

[1] Remote Sensing and Image Interpretation by Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman

[2] Geographic Information Systems and Environmental Modeling by Clarke, Keith C., Bradley O. Parks, and Michael P. Crane. Upper Saddle River, NJ: Prentice Hall, 2002.
[3] Principles of Remote Sensing- Edition: ITC Educational Textbook Series 2, Publisher: ITC, nschede Editors: N. Kerle, L.L.F. Janssen, G.C. Huurneman.

Reference Books:

[1] Bhatta, B. (3 Nov 2011). Remote Sensing and GIS (ISBN 019569239X, 9780195692396 ed.). University of Minnesota: Oxford University Press, 2008

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	2
CO2	3	2	3	2	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Project Economics & Financial Management

Course Code: CM(PE)-25002	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
	ESE: 50

Course Outcomes: Students will be able to:

1. Analyze fundamental economic principles and their application in construction projects.
2. Apply financial tools for project evaluation, cost planning, and budgeting.
3. Design financial strategies including capital structure, taxation, and risk management.
4. Evaluate project economics through case studies of infrastructure and PPP projects

Unit 1: Principles of Economics and Capital Management [8 Hrs]
Concepts of economics in construction, objectives of business firms, growth motives and obstacles, present economy overview, working capital requirements, estimation and management of working capital, credit and cash management, supplier payments and outstanding management.

Unit 2: Economic Analysis and Project Appraisal [8 Hrs]
Cost implications of construction and maintenance, installation and operating costs of services, capital investment in projects, cost planning and control techniques, depreciation methods, appraisal criteria (NPV, IRR, BCR, Payback), break-even and cash flow analysis, risk analysis, lender's engineer role.

Unit 3: Financial Planning and Budgeting [8 Hrs]
Long-term financial planning, sources of finance (stock, borrowings, debentures, deposits, reserves), dividend policies, capitalization issues, micro-financing in construction, budgetary control system, types of budgets, master budget preparation, budget manual.

Unit 4: Corporate Finance and Construction Accounts [8 Hrs]
Corporate tax planning, policies, grading of construction entities (ICRA, CIDC), world financial markets, role of financing institutes, venture capital financing in India, SEBI regulations, accounting process, profit and loss account, balance sheet, contract accounts, project site accounts, ratio analysis, escrow accounts for PPP projects.

Unit 5: Case Studies in Project Economics and Finance [8 Hrs]
Case studies of BOT, dams, mass transit, and infrastructure projects focusing on project appraisal, financing, and cost-to-complete analysis.

Unit 6: Self-Study
Emerging trends in infrastructure finance, project risk modeling using digital tools, international PPP models, sustainable financing, impact of GST and digital taxation systems, global case studies of megaproject economics.

Textbooks:

[1] Prasanna Chandra, *Projects: Planning, Analysis, Selection, Implementation & Review*, Tata McGraw Hill.
[2] Singh H., *Construction Management and Accounts*, Tata McGraw Hill.
[3] Mubarak, *Construction Project Scheduling and Control*, Wiley India

Reference Books:

[1] Brealey, R.A., *Principles of Corporate Finance*, Tata McGraw Hill.
[2] Leland Blank & Anthony Tarquin, *Engineering Economy*, McGraw Hill.
[3] Bedworth, D., & Randhawa, S., *Engineering Economics*, McGraw Hill.
[4] Bruggeman, W., & Fisher, J., *Real Estate Finance and Investment*, McGraw Hill.
[5] Block & Hirt, *Foundations of Financial Management*, McGraw Hill.
[6] Oliver, L., *The Cost Management Toolbox: A Manager's Guide to Controlling Costs and*

Boosting Profits, Tata McGraw Hill.

Web Resources:

[1] SEBI India – https://www.sebi.gov.in/
[2] Construction Industry Development Council (CIDC) – https://www.cidc.in/
[3] World Bank PPP Knowledge Lab – https://pppknowledgelab.org/
[4] Investopedia (Financial Analysis Tools) – https://www.investopedia.com/

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	1	3	2	2
CO2	2	2	3	2	2
CO3	2	1	3	3	2
CO4	3	2	3	2	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Sustainable Construction

Course Code: CM(PE)-25003	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab: 0	ESE: 50

Course Outcomes: Students will be able to:

1. Categorize and critically examine concepts of sustainable construction.
2. Apply sustainability principles in project planning and management.
3. Develop and assess sustainable materials and renewable energy techniques for civil engineering projects.
4. Analyze and evaluate the environmental impacts of construction activities.

Unit 1: Fundamentals of Sustainability [8 Hrs]

Sustainability and sustainable development, definitions and perspectives, theory and background to sustainable construction planning, the three E's – Environment, Economics, and Ethics, ecology of sustainable development, global sustainability challenges.

Unit 2: Sustainable Construction Planning [8 Hrs]

Principles of sustainable construction, environmental challenges and climate change, global warming and carbon footprint, introduction to green buildings, building energy systems and strategies, energy conservation in buildings, energy-efficient projects, HVAC systems, water conservation in buildings, rainwater harvesting, and water cycle management. Case studies.

Unit 3: Sustainable Buildings [8 Hrs]

Site selection for green construction, design considerations, objectives of green building movement, sustainable construction materials and resources, eco-friendly, recyclable, and reusable materials, embodied energy in materials, and sustainable material selection strategies.

Unit 4: Codes and Specifications [8 Hrs]

Green building codes and standards, IGBC, GRIHA, LEED credits and certification system, international codes and frameworks, carbon accounting and environmental declarations, sustainability assessment methods, life cycle analysis (LCA).

Unit 5: Innovations in Sustainable Construction [8 Hrs]

Renewable energy integration in construction, waste minimization and management, circular economy in construction, sustainable transportation and logistics, smart materials and technologies, net-zero energy buildings, and case studies of sustainable projects.

Unit 6: Self-Study

Emerging concepts in sustainable infrastructure, UN Sustainable Development Goals (SDGs) in construction, climate-resilient structures, digital tools (BIM for sustainability, IoT-enabled energy monitoring), and international case studies of mega sustainable projects. Study of HVAC, water and energy efficiency through projects.

Textbooks:

[4] Kibert, C. J., *Sustainable Construction: Green Building Design and Delivery*, Wiley, 4th Edition.

[5] Charles J. Kibert, *Sustainability of Construction and Sustainable Development*, Wiley. Mujumdar, Mili (Ed.), *Energy Efficient Buildings in India*, TERI Press.

[6] Krishna, Arvind, *Climate Responsive Architecture*.

Reference Books:

[7] Halliday, S., *Sustainable Construction*, Routledge.

[8] Rossi, F., *Green Building and Sustainable Development*, Springer.

[9] Yudelson, J., *The Green Building Revolution*, Island Press.

[10] Gonzales, M., *Green Building: Principles and Practices in Residential Construction*, Cengage Learning.

[11] TERI, *Energy Efficient Buildings in India: Case Studies*, TERI.

[12] Doty, Steve & Turner, Wayne C., *Energy Management Handbook*, 8th Edition.

Web Resources:

[5] Indian Green Building Council (IGBC) – https://igbc.in/

[6] GRIHA Council – https://www.grihaindia.org/

[7] U.S. Green Building Council (USGBC/LEED) – https://www.usgbc.org/

[8] UNEP Sustainable Buildings and Climate Initiative – https://www.unep.org/

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2	3	3	2
CO2	2	1	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Quantitative Methods in Construction

Course Code:	**CM(PE)-25004**	**Credit: 3**	
Teaching Scheme: Hrs/Week		**Examination Scheme:**	
Lectures:	3	MSE:	30
Self-Study:	1	TA	20
		ESE:	50

Course objectives: At the end of the course, the student is able to:

1. Formulate and solve the deterministic optimization problems.
2. Model risk and uncertainty in construction projects.
3. Apply transportation and assignment algorithms to real-world resource allocation problems
4. Use dynamic programming, decision theory, queuing theory, and game theory in project planning
5. Develop Monte Carlo simulation models for risk and uncertainty analysis.
6. Integrate probability, statistics, and optimization techniques into engineering design and management.

Unit 1: Introduction to Quantitative Techniques (8Hrs)

Probability: Conditional probability, Probability distributions (Normal, Bayesian, Poisson, Exponential), Probability density functions.

