M.E. DEGREE (CONSTRUCTION ENGINEERING AND MANAGEMENT) PROGRAMME

CURRICULUM AND DETAILED SYLLABI

FOR

FIRST SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2026-27 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

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Passed in Board of Studies Meeting held on 23.05.2026 Approved in 71st Academic Council meeting on 27.06.2026

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
M.E. Degree Programme

COURSES OF STUDY
(For the candidates admitted from 2026-27 onwards)

FIRST SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
26PBKA0	Applied Statistics and Optimization	FC	2	1	-	3
26PBCA0	Construction Methods and Equipments	PCC	3	-	-	3
26PBCB0	Procurement, Tendering and Contracts	PCC	3	-	-	3
26PBCC0	Building Information Modeling	PCC	3	-	-	3
26PBPXX	Program Elective Course - 1	PEC	3	-	-	3
THEORY CUM PRACTICAL						
26PBCD0	Project Formulation and Implementation	PCC	2	-	2	3
PRACTICAL						
26PBCE0	Building Information Modeling Laboratory	PCC	-	-	4	2
VALUE ADDED COURSES						
26XXXXX	VAC - 1	VAC				-
		Total				**20**

FC : Foundation Course
PCC : Programme Core Courses
PEC : Programme Elective Courses
VAC : Value Added Courses

L : Lecture
T : Tutorial
P : Practical

Note:
1 Lecture Period/week is equivalent to 1 credit
1 Tutorial Period/week is equivalent to 1 credit
1 Practical Period/week is equivalent to 0.5 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
M.E. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2026-27 onwards)

FIRST SEMESTER

S.No	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	26PBKA0	Applied Statistics and Optimization	3	40	60	100	27	50
2	26PBCA0	Construction Methods and Equipments	3	40	60	100	27	50
3	26PBCB0	Procurement, Tendering and Contracts	3	40	60	100	27	50
4	26PBCC0	Building Information Modeling	3	40	60	100	27	50
5	26PBPXX	Program Elective Course - 1	3	40	60	100	27	50
THEORY CUM PRACTICAL								
6	26PBCD0	Project Formulation and Implementation	3 (Terminal Exam Type : Theory)	50	50	100	22.5	50
PRACTICAL								
7	26PBCE0	Building Information Modeling Laboratory	3	60	40	100	18	50

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI –625015

M.E. DEGREE PROGRAMMES

CREDIT DISTRIBUTION

(For the students admitted from the Academic Year 2026-27 onwards)

Sl.No.	Category	Credits
A.	Foundation Course (FC)	03
B.	Program Core Courses (PCC)	22
C.	Program Elective Courses (PEC)	18
D.	Research Methodology and IPR course (RMC)	03
E.	Employability Enhancement Course (EEC)	27
F.	Value Added Courses (VAC) (Non-Credit and not included in CGPA) (04credits)	-
	Minimum Credits to be earned for the award of the Degree	73
		From A to E and the successful completion of F

M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT SCHEDULING OF COURSES FOR STUDENTS JOINED FROM ACADEMIC YEAR 2026-27 ONWARDS

Sem	Theory						Theorycum Practical	Practical	ValueAdded Courses	Employability Enhancement Courses	Credit
	1	2	3	4	5	6	7	8			
I	26PBKA0 Applied Statistics and Optimization (FC-3)	26PBCA0 Construction Methods and Equipments (PCC-3)	26PBCB0 Procurement, Tendering and Contracts (PCC-3)	26PBCC0 Building Information Modeling (PCC-3)		PEC-1 (PEC-3)	26PBCD0 Project Formulation and Implementation (PCC-3)	26PBCE0 Building Information Modeling Laboratory (PCC-2)	VAC-1 (2 credits)		20
II	26PBCF0 Construction Quality and Safety (PCC-3)	PEC-2 (PEC-3)	PEC-3 (PEC-3)			Research Methodology and IPR Course (3 Credits)	26PBCG0 Project Planning and Control (PCC-3)	26PBCH0 Project Management Laboratory (PCC-3)	VAC-2 (2 credits)	Mini Project (3 credits)	20
III	PEC-4 (PEC-3)	PEC-5 (PEC-3)	PEC-6 (PEC-3)							Project-I (9 credits)	18
IV										Project-II (15 Credits)	15
											73