Unit 2: Linear Programming Models and Solution Methods (8Hrs)

Formulation of LP problem: Basic variables, constrains, corner points, augmented form, maximization and minimization problems. Solution methods: Graphical method, Algebraic method, Simplex method (Tabular and Matrix form). Integer linear programming; Big M method and Two-phase method; Duality and sensitivity analysis in construction decision models

Unit 3: Transportation and Assignment Problems (8Hrs)

Transportation problems: Basic feasible solutions using N-W Corner rule, Minimum cost method, Vogel's approximation method. Optimal solutions using Stepping Stone Method, Modified distribution method formulation and solution using approximation methods; Assignment problems: Hungarian method and applications in resource allocation; Case studies in logistics and equipment scheduling

Unit 4: Decision theory: (8Hrs)

Decision in certainty: Analytical hierarchy approach, Comparison Matrix, Consistency test, Oil exploration problem, Manpower planning problem. Probabilistic decision making: Expected value approach, sensitivity analysis on payoffs, Optimal decision strategy.

Unit 5: Simulation Techniques (8Hrs)

Decision-making under certainty, risk, and uncertainty; Queuing theory: single/multi-server models and performance metrics; Game theory: competitive strategies and payoff analysis; Monte Carlo simulation for risk and uncertainty modelling; Forecasting: Quantitative methods-Time series (average method, moving average method, exponential smoothing, mean square error), Regression analysis. Qualitative methods.

Unit 6: Self Study (8Hrs)

Spreadsheet-based LP model for material cost optimization; Simulation of construction equipment allocation using Monte Carlo methods; Queuing model for site logistics and material handling; Decision tree analysis for project selection under uncertainty; Visualization of scheduling strategies using 3D simulation tools.

Textbooks:

1. H. A. Taha, Operations Research: An Introduction, Pearson, 10th Edition
2. S. D. Sharma, Operations Research, K. N. Ramnath & Co.

Reference Books:

1. G. Srinivasan, Quantitative Models in Operations Management, PHI Learning
2. D. C. Montgomery, Introduction to Statisical Quality Control, Wiley
3. J. N. Srivastava, Quantitative Techniques for Managers, PHI Learning

---

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	2
CO2	3	2	3	2	3
CO3	3	2	3	2	2
CO4	3	2	3	2	3
CO5	3	2	3	2	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Functional Planning, Building Services, and Maintenance

Course Code: CM(PE)-25005	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
	ESE: 50

Course Outcomes: Students will be able to:

1. Apply planning principles, byelaws, and climatology concepts for functional building design.
2. Select and design appropriate building services (plumbing, sanitation, electrical, HVAC, mechanical).
3. Incorporate fire safety, acoustic treatment, and universal accessibility in building design.
4. Evaluate building defects and implement suitable maintenance, repair, and retrofitting strategies.
5. Integrate sustainable and energy-efficient practices in building planning and maintenance.

Unit 1: Functional Planning and Climatology [8 Hrs]

Classification of buildings: residential (HIG, MIG, LIG, EWS), row houses, apartments, colonies, public buildings. Anthropometry and space standards for functional planning. Building orientation: sun, wind, climate zones in India, thermal comfort. Climatic considerations: natural & artificial lighting, natural and mechanical ventilation. NBC provisions and planning considerations.

Unit 2: Building Byelaws and Regulations [8 Hrs]

Objectives and importance of building byelaws. Plot sizes, open spaces, FAR, FSI, plinth area, carpet area, super built-up area. Regulations related to lighting, ventilation, parking, fire safety, and water supply. Introduction to universal design: accessibility for physically challenged and elderly. Overview of NBC 2016 provisions related to building services.

Unit 3: Building Services (Plumbing, Water Supply, Sanitation & Electrical) [8 Hrs]

Water quality, purification, and treatment. Internal and external water supply systems, municipal bye-laws, rainwater harvesting. Plumbing fixtures, drainage systems, stormwater disposal, septic tanks, and sewage treatment. Basics of electricity: wiring systems, earthing, distribution boards, transformers, switchgears. Electrical layout for different buildings (residential, institutional, commercial). Renewable energy systems in buildings: solar PV, solar water heating.

Unit 4: HVAC and Mechanical Services [8 Hrs]

Air-conditioning: principles, temperature & humidity control, air distribution. Types of systems: window, split, central air-conditioning. Mechanical services in buildings: lifts, escalators, conveyors – types, design considerations, safety aspects. Emerging mechanical services for modern high-rise buildings.

Unit 5: Fire Protection, Acoustics, and Sound Insulation [8 Hrs]

Causes and effects of fire in buildings, fire load, NBC & IS code provisions. Fire safety planning: fire-resistant materials, fire exits, staircases, fire lifts, alarm systems, sprinklers. Acoustics: requirements for good acoustics in buildings, sound-absorbing materials. Noise control measures for residential, commercial, and institutional buildings.

Unit 6: Building Maintenance and Special Repairs

Necessity and role of maintenance in building durability and serviceability. Types of maintenance:

preventive, remedial, routine, pre-monsoon, and special. Common defects in buildings: foundations, masonry, plastering, RCC, flooring, corrosion. Repairs and strengthening: waterproofing, crack repair, termite treatment, roof rectification. Repair materials, retrofitting, rehabilitation techniques, and economic aspects of maintenance.

Textbooks:

1. National Building Code of India (NBC 2016), Bureau of Indian Standards.
2. M. Y. Luhar, *Building Services and Maintenance*.
3. S. C. Rangwala, *Building Construction*.
4. P. C. Varghese, *Building Construction*.
5. R. Barry, *Construction of Buildings*.
6. Relevant IS Codes (IS 3362, IS 1642, IS 875, etc.).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	2	3	3	3
CO4	3	2	3	2	3
CO5	3	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Sensors and Automation

Course Code: CM(PE)-25006		**Credit: 3**		
Teaching Scheme: 3 Hrs/Week		**Examination Scheme:**		
Lectures:	3	MSE:	30	LAB CIE:
Self-Study:	1	TA	20	LAB ESE:
Lab:		ESE:	50	

Course Outcomes: Students will be able to:

1. Explain the principles, classifications, and working of construction-related sensors.
2. Apply automation techniques to construction processes such as monitoring, scheduling, and equipment management.
3. Utilize sensing technologies for quality assurance, safety management, and predictive maintenance.
4. Evaluate and design sensor-integrated systems for smart construction and infrastructure management.
5. Critically assess the role of IoT, AI, and robotics in construction automation.

Unit 1: Introduction to Sensors and Automation **[6 Hrs]**

Introduction to automation in construction management, Classification of sensors: displacement, strain, pressure, vibration, temperature, proximity, etc., Principles of operation, characteristics, and selection criteria, Fundamentals of signal conditioning and data acquisition systems.

Unit 2: Sensors in Civil and Construction Applications **[6 Hrs]**

Structural health monitoring: strain gauges, accelerometers, corrosion sensors., Environmental monitoring: temperature, humidity, noise, dust., Positioning and tracking technologies: GPS, RFID, LiDAR., Case studies: bridges, high-rise buildings, tunnels.

Unit 3: Robotics and Automation in Construction Processes **[6 Hrs.]**

Robotics in construction: brick-laying robots, 3D printing, demolition robots, Automated surveying and monitoring: drones, laser scanning, Smart equipment and machinery: IoT-enabled tools, predictive maintenance, Automation in planning, scheduling, and safety monitoring.

Unit 4: Integration with IoT and Digital Technologies **[6 Hrs]**

Internet of Things (IoT) in construction, Building Information Modeling (BIM) with sensor integration, Digital twins for construction management, Cloud computing and data analytics for sensor data.

Unit 5: Artificial Intelligence and Advanced Technologies **[6 Hrs.]**

AI and machine learning for automation in construction, Cyber-physical systems and Industry 4.0 applications, Robotics and autonomous systems for infrastructure projects, Blockchain for construction automation and supply-chain transparency.

Self Study **[6 Hrs.]**

Smart cities and intelligent infrastructure management, Sustainability through sensors and automation (energy, waste, environment), Global case studies on sensor-based and automated mega projects, Future directions: human-robot collaboration, digital construction ecosystems.

Textbooks:

[1] N. Mohan, T. Undeland, W. Robbins – *Power Electronics: Converters, Applications and Design*.
[2] Ernest O. Doebelin – *Measurement Systems: Application and Design*.
[3] Li, Heng – *Virtual Prototyping & Construction Automation*.

Reference Books:

[1] Beliveau, Yvan – *Automation and Robotics in Construction*.
[2] Reddy, B. Srinivasa, *Construction Automation and Robotics*.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	2
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

SEMESTER – II

Construction Cost Dynamics

Course Code:		**Credit: 4**	
Teaching Scheme: Hrs/Week		**Examination Scheme:**	
Lectures:	3	MSE: 30	LAB CIE: 50
Self-Study:	1	TA 20	LAB ESE: 50
Lab:	2	ESE: 50	

Course Outcomes: Students will be able to:

1. Execute economic analysis of different construction projects
2. Interpret the importance of risk and its application in a construction project
3. Apply knowledge of construction cost dynamics to bid on a project
4. Implement concepts of finance management in practice.

Unit 1: **[8 Hrs]**

Introduction to Engineering economics: Importance, demand and supply, types of costs, Time and equivalence, tangible and intangible factors, Cash flow diagram (CFD), Factors affecting project cash flow, Project cash flow diagram.

Unit 2: **[8 Hrs]**

Pre-tax CFD Present worth method, equivalent annual cost method, capitalized cost method, net present value, and internal rate of return evaluation of alternatives.

Unit 3: **[8 Hrs]**

Depreciation and tax considerations in alternative, Post-tax CFD, Present worth method, equivalent annual cost method, capitalized cost method, net present value, and internal rate of return evaluation of alternatives.

Unit 4: **[8 Hrs]**

Benefit cost ratio, public projects evaluation, Breakeven analysis, Value engineering.

Unit 5: **[8 Hrs]**

Risk analysis, Sensitivity analysis, Earned value management, Escalation Bidding Model.

Self-Study

Interest – simple, compound, continuous, effective. Introduction to inflation. Interest factors – Uniform series factors – derivations, Depreciation, Basic concept of financial management-working capital management, balance sheet, funds flow statement.

Reference Books:

1. Riggs, J.L., Bedworth, D.D., and Randhawa, S.U. (2005). Engineering Economics Tata-McGraw Hill Publishing Co Ltd.
2. Tarquin, A.J. and Blank, L.T. (2012) Engineering Economy, A Behavioural Approach McGraw Hill Book Company, 7e.
3. Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition
4. Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
5. Van Horne, J.C. (1990). Fundamentals of Financial Management, Prentice-Hall of India Ltd.
6. Brigham, E.F. (1978). Fundamentals of Financial Management, The Dryden Press, Hinsdale, Illinois.
7. Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management. D.C. Heath & Co.

Assignments for Lab:-

1. Solve two numerical problems, each on simple, compound, and effective interest, and write short notes on inflation and working capital.
2. Prepare a cash flow diagram (CFD) for any real or hypothetical project.
3. Evaluate a suitable investment alternative using any two methods.
4. Calculate the depreciation of any selected asset using two methods and create a post-tax cash flow table.
5. Perform a Benefit–Cost ratio Analysis for a public project.
6. Perform a Break-Even analysis for any project or product of your choice.
7. Conduct a sensitivity analysis and prepare an Earned Value Management (EVM) table for a sample project.
8. Any other assignments assigned by the faculty.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	-	3	-	2
CO2	2	3	-	2	2
CO3	2	-	3	-	2
CO4	-	3	2	2	-

1 – Slightly; 2 – Moderately; 3 - Substantially

Construction Techniques

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab: 0	ESE: 50

Course Outcomes: Students will be able to:

1. Apply construction techniques for roads, bridges, tunnels, marine works, and high-rise structures
2. Evaluate alternative construction methods based on safety, quality, and performance.
3. Evaluate construction sequencing, sustainability practices, and innovative technologies in major projects.
4. Analyse processes, methods, and equipment used in specialised construction works.

Unit 1: Roads and Pavements **[8 Hrs]**

Rigid pavement construction techniques; flexible pavement construction techniques; overlay construction; pavement rehabilitation methods; strategies for improving service life; quality control and performance monitoring measures.

Unit 2: Bridges and Sub-Structure Systems **[8 Hrs]**

Types of bridges: arch, suspension, cable-stayed, segmental; construction of sub-structures: foundations, piers, abutments; construction of super-structures: decks, girders, cables; bridge launching methods: incremental launching, balanced cantilever, lift-and-push techniques; use of cofferdams and caissons.

Unit 3: Tunnels and Underground Construction **[8 Hrs]**

Tunnelling in soft ground, hard rock, and mixed strata; tunnel linings; cut-and-cover method; trenchless construction; NATM (New Austrian Tunnelling Method); tunnel boring machines (TBM); safety in underground works; ventilation systems.

Unit 4: Ports and Marine Structures **[8 Hrs]**

Construction of docks, jetties, and fender systems; container and oil terminals; underwater construction methods; dredging operations; channel deepening; navigation improvement techniques.

Unit 5: High-rise and Specialized Construction Techniques **[8 Hrs]**

High-rise construction systems; advanced formwork techniques; maintenance strategies for tall buildings; foundation treatments: grouting, underwater concreting, pile foundations; construction of earth dams and gravity dams; specialized techniques: dewatering, slip-form construction, diaphragm wall construction; demolition of tall structures using mechanical and controlled blasting methods.

Unit 6: Self-Study

Case studies of mega projects (bridges, tunnels, ports, skyscrapers); innovations in sustainable construction; emerging technologies in specialized construction; digital tools for construction sequencing and monitoring.

Textbooks:

[5] Chaundley R., *Construction Technology* Vol-I to IV, ELBS Edition.
[6] Seeley Ivor, *Building Technology*, McMillan.
[7] Fleming, E. (2005). Construction Technology: An Illustrated Introduction.
[8] Chudley, R., Greeno, R., Boston, A., London, H., Oxford, Y., San, P., San, D., Singapore, F., & Tokyo, S. (2006). BUILDING CONSTRUCTION HANDBOOK Sixth edition BA (Hons) FCIOB FIPHE FRSA. http://elsevier.com/

Reference Books:

[11] Peurifoy & Schexnayder, Construction Planning, Equipment and Methods, McGraw-Hill
[12] Christian John A., Management, Machines and Methods, Oxford & IBH.
[13] Hewry Parker & Clarkson Oglesby, Methods Improvement for Construction Managers.
[14] Singh Jagman, Heavy Construction Planning, Equipment and Methods, Oxford & IBH.
[15] Mahesh Varma, Construction Equipment and its Planning and Application.

Web Resources:

[6] National Highways Authority of India (NHAI) – https://nhai.gov.in/
[7] Institution of Civil Engineers (ICE) – https://www.ice.org.uk/
[8] Construction Industry Institute (CII) – https://www.construction-institute.org/

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	-	2
CO2	2	1	2	3	3
CO3	2	2	3	3	2
CO4	3	2	3	-	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Professional Practices in Construction

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Tutorial: 0	ESE: 50

Course Outcomes: Students will be able to:

1. Analyze civil engineering ethics, conflicts of interest, and professional misconduct.
2. Interpret and evaluate standard construction contract clauses.
3. Distinguish ADR methods – arbitration, mediation, negotiation.
4. Identify key elements and stages of competitive bidding and tender evaluation.
5. Apply labour laws for safe and legal construction practices.

Unit 1: Professional Practice and Professional Ethics **[6 Hrs]**

Professional Practice: Govt – regulates; BIS/IRC – standards; IEI/IIA/COA/ECI – certify & guide; Clients – define scope; Developers – RERA; Consultants – advice; Contractors – execute; Vendors – supply.

Professional Ethics: Ethics – moral conduct; IEI Code – integrity, competence, fairness; Issues – conflict, bribery, negligence, environment; Vigilance – whistleblowing

Unit 2 Legal Framework of Construction Contracts. **[8 Hrs]**

Contract formation, types, validity; tenders & bids; clauses & awards; variations, delays, force majeure, damages; unethical practices; BOO, PPP, INCOTERMS.

Unit 3: Dispute Resolution Mechanisms **[10 Hrs]**

Arbitration – scope, types, 1940 vs 1996 Act, UNCITRAL, tribunal, award, enforcement, foreign awards, ADR – conciliation, negotiation, mediation; dispute boards; Lok Adalats; confidentiality, costs, judicial recourse.

Unit 4: Contract Formation and Tendering **[10 Hrs]**

CPWD/MES/PWD contracts; tendering – open, limited, negotiated, two-stage; pre-bid, pre-qualification, bid evaluation, pricing – item-rate, lump sum, cost-plus; e-Tendering, AI & blockchain, GeM/eProcure; ethical, green, ESG-compliant procurement.

Unit 5: Labour Engagement & Construction Laws **[6 Hrs]**

Role & engagement (on-roll, sub-contract, piece-rate); key laws – Industrial Disputes Act 1947, Standing Orders Act 1946, Workmen's Compensation Act 1923, Building & Other Construction, Workers Act 1996, RERA 2017, NBC 2017.