Passed in Board of Studies Meeting held on 23.05.2026

Approved in 71st Academic Council Meeting on 27.06.2026

26PBKA0	APPLIED STATISTICS AND OPTIMIZATION

Category*	L	T	P	Credit
FC	2	1	0	3

Preamble

This course introduces fundamental concepts of statistical analysis and operations research for problem solving and decision making. It covers correlation, regression analysis, and hypothesis testing for data analysis and inference. The course also includes design of experiments, mathematical modeling, and graphical solution techniques in operations research. Further, it focuses on linear programming problems and their applications in optimal resource allocation and management.

Prerequisite

- NIL

Course Outcomes

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

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	Conduct one-sample z-tests and t-tests to evaluate hypotheses about a population mean and population proportion.	TPS3	16	SDG4	2
CO2	Conduct two-sample z-tests, t-tests, and F-tests to evaluate hypotheses about difference between population means, proportions, and variances.	TPS3	17	SDG4	2
CO3	Apply analysis of variance techniques for analyzing experimental data and interpreting results	TPS3	17	SDG4	2
CO4	Formulate and solve linear programming models for real-life problems using graphical methods.	TPS3	15	SDG4	2
CO5	Apply optimization techniques such as the Simplex method and Big-M method to solve linear programming problems	TPS3	20	SDG4	2
CO6	Apply transportation, assignment, and traveling salesman problem techniques for optimal resource allocation and decision making	TPS3	15	SDG4	2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	S	S	L	-	-	-	-	-	-	-	-	L	-
CO2	S	S	L	-	-	-	-	-	-	-	-	L	-
CO3	S	S	L	-	-	-	-	-	-	-	-	L	-
CO4	S	S	L	-	-	-	-	-	-	-	-	L	-
CO5	S	S	L	-	-	-	-	-	-	-	-	L	-
CO6	S	S	L	-	-	-	-	-	-	-	-	L	-

S - Strong; M - Medium; L – Low

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	32	32			16
CO2	34	34			17
CO3	34	34			17
CO4			20	20	10
CO5			40	40	20
CO6			40	40	20
Total	**100**	**100**	**100**	**100**	**100**

Syllabus

Testing of Hypothesis: Hypotheses and Test Procedures – z tests for Hypotheses about a Population Mean – The One Sample t test – Tests Concerning a Population Proportion – z Tests and Confidence Intervals for a Difference between Two Population Means – The Two Sample t Test and Confidence Interval – Inferences Concerning a Difference between Population Proportions – Inferences Concerning Two Population Variances.

Design of Experiments: Analysis of Variance – Single-Factor ANOVA – Two-Factor ANOVA – Three-Factor ANOVA.

Linear Programming – Formulation & Graphical Solution: Formulation of Linear Programming Problems – Canonical and Standard Forms of Linear Programming Problem – Graphical method of Solution.

Linear Programming – Solution Methods: The Simplex Method – Big-M Method.

Applications of Linear Programming Problem: The Transportation Model – Formulation and Solution of Transportation Models – The Assignment Model – The Hungarian method for Solution of the Assignment Problem – The Travelling Salesman Problem.