Unit 6: Self-Study **[6 Hrs]**

Forms: Copyright, Trademarks, Patents, Designs, Trade-Secrets.

Copyright: Act 1957, ownership, infringement, computer programs, internet piracy.

Patents: Act 1970, patentable inventions (including biotech/software), application & approval, PCT, rights, duration, infringement remedies.

Textbooks:

1. Construction Contracts, Jimmie Hinze, 3rd Edition, McGraw Hill publication 2.
2. Construction Contracts: Law and Management, Will Hughes, Ronan Champion, 5th Edition,
3. Civil Engineering Contracts and Estimates, B. S. Patil, 2006 Edition, Universities Press.
4. Law of contract Part I and Part II, Dr. R.K. Bangia, 2005 Edition, Allahabad Law Agency.
5. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.

Reference Books:

[1] Law of Contract – Avtar Singh
[2] The Indian Contract Act (9 of 1872), 1872, Bare Act, 2006 edition, Professional Book publishers
[3] Construction Law – Julian Bailey (3 Vol Set)
[4] CPWD Works Manual – Central Public Works Department, Govt. of India
[5] Arbitration and Conciliation Act, 1996 – Bare Act Edition
[6] The Workmen's Compensation Act, 1923 (8 of 1923) Bare Act- 2005- Professional Book Publishers.
[7] Law Relating to Infrastructure Projects – Gajaria.
[8] The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration, Kwatra G.K. (2005).
[9] Professional Ethics in the Construction Industry, Engineering Construction and Architectura management, Vol.10, Iss2,pp 117-127, MCB UP Ltd. Vee, Charles & Skitmore, Martin (2003).
[10] Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill .
[11] Engineering Ethics, National Institute for Engineering Ethics, USA.

Web Resources:

1. Indian Contract Act https://indiacode.nic.in
2. CPWD Manuals https://cpwd.gov.in
3. E-Tendering Guidelines https://eprocure.gov.in
4. Arbitration and Conciliation Act https://legislative.gov.in
5. Construction Law Cases https://indiankanoon.org
6. Ministry of Statistics Model Contracts https://mospi.gov.in
7. Dispute Review Board Foundation https://www.drb.org
8. Construction Contracts, http://www.jnormanstark.com/contract.htm
9. Types Of Contracts and Important Provisions, http://www.worldbank.org/html/opr/consult/guidetxt/types.html
10. Contract Types/Pricing Arrangements Guideline-1.4.G(11/04/02), http://www.sandia.gov/policy/14g.pdf

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	3
CO2	2	2	3	2	2
CO3	2	2	3	2	2
CO4	2	2	3	2	2
CO5	2	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantial

Total Quality Management and MIS in Construction

Course Code:		Credit: 3	
Teaching Scheme: Hrs/Week		Examination Scheme:	
Lectures:	3	MSE:	30
Self-Study:	1	TA	20
Tutorial:	0	ESE:	50

Course objectives: At the end of the course, student is able to:

CO1: Understand TQM principles and quality frameworks used in construction projects.

CO2: Design and document process-based quality systems and apply PDCA for continuous improvement.

CO3: Apply standards, Six Sigma tools and QFD to evaluate and improve construction quality.

CO4: Use statistical quality control and non destructive testing methods to monitor material and process quality.

CO5: Develop and use MIS and operations-research methods (simulation, Monte Carlo, BIM/IoT) for decision support and economic monitoring in construction projects.

Unit 1: Introduction to TQM in Construction [8 Hrs]

Definition of quality (Deming, Juran, Crosby) and QA vs QC vs TQM; Need for TQM in the construction industry

Unit 2: Systems Approach and Process Automation [8 Hrs]

Manual systems vs computerized systems; System analysis, design, development and implementation; Process automation tools for construction engineering functions; Designing a quality manual: contents, data requirements, responsibility matrix, PDCA monitoring.

Unit 3: Standards, Six Sigma & Integration [8 Hrs]

ISO 9001 vs ISO 9004: standards, certification process, eight management principles; Achieving TQM on construction projects: barriers, benefits, cost of poor quality, QFD; Six Sigma fundamentals and applications to RCC work and road layer construction; Integrating MIS dashboards with real-time quality and performance metrics

Unit 4: Quality Control Tools & Human Resource Development [8 Hrs]

Quality control tools: Histogram, Pareto, Fishbone, Control Charts; Material testing for RCC: destructive and non-destructive tests; Statistical quality control: benchmarking and dispersion methods; Training needs assessment, PRRT software for checklist preparation, quality circles and 360° feedback

Unit 5: Advanced MIS Tools & Economic Analysis [8 Hrs]

Operations Research and MIS in civil-engineering decision-making; MIS components and information requirements analysis; Simulation and Monte Carlo methods for process and risk modelling; 3D visualization of construction processes (BIM, VR); Data acquisition systems: sensors, IoT and mobile communication techniques; Economic analysis: project financial planning, budget allocation, earned-value monitoring

Self-Study

PDCA cycle; Quality Gurus; Fish Bone; Ishikava; Develop an MIS dashboard for QC metrics using Excel or Power BI; Build a Monte Carlo simulation model for project schedule risk in @RISK or MATLAB;

Create a 3D BIM visualization of a site logistics workflow; Conduct a mock ISO 9001 audit: prepare audit checklists and non-conformity reports; Apply the DMAIC cycle to reduce NCRs in an RCC concreting case study.

References:

- Hamdy A.Taha, Operations Research, Pearson Education India, 10th Edition, 2016.
- Vohra, N. D., Quantitative Techniques in Management, McGraw Hill Education, 5th Edition, 2017.
- Ravindran, Engineering Optimization Methods and Applications, John Wiley and Sons, Inc., 9th Edition, 2011.

Web Resources:

- INFORMS (Institute for Operations Research): www.informs.org
- American Society for Quality (ASQ): www.asq.org
- QGIS Documentation: www.qgis.org/en/docs
- ISO Standards Portal: www.iso.org

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	1	1
CO2	3	2	2	2	2
CO3	2	2	3	2	2
CO4	2	3	3	2	1
CO5	3	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Conservation and Management of Heritage Structures

Course Code:		**Credit: 3**	
Teaching Scheme: Hrs/Week		**Examination Scheme:**	
Lectures:	3	MSE:	30
Self-Study:	1	TA	20
Tutorial	0	ESE:	50

Course objectives: At the end of the course, student is able to:

CO1: Understand the significance and principles of heritage conservation.
CO2: Analyse structural behaviour and deterioration in heritage structures**.**
CO3: Propose appropriate restoration and retrofitting solutions.
CO4: Prepare conservation management plans for heritage projects

Unit 1: Introduction to Heritage Structures (8Hrs)

Overview of heritage structures, their historical significance, architectural styles, and key conservation principles, along with major national and international charters guiding preservation.

Unit2: Materials and Deterioration Mechanisms (8Hrs)

Traditional materials such as stone, brick, lime, timber, and metals, types of material deterioration, and identification of structural and surface defects.

Unit 3: Structural Assessment and Investigation (8Hrs)

Methods for assessing heritage buildings through visual inspection, defect mapping, and non-destructive testing, including understanding load paths and preparing condition assessment reports.

Unit 4: Conservation, Repair, and Restoration Techniques (8Hrs)

Key techniques such as grouting, stitching, jacketing, and retrofitting, with emphasis on selecting interventions that retain authenticity and improve safety and durability.

Unit 5: Heritage Project Planning and Management (8Hrs)

Planning, budgeting, and regulatory requirements for conservation projects, including heritage policies, risk management, sustainability practices, and case study-based learning..

Self-Study:

Documentation of a local heritage structure, covering its history, materials, defects, and a preliminary conservation strategy.

References:

- Feilden BM. Conservation of Historic Buildings. Architectural Press; 2003.
- Jokilehto J. A History of Architectural Conservation. Routledge; 2007.
- Ashurst J. Conservation of Building and Decorative Stone. Butterworth-Heinemann; 2007.
- Ashurst J, Ashurst N. Practical Building Conservation. English Heritage; 2012.
- ICOMOS. Principles for the Preservation of Historic Timber Structures. ICOMOS; 1999.

- Thompson R. Repair of Historic Buildings. Thomas Telford Publishing; 2003.
- Ortega J, Moreno A. Structural Analysis of Historical Constructions. CRC Press; 2006.
- ICOMOS Guidelines. Principles for the Analysis, Conservation & Structural Restoration of Architectural Heritage. ICOMOS; 2003.
- D'Souza L. Heritage Conservation in India: Approaches and Techniques. INTACH Publications; 2018.
- India Standards (BIS). Relevant codes for conservation, structural inspection, and NDT methods.

Web Resources:

- UNESCO World Heritage Centre, Operational guidelines, case studies, documentation, https://whc.unesco.org
- ICOMOS Internationa, Charters, principles, and technical papers on conservation, https://www.icomos.org
- Getty Conservation Institute (GCI), Research papers on materials, deterioration, and restoration technologies, https://www.getty.edu/conservation
- ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property), Training modules, e-learning, and documentation guides, https://www.iccrom.org

CO and PO mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	1	1	2	2	1
CO2	2	1	3	2	2
CO3	3	2	3	2	3
CO4	2	3	3	3	2

1 – Slightly; 2 – Moderately; 3 - Substantially

Advanced Optimization Techniques in Construction

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab: 2	ESE: 50

Course Outcomes: At the end of course students will be able to:

CO1: Formulate and solve classical optimization problems, both constrained and unconstrained.

CO2: Develop and apply linear programming models and conduct sensitivity analysis for engineering scenarios.

CO3: Employ integer and dynamic programming techniques for resource allocation and scheduling.

CO4: Design and implement evolutionary algorithms—including genetic algorithms and genetic programming—for optimization tasks.

CO5: Understand and apply fuzzy optimization and heuristic methods to decision-making under uncertainty.

Unit 1: Classical Optimization Techniques **[8 Hrs]**

Single-variable and multivariable optimization methods, Lagrange multipliers and Kuhn–Tucker conditions, Numerical techniques: Steepest descent and Newton's method, Case examples in mechanical design and manufacturing.

Unit 2: Linear Programming & Sensitivity Analysis **[8 Hrs]**

LP formulation and graphical solution approach; Simplex and Dual Simplex algorithms; Sensitivity analysis and interpretation of dual variables; Case studies: material allocation and production planning

Unit 3: Integer & Dynamic Programming **[8 Hrs]**

Integer programming: Branch-and-Bound, Gomory's cutting plane, 0–1 programming; Dynamic programming: multistage decision processes, recursive relations; Applications in project scheduling and resource optimization

Unit 4: Evolutionary Algorithms **[8 Hrs]**

LP formulation and graphical solution approach; Simplex and Dual Simplex algorithms; Sensitivity analysis and interpretation of dual variables; Case studies: material allocation and production planning

Unit 5: Fuzzy Optimization & Heuristics **[8 Hrs]**

Fundamentals of fuzzy set theory and membership functions; Fuzzy logic-based optimization frameworks; Heuristic and metaheuristic methods for complex design problems; Decision-making in uncertain and imprecise environments.

Self-Study

MADM; Multi-criteria decision-making techniques (AHP, TOPSIS); Robust optimization and design under uncertainty; Software tutorials: MATLAB Optimization Toolbox, Python (SciPy, DEAP); Development of a mini-project on an optimization topic of choice.

Textbooks:

1. S.S. Rao, Engineering Optimization
2. Kalyanmoy Deb, Optimization for Engineering Design
3. D.E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning

Reference Books:

1. F.S. Hillier & G.J. Lieberman, Operations Research
2. Jasbir Arora, Optimal Design
3. Christodoulos A. Floudas, Nonlinear and Integer Optimization

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	3
CO2	3	3	3	2	2
CO3	3	2	3	1	3
CO4	3	2	3	2	2
CO5	2	2	3	3	2

1 – Slightly; 2 – Moderately; 3 - Substantially

Soft Computing Techniques

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab: 2	ESE: 50

Course Outcomes: Students will be able to:

1. Apply genetic algorithms for optimization problems in engineering.
2. Design fuzzy systems for handling uncertainty and imprecision.
3. Implement artificial neural networks for classification, prediction, and modeling.
4. Integrate hybrid soft computing techniques to solve complex engineering problems.
5. Use MATLAB/Python toolboxes for implementing soft computing techniques.

Unit 1: Introduction and Genetic Algorithms [6 Hrs]

Hard computing vs. soft computing. Goals of optimization, limitations of traditional methods. Genetic algorithm (GA) terminology: strings, schemata, operators (selection, crossover, mutation), coding, fitness function. Canonical GA and variations. Applications of GA in optimization, scheduling, and engineering design.

Unit 2: Fuzzy Logic [6 Hrs]

Concepts of uncertainty, imprecision, and vagueness. Classical vs. Fuzzy Sets: Properties, Operations, and Fuzzy Relations. Membership functions and their types. Fuzzy logic and fuzzy inference systems: fuzzification, fuzzy rules, fuzzy propositions, defuzzification methods. Applications of fuzzy logic in control, decision-making, and civil/structural engineering problems.

Unit 3: Artificial Neural Networks (ANN) [6 Hrs]

Biological neuron model, ANN architecture, and learning paradigms. Models: perceptron, multi-layer feedforward networks (MLFFN), radial basis function networks (RBFN), recurrent neural networks (RNN). Learning processes: supervised, unsupervised, reinforcement learning. Training algorithms: error-correction, Hebbian learning, least mean square algorithm, backpropagation. Applications: pattern recognition, prediction (e.g., concrete strength), structural health monitoring, demand forecasting.

Unit 4: Evolutionary and Swarm Intelligence Methods [6 Hrs]

Overview of evolutionary computation. Genetic programming (GP). Particle swarm optimization (PSO): concepts, velocity & position updates, applications. Ant colony optimization (ACO): pheromone trails, probabilistic search, engineering applications. Comparative study of GA, PSO, and ACO.

Unit 5: Hybrid Systems [6 Hrs]

Motivation for hybridization. Neuro-fuzzy systems: architecture and applications. Genetic fuzzy systems: GA for optimizing fuzzy rules and membership functions. Genetic neural systems: GA for training neural networks. Case studies of hybrid soft computing in engineering optimization and decision support.

Unit 6: Applications and Tools [6 Hrs]

Applications in engineering: structural optimization, water resources, traffic flow, construction scheduling, material property prediction. Emerging trends: deep learning vs.

soft computing, hybrid AI methods. Hands-on: MATLAB/Python toolboxes for fuzzy logic, ANN, GA, and PSO.

Textbooks:

[5] S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*, PHI.

[6] S. N. Sivanandam & S. N. Deepa, *Principles of Soft Computing*, Wiley.

[7] J. S. R. Jang, C. T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI.

[8] D. E. Goldberg, *Genetic Algorithms in Search, Optimization, and Machine Learning*.

[9] Recent IEEE/Elsevier journal papers on applications of soft computing in engineering.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	3	1	2
CO2	2	-	3	1	2
CO3	3	-	3	1	3
CO4	3	2	3	1	3
CO5	2	-	2	1	2

1 – Slightly; 2 – Moderately; 3 - Substantially

Underground Openings

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab:	ESE: 50

Course Outcomes: At the end of the course, the students are able to:

1. Comprehend the design aspects of various underground structures in soil and rock mass
2. Identify the excavation methods for construction of underground structures in different ground conditions
3. Analyze the underground structures in rock and soil using elastic and elastoplastic solutions
4. Design the support and safety system for underground structures

Unit 1: Introduction: **[8 Hrs]**

Introduction to underground space and tunnelling, History, Tunnelling challenges, Types and classification of underground opening, Factors affecting design, Design methodology, Functional aspects, Size and shapes, Support systems, Codal provisions

Unit 2: Excavation Method and Machinery: **[8 Hrs]**

Drilling and Blasting for Underground and Open Excavations, blast operation planning, Explosive products, Blast Design, controlled Blasting techniques, Blasting damage and control, safe practices with explosives and shots. Tunnel driving techniques, TBM techniques, Bottom up and bottom down method, Tunnelling in difficult ground condition, Underground supports, theory of arching, rock loads and loads on tunnel linings, Safety aspects, Case histories.

Unit 3:Analysis And Design of Underground Openings: **[8 Hrs]**

Analysis of Underground openings, stresses around different shapes, initial state of stresses, Closed form solutions, BEM, FEM, Design based on analytical methods, Empirical methods based on RSR, RMR, Q systems, Observational method- NATM, Convergence-confinement method, Design based on Wedge failure and key block analysis, Design of Shafts and hydraulic tunnels.

Unit 4:Design Of Support System: **[8 Hrs]**

Tunnel support systems, Different type of supports, Standup time, Ground Reaction Curve, Stability of excavation face and Tunnel portals, Surface settlement due to underground works, Ground subsidence study, Use of appropriate software packages, Shotcreting including some case histories, Underground instrumentation and monitoring.