Learning Resources

7.1 Text Book

1. Jay Devore, “Probability and Statistics for Engineering and the Sciences”, Brooks/Cole Pub Co, 9th Edition, 2015.
   Testing of Hypothesis: 8. 1 – 8.4, 9.1, 9.2, 9.4, 9.5
   Design of Experiments: 10.1, 11.1, 11.2, 11.3
2. Prem Kumar Gupta and D.S. Hira. “Problems in Operations Research”, S. Chand & Co Pvt Ltd, 7th Revised Edition, 2014.
   Linear Programming – Formulation & Graphical Solution: 2.6, 2.9, 2.12
   Linear Programming – Solution Methods: 2.16, 2.17.1
   Applications of Linear Programming Problem: 3.5 Step II: Method 5, Step III: Method 2, 4.5, 4.10

7.2 Reference Books & Web resources

1. Irwin Miller, John E. Freund “Probability and Statistics for Engineers” Prentice Hall of India Pvt. Ltd.; New Delhi, 2nd Edition, 1977.
2. T. Veerarajan “Probability, Statistics and Random Processes” Tata McGraw-Hill, New Delhi, 4th Edition, 2015.

8 Course Contents and Lecture Schedule

Module No	Topics	No of Periods
1	**Testing of Hypothesis**	
1.1	Hypotheses and test procedures	1
1.2	z tests for hypotheses about a population mean	1
	Tutorial	1
1.3	The one sample t test	1
1.4	Tests concerning a population proportion	1
	Tutorial	1
1.5	z Tests and Confidence Intervals for a Difference Between Two Population Means	1
1.6	The Two-Sample t Test and Confidence Interval	1
	Tutorial	1
1.7	Inferences Concerning a Difference Between Population Proportions	1
1.8	Inferences Concerning Two Population Variances	1
	Tutorial	1
2	**Design of Experiments**	
2.1	Analysis of Variance	1
2.2	Single-Factor ANOVA	1
	Tutorial	1
2.3	Two-Factor ANOVA	1
2.4	Three-Factor ANOVA	1
	Tutorial	1
3	**Linear Programming – Formulation & Graphical Solution**	
3.1	Formulation of Linear Programming Problems	1
3.2	Canonical and Standard Forms of Linear Programming Problem	1
	Tutorial	1
3.3	Graphical method of solution	2
	Tutorial	1
4	**Linear Programming – Solution Methods**	
4.1	Simplex method	2
	Tutorial	1
4.2	Big -M method	2
	Tutorial	1
5	**Applications of Linear Programming Problem**	
5.1	Formulation and Solution of Transportation Models	2
	Tutorial	1
5.2	The Hungarian method for Solution of the Assignment Problem	1
5.3	The Traveling salesman problem	1
	Tutorial	1
	Total	**36**

9 Course Designer(s):

1. Dr. K. Saravanakumar, kskmat@tce.edu
   Assistant Professor, Department of Mathematics
2. Dr. P. Jeyadurga, pjdmat@tce.edu
   Assistant Professor, Department of Mathematics
3. Dr. A. Muneesh Kumar, amkmat@tce.edu
   Assistant Professor, Department of Mathematics

26PBCA0	CONSTRUCTION METHODS AND EQUIPMENTS

Category	L	T	P	Credit
PCC	3	0	0	3

Preamble

This course provides advanced knowledge of modern construction techniques, mechanized construction practices, and equipment management required for efficient execution of infrastructure and building projects. It equips construction professionals with the ability to select, plan, operate, and manage appropriate construction equipment and methods to enhance productivity, safety, quality, cost-effectiveness, and sustainability in construction projects, while addressing contemporary industry practices and technological advancements.