Unit 5: Tunnel Health and Safety Issues: **[8 Hrs]**

Construction methods, Ventilation, De-watering, Control and monitoring system: services, operations and maintenance, Lighting: specifications, maintenance, emergency lighting, Power supply and distribution, Water supply and distribution, Safety provisions, Localised hazards, Fire hazards in highway tunnels, Rapid transit tunnels. Surveillance and control system for highway tunnels. Tunnel finish, Rehabilitation: Inspection methods, Repairs, Tunnel construction contracting.

Unit 6: Self-study:

Prepare brief Indian tunnel case histories, compare common tunnel shapes, summarise TBM use in metros, review one blasting-related accident, run a basic PLAXIS circular-tunnel analysis, document a tunnel failure and an urban settlement case, and outline metro tunnel fire safety and ventilation differences with highway tunnels.

References:

1. Ramamurthy T., “Engineering in Rocks for Slopes, Foundation and tunnels”, Prentice Hall of India Pvt Ltd, New Delhi, 2010.
2. Kolymbas, D., “Tunneling and tunnel mechanics: A rational approach to tunnelling” Springer Publications. 2008.
3. Goodman, R. E., “Introduction to Rock Mechanics”, John Wiley & Sons, 1989.
4. Hoek, E. and Brown, E. T., “Underground excavations in rock”, The Institute of Mining and Metallurgy. 2005.
5. Brady, B. H. G. and Brown, E. T., “Rock mechanics for underground mining”, Springer Publication, 2006.
6. Obert, L. and Duvall, W.I., “Rock mechanics and the design of structures in rock”, John Wiley and Sons, 1967.
7. Chapman D, Metje, N and Stark A, “Introduction to tunnel construction”, Spon Press, Taylor and Francis, 2010.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	2	2
CO2	3	2	3	2	3
CO3	3	2	3	2	3
CO4	3	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Construction Safety and Human Resource Development in Construction

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab:	ESE: 50

Course Outcomes: At the end of the course, the students are able to:

1. Identify construction safety principles, hazards, and responsibilities.
2. Apply safety regulations and standards for compliance.
3. Develop and implement accident prevention plans.
4. Analyze HRD practices for training, skills, and workforce safety.
5. Implement labour laws and welfare programs to ensure employee well-being and compliance.

UNIT I: Introduction to Construction Safety **[8 Hrs]**

Safety importance, hazards, accidents, safety culture, SMS, roles of management, supervisors & workers.

UNIT II: Construction Safety Regulations and Standards **[8 Hrs]**

National laws (Factories Act, BOCW Act), international standards (OSHA, ISO 45001), safety codes, audits & inspections, PPE use & maintenance, safety signage & communication, safety code violations, Toolbox meeting on - Hazards and risk control, PPE and signage , Leadership communication techniques , Worker welfare guidelines

UNIT III: Safety Planning and Accident Prevention **[8 Hrs]**

Hazard ID, risk assessment, safety planning, accident investigation, emergency preparedness, training & awareness. Role-Play & Simulation Activities- Safety officer conducting site induction, Inspector checking PPE compliance, Emergency drill simulation, Supervisor resolving worker conflict, Union representative meeting management, Case Study-safety incidents.

UNIT IV: Human Resource Development (HRD) in Construction **[8 Hrs]**

HRD, workforce planning, training & skills, leadership, communication, team building, performance & career development, Bridging safety engineering with HR management practices - Redesigning a worksite layout to eliminate hazards, Creating a training plan for unskilled labour, Designing a welfare facility plan for a new project, Preparing an HRD plan to improve safety culture.

UNIT V: Labour Welfare and Labour Laws **[8 Hrs]**

Labour welfare, facilities, key laws (BOCW, Industrial Disputes, Contract Labour, Compensation), social security, unions, worker participation, Industry Interaction & Expert Talks - Safety officers, HR managers, Labour welfare officers.

UNIT VI: Self Study **[8 Hrs]**

Environmental & occupational hazards, health & hygiene, waste control, sustainable construction, HSE integration, monitoring & improvement.

Text books-

1. Construction Safety Management - Kumar Neeraj Jha, Dilip A. Patel, Amarjit Singh.
2. Safety Management In Construction: Principles & Practice – S.K. Bhattacharjee.
3. Construction Safety -R.K. Mishra.

Reference books-

1. Construction Safety Management System - Steve Rowlinson.
2. Human Resource Management in Construction: Critical Perspectives - Andrew Dainty and Martin Loosemore.
3. Human Resource Management in Construction Projects: Strategic and Operational Approaches- Andrew Dainty, Helen Lingard, Martin Loosemore.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	2	2	3	3	2
CO5	2	2	3	3	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Infrastructure Development and Management

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab:	ESE: 50

Course objectives: At the end of the course, the student is able to:

1 Analyse key infrastructure sectors, policies and programs in India and outline project life-cycles and stakeholder roles
2 Evaluate project feasibility using economic, financial and PPP models.
3 Identify and classify project risks (demand, political, economic, social, technical, environmental, legal) and propose mitigation strategies.
4 Map internal and external stakeholders, design engagement and negotiation plans
5 Apply flexible contracts, real-option analysis, design thinking and relational contracting to infrastructure megaprojects

Unit 1: **(8Hrs)**

Overview of Infrastructure Sectors, Policies & Programs in India; Phases of an Infrastructure Project; Key Players; Roles of Government, Private Agencies, NGOs & Construction Organisations

Unit 2: **(8Hrs)**

Infrastructure Economics, Finance & Project Feasibility; Public-Private Partnerships; Draft Concession & Escrow Agreements; Case Studies

Unit 3: **(8Hrs)**

Risk Taxonomy in Infrastructure Projects – Demand, Political, Economic, Social, Technical, Technological, Environmental & Legal Risks; Risk Identification & Mitigation; Case Studies.

Unit 4: **(8Hrs)**

Stakeholder Mapping & Management – Internal vs External Stakeholders; Roles & Responsibilities; Engagement Strategies; Negotiation Management; Exposure to Infrastructure Megaprojects & Technological Advancements; Flexible Contracts; Real Options; Design Thinking; Relational Contracts.

Unit 5: **(8Hrs)**

Disaster Management for Infrastructure – Disaster Cycle; Hazard & Vulnerability Assessment; Institutional Framework (NDMA, NDRF, NIDM); Pre & Post-Disaster Activities; Mitigation & Planning Strategies; Role of GIS & Remote Sensing in Disaster Risk Reductio

Self-Study

Field visits to PPP highways/urban metro projects; GIS-based vulnerability mapping workshops; Group presentation on a recent infrastructure PPP case; Industry panel reflections on flexible contracting and real options.

Reference Books:

1. Infrastructure Planning and Management – G. Raghuram & Rekha Jain
2. Public Infrastructure Asset Management – Waheed Uddin

3. PPP in Infrastructure Resource Book – DEA, Government of India
4. Smart Cities: Foundations, Principles, and Applications – H. Ahvenniemi et al.
5. Reports: NIP, PM Gati Shakti, Smart Cities Mission, NITI Aayog Infrastructure Vision
6. S. Sharma, "Infrastructure Development in India: Policies and Practices," Sage, 2018

Web Resources:

1. National Disaster Management Authority (NDMA) – https://ndma.gov.in
2. World Bank PPP Knowledge Lab – https://ppp.worldbank.org
3. QGIS Documentation – https://qgis.org/en/docs

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	2
CO2	3	2	3	2	3
CO3	3	-	3	3	3
CO4	2	-	3	3	2
CO5	2	-	3	2	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Application of Artificial Intelligence and Machine Learning in Civil Engineering

Course Code:	**Credit: 3**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 3	MSE: 30
Self-Study: 1	TA 20
Lab:	ESE: 50

Course objectives: At the end of the course, the student is able to:

1 Understand fundamental concepts of AI and Machine Learning and their applications in civil engineering decision-making and smart infrastructure.
2 Apply supervised learning techniques, including regression, classification, decision trees, and random forests, to civil engineering problems.
3 Implement unsupervised learning methods, clustering, and dimensionality reduction for civil engineering data analysis and feature extraction.
4 Utilize neural networks, deep learning, and advanced ML methods for applications such as structural health monitoring, traffic prediction, and water resources modeling.
5 Conduct independent projects involving data preprocessing, ML model selection, residual analysis, visualization, and interpretation for practical civil engineering applications.

Unit 1 Introduction to Artificial Intelligence (05 hrs)

Introduction to AI and its relevance to civil engineering, history and evolution, key applications across civil domains (construction, structural monitoring, transportation, water resources). Basic concepts: problem-solving, knowledge representation, search and optimization explained in an easy, conceptual manner. Role of AI in enabling smart infrastructure, digital construction, and decision-support systems.

Unit 2 Fundamentals of Machine Learning and Data Analytics (05hrs)

Introduction to ML concepts, supervised and unsupervised learning, classification and regression, clustering, dimensionality reduction (PCA, kernel PCA). Data types in civil engineering, preprocessing, feature selection, formalizing learning tasks, handling missing data, and importance of studentized residual tests and error analysis for model evaluation.

Unit 3 Supervised Learning Techniques and Civil Engineering Applications (07 hrs)

Regression techniques (linear, multiple, polynomial, logistic), classification techniques (k-nearest neighbors, support vector machines, decision trees, random forests, ensemble methods). Applications include structural damage detection, soil classification, traffic prediction, water quality modeling, and predictive maintenance of infrastructure. Case studies demonstrating model implementation with civil datasets.

Unit 4 Unsupervised Learning and Feature Extraction (06 hrs)

Clustering methods: k-means, hierarchical clustering, DBSCAN. Feature extraction and dimensionality reduction (PCA, kernel PCA) for civil engineering applications such as site characterization, anomaly detection in structural health monitoring, transportation mode inference, and level-of-service prediction. Visualization and interpretation of unsupervised learning results.

Unit 5 Neural Networks, Deep Learning, and Advanced ML Techniques (06 hrs)

Study of Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) with LSTM, and Generative Models such as

Variational Autoencoders (VAE) and GANs. Brief introduction to ML frameworks: Keras, PyTorch, and Spark.

Self-Study / Project-Based Learning **(05 hrs)**

Guest lecture on AI/ML applications in civil engineering by industry experts (e.g., Autodesk, Leica, major GCs), Mini-project on a civil engineering problem using ML techniques, Data preprocessing, feature selection, and model evaluation, Analysis, visualization, and interpretation of results, Submission of concise report and presentation.

Reference Books:

[1] Zhang, L., Pan, Y., Wu, X., & Skibniewski, M. J. (2021). Artificial Intelligence in Construction Engineering and Management. Springer.

[2] Heggond, S. (2025). Artificial Intelligence and Machine Learning for Smart Construction: Enhancing Real-Time Monitoring and Decision Making. Deep Science Research.

[3] Siddiqui, S. (2024). AI in Construction: AI Tools for Smarter, Safer Construction. Atlantic Publishers.

[4] Bahrami, N. (2023). AI in Construction Technology: A Deep Learning Approach to Building Better. Atlantic Publishers.

[5] Russell, S. J., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.

[6] Christopher M. Bishop, 2006, Pattern recognition and machine learning, Springer.

[7] Bernhard Scholkopf, and J Smola Alexander, 2002, Learning with kernels: support vector machines, regularization, optimization, and beyond, MIT press.

[8] Tom Michael Mitchell, 1998, Machine Learning, McGraw-Hill Education.

[9] John Shawe-Taylor & Nello Cristianini, 2000. Support Vector Machines and other kernel-based learning methods, Cambridge University Press.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	-	3	1	2
CO2	3	-	3	1	3
CO3	3	2	3	1	3
CO4	3	2	3	1	3
CO5	3	2	3	1	3

Road Safety and Road Safety Audit

Course Code:		**Credit: 3**	
Teaching Scheme: Hrs/Week		**Examination Scheme:**	
Lectures:	3	MSE:	30
Self-Study:	1	TA	20
Lab:	0	ESE:	50

Course Outcomes: Students will be able to:

1. Define key aspects of road accidents, distinguish accidents from crashes, and recall elements of road safety plans.
2. Explain the impact of human factors on road safety, analyze planning considerations, and comprehend crash reconstruction principles and statistical analysis of accidents.
3. Utilize road safety engineering principles for designing safe road links and junctions, apply statistical analysis to predict accidents, and use crash data for hazard identification.
4. Evaluate economic aspects of accidents, analyze road safety audits, and critically assess crash locations through diagnostic processes and data interpretation.
5. Assess the effectiveness of road safety strategies, before-after methods in crash analysis, and critically evaluate statistical models related to accidents and road safety audits.

Unit 1: Introduction **[7 Hrs]**

Road traffic accidents scenario in India, characteristics of accidents, accident vs. crash, effect of human factors, planning for road network, land use and road environment for safety, designing for road safety - links and junctions, road safety engineering, road safety improvement strategies, elements of a road safety plan.

Unit 2: Crash investigation and analysis **[9 Hrs]**

Steps in treatment of crash locations, diagnosing crash problem and solutions, accident report form, storing of data, using and interpreting crash data, identifying and prioritizing hazardous locations, condition and collision diagrams; Vulnerable Road Users: crashes related to pedestrian and bicyclists, their safety, provision for disabled; Crash reconstruction: understanding basic physics, calculation of speed for various skid, friction, drag, and acceleration scenarios

Unit 3: Statistical analysis of accidents **[7Hrs]**

Descriptive statistics, confidence interval, hypothesis testing, models related to accident frequency, accident severity, accident duration, various methodological issues - over/under dispersion, time-varying explanatory variables, unobserved heterogeneity, endogeneity, under-reporting, spatial and temporal correlation, etc; Accident prediction model.

Unit 4: Before -after methods in crash analysis **[6Hrs]**

Before and after study, before and after study with control sites, comparative parallel study, before, during and after study, Empirical Bayes method

Unit 5: Economic analysis of accidents **[6Hrs]**

Introduction to Economic Analysis of Accidents, Components of Accident Costs, Accident costing-economic appraisal, Methods of accident costing, Economic Appraisal of Road Safety Projects, EUAC, PWOC, B/C ratio, IRR, NPV.

Unit 6: Self-Study

National and international standards for road safety (IRC, MoRTH, AASHTO, PIARC guidelines), Legal and institutional aspects of road safety in India, Road safety action plans and policies (state and national level), Road safety education, enforcement, and awareness programs, Emerging technologies in road safety (AI-based video analytics, drones for safety monitoring).

Textbooks:

1. R.S. Jacob & Dr. K. Ramachandran, Road Safety Engineering, PHI Learning (2018)
2. Dr. S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Highway Safety and Accident Analysis, Nem Chand Publishers
3. Rune Elvik, Alena Høye, Truls Vaa, Michael Sørensen, Highway Safety Engineering, Cengage Learning, Latest Edition
4. Roger P. Roess, Elena S. Prassas, William R. McShane, Traffic Engineering. Pearson Education, 5th Edition
5. Simon Washington, Matthew Karlaftis, Fred Mannering, Transportation Statistics and Microsimulation, CRC Press, 2nd Edition

Reference Books:

1. PIARC (World Road Association) – *Technical Reports on Road Safety & AI Applications*; International Best Practices
2. IRC: SP: 88 – *Manual on Road Safety Audit: Road Safety Audit Guidelines (India)*
3. IRC: SP: 84, IRC: 35, IRC: 67: Road Accident Investigation
4. MoRTH – *Road Accident Report Annual Publications: Crash Data & Institutional Aspects*

Web Resources:

[6] National Highways Authority of India "Manual on Road Safety Audit" (PDF) — provides procedure, stages of audit (feasibility, design, construction, operational) and India-context details.

[7] Urban-Road Safety Audit guideline (PDF) — focused on urban contexts: land-use, pedestrian/bicycle vulnerable users etc.

[8] "RSA of Roads more than 5 KM in length" – Government of India portal (NRIDA/PMGSY) — audit requirement for rural roads, good for link with planning, land-use, safety elements.

[9] "Road Safety Audit Guidelines of Selected Nations — comparative review" (journal article) — helpful for self-study of international vs Indian standards, institutional/legal aspects.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	1	2	1	1
CO2	3	2	3	2	2
CO3	3	2	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	3	3

1 – Slightly; 2 – Moderately; 3 – Substantially

Construction Management Lab -II

Course Code:	**Credit: 2**
Teaching Scheme: Hrs/Week	**Examination Scheme:**
Lectures: 0	Lab ISE: 50 (CIE)
Self-Study: 1	Lab ESE: 50
Lab: 4	

Course Outcomes: Students will be able to:

1. Prepare and evaluate project cash flows, tender analyses, and financial statements.
2. Develop method statements, resource plans, and feasibility studies for advanced construction technologies.
3. Draft and compare tender/contract documents with technical, financial, and legal aspects.
4. Interpret and evaluate site practices related to planning, execution, safety, quality, and resource management through field visits.
5. Apply analytical, statistical, optimisation, and visualisation tools to support decision-making in construction projects.