Prerequisite

NIL

Course Outcomes

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

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	Apply advanced construction methods with a focus on safety and material expertise.	TPS 3	10	9	1
CO2	Apply the suitable techniques to construct the substructure based on site condition	TPS 3	20	9	1
CO3	Apply the suitable techniques and equipments for any type of superstructure construction	TPS 3	20	9	1
CO4	Apply principles of construction equipment selection and productivity assessment for Various construction activities.	TPS 3	10	9	1
CO5	Apply knowledge of earthwork, concreting, and road construction equipment to select andoperate appropriate machinery for specificconstruction activities.	TPS 3	20	9	1
CO6	Apply the role of modern technologies and automation in construction management in enhancing project performance.	TPS 3	20	9	1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	S	M	L	-	-	L	S	L	L	L	L	M	L
CO2	S	M	L	-	-	L	S	L	L	L	L	M	L
CO3	S	M	L	-	-	L	S	L	L	L	L	M	L
CO4	S	M	L	-	-	L	S	L	L	L	L	M	L
CO5	S	M	L	-	-	L	S	L	L	L	L	M	L
CO6	S	M	L	-	M	L	S	L	L	L	L	M	L

S-Strong;M-Medium;L-Low

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	**30**	**30**	**-**	**-**	**10**
CO2	**35**	**35**	-	-	**20**
CO3	**35**	**35**	**-**	**-**	**20**
CO4	**-**	**-**	**35**	**35**	**20**
CO5	-	-	35	35	20
CO6	**-**	**-**	**30**	**30**	**10**
Total	**100**	**100**	**100**	**100**	**100**

Syllabus

Introduction to construction methods:

Construction Methods - High rise Buildings, Highways, Bridges,Offshore platforms, Slip form for Chimneys and Cooling Towers, Steel construction-fabrication and erection.

Sub Structure Construction:

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

Super structure Construction:

Launching girders, bridge decks, offshore platforms – Material handling – erecting lightweight components on tall structures – Embankment Construction – Ground improvement techniques – Retaining and Breast walls on hill

road Bituminous Constructions – Concrete road construction

Introduction to Construction Equipment

Importance and Classification of construction equipment, Functions and operations of Construction equipments, Commonly used Machineries and hand tools, Environmental impacts of construction equipment,Equipment productivity- Factors affecting &Methods of estimation.

Construction machinery for Earth moving, concreting and Road works

Heavy earth moving equipment Construction machinery for Concreting Concrete Batching Plants Road making –Grading and compaction equipment, Hot mix plant and asphalt paver Machine

Modern Trends in Equipment Management

Digital Solution in Construction Projects, Introduction to 3D Concrete Printer, GPS tracking, IoT sensors, and data-driven maintenance, Real-world applications from construction companies

6.1 Text Book

1.Robert L. Peurifoy,Clifford J. Schexnayder,Aviad Shapira,Robert L. Schmitt,AaronCohen, Construction Planning, Equipment and Methods, McGraw Hill, New Delhi, tenth Edition, 2024

6.2 Reference Books &Web resources

1.James J. O'Brien, John A. Havers, Frank W. Stubbs Jr. Standard Handbook of Heavy Construction, 3rd Edition, McGraw-Hill

2.F. Harris, Modern Construction and Ground Engineering Equipment and Method, Prentice Hall 2nd Edition, 1994.

3.Sharma, S.C., Construction Equipment & Management, 2019, Khanna Publishing House, India

7. Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1.0	**Introduction to construction methods:**		
1.1	Construction Methods - High rise Buildings and Highways	1	CO1
1.2	Construction Methods – Bridges and Offshore platforms	1	
1.3	Slip form for Chimneys and Cooling Towers	1	
1.4	Steel construction-fabrication and erection.	1	
2.0	**Sub Structure Construction**		CO2
2.1	Techniques of Box jacking – Pipe Jacking	2	
2.2	Under water construction of diaphragm walls and Basement	1	
2.3	Tunneling techniques	1	
2.4	Piling techniques	1	
2.5	Dewatering and standby Plant equipment for underground open excavation	1	
2.6	Case studies	1	
3.0	**Super structure Construction**		CO3
3.1	Launching girders, bridge decks, offshore platforms.	2	
3.2	Material handling – erecting lightweight components on tall structures	2	
3.3	Bituminous Constructions – Concrete road construction	1	
3.4	Embankment Construction – Ground improvement techniques Retaining and Breast walls on hill road	2	
4.0	**Introduction to Construction Equipment**		CO4
4.1	Importance and Classification of construction equipment	1	
4.2	Functions and operations of Construction equipment	1	
4.3	Commonly used Machineries and hand tools	1	
4.4	Equipment productivity- Factors affecting& Methods of estimation.	1	
5.0	**Construction machinery for Earth moving, concreting and Road works**		CO5
5.1	Heavy earth moving equipment	1	
5.2	Construction machinery for Concreting	1	
5.3	Concrete Batching Plants	1	
5.4	Road making –Grading and compaction equipment	2	
5.5	Hot mix plant and asphalt paver Machine	2	
6.0	**Modern Trends in Equipment Management**		CO6
6.1	Digital Solution in Construction Projects	2	
6.2	Introduction to 3D Concrete Printer	1	
6.3	GPS tracking, IoT sensors, and data-driven maintenance	2	
6.4	Real-world applications from construction companies	2	
	Total Hrs.	36	

8.Course Designer(s):

1. Dr. V. Ravisankar, Associate Professor, Department of Civil Engineering,	environmentalengr@tce.edu
2. Mr. B. Dinesh Kumar, Assistant Professor, Department of Civil Engineering	bdciv@tce.edu

26PBCB0	PROCUREMENT,TENDERING AND CONTRACTS

Category	L	T	P	Credit
PCC	3	0	0	3

1. Preamble

Every construction project is bound by a Contract. Proper Contract Management plays a major role in the effective management of construction projects.The course covers all the fundamentals required for a good understanding of construction contracts.This course provides knowledge on tendering procedures, construction contracts, and legal regulations involved in construction projects. It also focuses on contract administration, claims management, arbitration, and dispute resolution techniques for effective project execution.

2. Prerequisite

NIL

3. Course Outcomes

After the successful completion of the course, students will

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	Apply the material procurement process,storage, vendor selection and inventory control in construction projects.	TPS 3	10	12	1
CO2	Demonstrate tendering processes in construction projects..	TPS 3	20	8	1
CO3	Analyse construction contract processes and associated procedural challenges.	TPS 4	20	11	1
CO4	Apply the principles of the Indian Contract Act, 1872, to administer contractual issues in construction projects	TPS 3	10	16	1
CO5	Apply contract clauses for risk allocation and claims management.	TPS 3	20	12	1
CO6	Apply dispute resolution methods for resolving construction contract disputes.	TPS 3	20	16	

4. Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	L	L	L	-	-	L	M	L	-	S	L	M	L
CO2	L	L	L	-	-	L	M	L	-	S	L	M	L
CO3	L	L	L	-	-	L	M	L	L	S	L	M	L
CO4	L	L	L	-	-	L	M	L	L	S	L	M	L
CO5	L	L	L	-	-	L	M	L	L	S	L	M	L
CO6	L	L	L	-	-	L	M	L	L	S	L	M	L

5. Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam

	% of Marks	**% of Marks**	**% of Marks**	**% of Marks**	**% of Marks**
CO1	**30**	**30**	**-**	**-**	**10**
CO2	**35**	**35**	**-**	**-**	**20**
CO3	**35**	**35**	**-**	**-**	**20**
CO4	**-**	**-**	**30**	**30**	**10**
CO5	-	-	**35**	**35**	20
CO6	**-**	**-**	**35**	**35**	**20**
Total	**100**	**100**	**100**	**100**	**100**

6. Syllabus

Material Procurement :

Importance of material management in construction industry**-** Vendor identification – prequalification and selection- Inventory and storage management- Negotiations and contracts with supplier-

Tendering process :

Understanding the tendering process-Tendering and proposal preparation**-**Prebid meeting, cost estimation**-**Evaluation of tender form **-**E tendering process-Tamilnadu Transparency in Tenders Act.