A. Students have to complete the following assigned works/assignments/projects as part of the laboratory.

1. Prepare a detailed project cash flow statement for a selected project and evaluate it using at least two methods.
2. Prepare a comparative cost analysis of two tender bids using item-rate contract data.
3. Prepare a method statement and resource plan (equipment, manpower, materials) for a specialised technique.
4. Conduct a feasibility analysis for adopting an advanced construction technology (e.g., precast vs. cast-in-situ) in terms of cost, time, and quality.
5. Prepare a draft tender/contract document for a medium-scale civil engineering project, incorporating general conditions, special conditions, payment terms, and dispute resolution clauses, etc.
6. Prepare a balance sheet and fund flow statement for a construction organisation, showing financial health indicators.
7. Any two assignments based on the chosen Elective-II, decided by the lab faculty.
8. Any two assignments based on the chosen Elective III, decided by the lab faculty.

Any other assignment/ Project decided by the lab Faculty.

B. Site Visits

- Visit building/infrastructure projects/ Sustainable Building/ Special Construction Projects, etc.
- Prepare reports on planning, execution, safety, quality, and resource management.

C. Software Applications

Use of different software like Primavera, MSP, SPSS, TORA, Advanced Excel, and Power BI, etc., for construction management applications.

	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	-	3
CO2	2	-	3	3	2
CO3	2	3	3	-	2
CO4	-	2	2	3	2
CO5	3	-	3	-	3

1 – Slightly; 2 – Moderately; 3 - Substantially

Technical Communication Skills

Course Code:	**Credit:** 2
Teaching Scheme	**Examination Scheme**
Lectures: 1 Hrs	MSE: Lab ISE:
Self-Study: 1 Hrs	TA:
Lab: 2 Hrs	

Course Outcomes: Students will be able to:

1. Produce effective dialogue for business related situations
2. Use listening, speaking, reading and writing skills for communication purposes and attempt tasks by using functional grammar and vocabulary effectively
3. Analyze critically different concepts/principles of communication skill s
4. To appreciate, analyze, and evaluate business reports and research papers

Unit 1: Fundamentals of Communication

7 Cs of communication, common errors in English, enriching vocabulary, styles, and registers.

Unit 2: Aural-Oral Communication

The art of listening, stress and intonation, group discussion, oral presentation skills.

Unit 3: Reading and Writing

Types of reading, effective writing, business correspondence, interpretation of technical reports and research papers.

Textbooks:

[1]. Raman Sharma, "Technical Communication", Oxford University Press.
[2]. Raymond Murphy "Essential English Grammar" (Elementary & Intermediate) Cambridge
[3]. University Press.
[4]. Markel, M., & Rosson, P. (2024). Technical Communication (14th ed.). Bedford/St. Martin's.
[5]. Shirley Taylor, "Model Business Letters, Emails and Other Business Documents" (seventh
[6]. edition), Prentice Hall
[7]. Thomas Huckin, Leslie Olsen "Technical writing and Professional Communications for Non- native speakers of English", McGraw Hill.

Reference Books:

[1]. Thomas Huckin, Leslie Olsen, "Technical writing and Professional Communications for Non- native speakers of English", McGraw-Hill.
[2]. Pfeiffer, W., & Goodall, H. L. (2024). Technical Communication: A Practical Approach. Pearson.

Web Resources:

[1]. MIT OpenCourseWare – Technical Communication, https://ocw.mit.edu/courses/technical- communication
[2]. Purdue OWL (Online Writing Lab) – Technical Writing, https://owl.purdue.edu/owl/subject_specific_writing/technical_writing/index.html

[3]. IEEE Author Center – Resources for Writing Technical Papers, https://authorcenter.ieee.org
[1]. Nature Masterclasses – Scientific Writing and Publishing, https://masterclasses.nature.com
[2]. Toastmasters International – Public Speaking Resources, https://www.toastmasters.org/resources
[3]. GitHub: Awesome Technical Writing, https://github.com/maestroj/awesome-technical- writing
[4]. The Hemingway App: A tool for clear writing, http://www.hemingwayapp.com/

Liberal Learning

Course Code:	**Credit: 1**
Teaching Scheme	**Examination Scheme**
Lectures: 0	ISE: 100
Lab: 2 hrs	
Self-study: 2 Hrs/week	

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

CO 1: Develop capacity to understand multidisciplinary sciences in a friendly manner.

CO 2: Create openness to diversity.

CO 3: Acquire ability to lead and examine life and value the need for life learning.

Student will be able to choose and enhance practical learning and application in the subject of his/her choice. One credit course spread over the semester to enhance practical learning and application.

- Dance
- Film Appreciation
- Music Vocal
- Painting
- Agriculture
- Business
- Clay Art & Pottery
- Corporate Culture
- Defense
- French
- Geography
- Holistic Health
- Modern Film Making
- Music (Instrumental)
- Photography
- Political Science
- Music (Vocal)
- Wood and Metal Art
- Japanese

SEMESTER III

Massive Open Online Course – I

Course Code:	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Lecture: 3 Hrs/week	CIE: 50
Self-study: 1 Hrs/week	ESE: 50

Course Outcomes: Students will be able to:

1. Acquire new skills or knowledge to enhance their personal and professional development.
2. Receive a flexible learning environment, allowing one to study at own pace and convenience.
3. Opportunity for lifelong learning.
4. Foster collaboration and networking among participants.

The students in consultation with the PG Coordinator/Faculty/Head of the department, opt for a course of 12 weeks PG level offered by the NPTEL/SWAYM in the semester. The students need to register for the examination conducted by the NPTEL.

Massive Open Online Course – II

Course Code:	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Lecture: 3 Hrs/week	CIE: 50
Self-study: 1 Hrs/week	ESE: 50

Course Outcomes: Students will be able to:

1. Acquire new skills or knowledge to enhance their personal and professional development.
2. Receive a flexible learning environment, allowing one to study at own pace and convenience.
3. Opportunity for lifelong learning.
4. Foster collaboration and networking among participants.

The students in consultation with the PG Coordinator/Faculty/Head of the department, opt for a course of 12 weeks PG level offered by the NPTEL/SWAYM in the semester. The students need to register for the examination conducted by the NPTEL.

Dissertation Phase – I

Course Code:

Credit: 11

Teaching Scheme

Lab: 22 Hrs

Self-Study: 12 Hrs

Examination Scheme

CIE: 70

ESE: 30

Course Outcomes: Students will be able to:

1. Demonstrate how to search the existing literature to gather information about a specific problem or domain.
2. Identify the state-of-the-art technologies and research in the chosen domain and highlight open problems that are relevant to societal or industrial needs.
3. Evaluate various solution techniques to determine the most feasible solution within the given constraints for the chosen dissertation problem.
4. Apply software engineering principles related to requirements gathering and design to produce relevant documentation.
5. Write a dissertation report that details the research problem, objectives, literature review, and solution architecture.
6. Deliver effective oral presentations to communicate the findings and outcomes of the research work.

Guidelines:

The dissertation is a year-long project, conducted and evaluated in two phases. It can be carried out either in-house or within an industry as assigned by the department. The project topic and internal advisor (a faculty member from the department) are determined at the beginning of Phase I.

Students are expected to complete the following activities in Phase-I:

1. Literature survey
2. Problem Definition and Research Gap
3. Aim and Objectives
4. Preliminary design /Experimentation/ feasibility / modular approaches

SEMESTER IV

Dissertation Phase – II

Course Code:	**Credit: 11**
Teaching Scheme	**Examination Scheme**
Lab: 22 Hrs	CIE: 70
Self-Study: 12 Hrs	ESE: 30

Course Outcomes: Students will be able to

1. Achieve proficiency in the languages, tools, libraries, and technologies used in the dissertation work.
2. Apply project planning principles and techniques to ensure effective and efficient project execution.
3. Demonstrate an understanding of the entire lifecycle of a software product or solution.
4. Produce artifacts such as source code, test plans, and test results based on the dissertation work.
5. Write research paper(s) and a thesis in accordance with publication ethics.
6. Exhibit the presentation skills needed to effectively present the work at various platforms.

Guidelines:

Students are expected to complete the following activities in Phase-II:

1. Implementation of the proposed approach in the first stage
2. Testing/ Data Collection, Analysis, and validation of the implemented solution
3. Writing of a report and presentation
4. Publish the work done at a suitable peer-reviewed conference/ journal.