Construction contract:

General Principles of Contract -Contract Terminologies & Definitions-

Types of Construction Contract and their Features -Standard Contract document International contract document- FIDIC form of Contract -Typical structure of contract-Preamble, Scope and Specifications-Preliminaries and General - Insurance policies, Bonds and Guarantees

Legal foundations of contract-Indian Contract act 1872 –Salient Features;Legal classifications of contract ;Essential elements of valid Contract; Performance of contract Breach of contract and its remediation.

Risk allocation and claims management:

contractual risk management -Variation ,change & Claims Management- Digital contract Management -Case studies –contract clause interpretation.

Dispute resolution in construction:

Alternate methods of dispute resolution-Arbitration and conciliation Act- Fundamentals of arbitration-Types of arbitration and arbitration awards-Conciliation.

7. Text Book

1. Avtar Singh's “Law of Contract & Specific Relief” by Rajesh Kapoor13th Edition 2022, Reprinted 2026 Eastern Book Company ISBN: 9789394364745, 9789347559433

8. Reference Books& web resources

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, 2000.
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 3rd Edition, 2013.
3. Ali D. Haidar, Handbook of Contract Management in Construction, Springer Cham, 1st Edition, 2021
4. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 4th Edition 2015.
5. DharmendraRautray, Principles of Law of Arbitration in India, Wolters Kluwer, 2018.

9. SDG Alignment

1. SDG-16-**Preparation of e-tendering documentation** following legal and regulatory frameworks
2. SDG-8-**Case study analysis** on fair labour practices in construction contracts

10. Course Contents and Lecture Schedule

Module No.	Topic	No.of Hours	Course Outcome
1.	**Material Procurement**		
1.1	Importance of material management in construction industry	1	CO1
1.2	Vendor identification – prequalification and selection.	1	
1.3	Inventory and storage management	1	
1.4	Negotiations and contracts with supplier	1	
2.	**Tendering process**		
2.1	Understanding the tendering process- Evaluation of tender form	2	CO2
2.2	Tendering and proposal preparation	2	
2.3	Prebid meeting, cost estimation	1	
2.4	E- tendering process	1	
2.5	Tamilnadu Transparency in Tenders Act.	1	
3.	**Construction contract**		
3.1	General Principles of Contract –Contract Terminologies & Definitions	1	
3.2	Types of Construction Contract and their Features -Standard Contract document	2	CO3
3.3	International contract document- FIDIC form of Contract	2	
3.4	Typical structure of contract- Preamble, Scope and Specifications-Preliminaries and Insurance policies, Bonds and Guarantees	2	
4.0	**Legal foundations of contract**		
4.1	Indian Contract act 1872 –Salient Features	1	CO4
4.2	Essential elements of valid Contract	1	
4.3	Performance of contract	1	
4.4	Breach of contract and its remediation.	1	
5.	**Risk allocation and claims management**		
5.1	contractual risk management	2	CO5
5.2	Variation ,change & Claims Management	2	
5.3	Digital contract Management	1	
5.4	Case studies –contract clause interpretation.	2	

6.	**Dispute resolution in construction**		
6.1	Alternate methods of dispute resolution- -	1	CO6
6.2	Fundamentals of arbitration- -	1	
6.3	Arbitration and conciliation Act	2	
6.4	Types of arbitration and arbitration awards	2	
6.5	Conciliation.	1	
	Total hours	36	

11. Course Designer(s):

1. Dr. V. Ravisankar, Associate Professor, Department of Civil Engineering — environmentengr@tce.edu
2. Mr. B. Dinesh Kumar, Assistant Professor, Department of Civil Engineering — bdkciv@tce.edu

22PBCC0	BUILDING INFORMATION AND MODELING

Category*	L	T	P	Credit
PCC	3	0	0	3

1. Preamble

The course is concerned specifically with the utilization of Building Information Modelling (BIM) This course introduces the fundamental concepts, workflows, and applications of Building Information Modelling in the Architecture, Engineering, and Construction (AEC) industry.

2. Prerequisite

NIL

3. Course Outcomes

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

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	**Apply** BIM concepts, dimensions, standards, workflows, and information management principles in construction project environments.	TPS 3	10	9	1
CO2	**Use** BIM collaboration processes, interoperability methods, and data exchange standards such as IFC and COBie for coordinated project delivery.	TPS 3	20	9	1
CO3	**Implement** BIM execution strategies including BEP, MIDP, MPDT, LOIN matrix, and common data environment (CDE) requirements for project information management.	TPS	20	9	1
CO4	**Apply** BIM tools and techniques for clash detection, 4D scheduling, 5D cost estimation, quantity takeoff, and earned value management in construction projects.	TPS	20	9	1
CO5	**Utilize** BIM applications for facility management, asset information modeling, sustainable building design, and digital construction practices.	TPS	20	11	1
CO6	**Demonstrate** the application of emerging digital technologies such as Scan-to-BIM, Digital Twin, IoT, Big Data, Augmented Reality, and Virtual Reality in BIM-enabled construction projects through case studies.	TPS	10	9	1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	S	M	L	-	-	L	M	L	-	L	L	M	L
CO2	S	M	L	-	-	L	M	L	-	L	L	M	L
CO3	S	M	L	-	-	L	M	L	L	L	L	M	L
CO4	S	M	L	-	-	L	M	L	L	L	L	M	L
CO5	S	M	L	-	-	L	M	L	L	L	L	M	L

CO6	S	M	L	-	-	L	M	L	L	M	L	M	L

S- Strong; M-Medium; L-Low

4. Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	**30**	**30**	**-**	**-**	**10**
CO2	**35**	**35**	-	-	**20**
CO3	**35**	**35**	**-**	**-**	**20**
CO4	**-**	**-**	**35**	**35**	**20**
CO5	-	-	35	35	20
CO6	**-**	**-**	**30**	**30**	**10**
Total	**100**	**100**	**100**	**100**	**100**

5. Syllabus

Building Information and Modelling – Evolution of BIM - Dimensions of BIM – LOD – LOI – BIM New tools and Process - Federated Model – Challenges with Collaboration

BIM Standards – ISO 19650 – BS1192 (6) - – CDE - BIM workflow - Information Exchange and Information Requirement (OIR, EIR, PIR, AIR) – Comparison of Traditional and BIM workflow – Data Exchange methods

Collaboration and Interoperability - Supports for Standardization – File based exchanges –IFC – COBIE - BIM for Owners and Facility Mangers – BIM for Architects and Engineers – BIM for Sub-contractors and Fabricators

BIM Adoption and Implementation – BIM road maps – Maturity models and measures – BIM guides by region and organization – Cybersecurity for BIM – BIM in sustainable building design – Model Production Delivery Table (MPDT) - Task Information Delivery Plan (MIDP)

BIM in Construction Operation – Clash – Types – Clash detection matrix – BIM Execution Plan(BEP) – role of BIM in asset operation and maintenance – challenges in integration – AIM – BIM in Practice – BIM approaches and protocols using case studies – Organizational Information requirement

Field BIM – Introduction – LOIN Matrix - concept of 4D BIM – Scan to BIM – 5D BIM – QTO – Cost – EVM – Asset Information Model – Concept of Industrialization – IoT – Big Data –Case Studies - Data Analytics and their application in BIM – Digital Twin – Augmented and Virtual Reality – Case Studies.

6.1 Text Book

1. BIM Handbook – A guide to Building Information Modeling for Owners, Designers, Engineers, Contractors and Facility Managers, Rafael sacks, Charles Eastman, Ghang Lee, Paul Teichoiz, , Third Edition, Wiley Publication, 2018

6.2 Reference Books & Web resources

1. BIM in Principle and in Practice, Peter Barnes and Nigel Davies, ICE Publishing, 2020
2. Building Information Modeling, “Ä Strategic Implementation Guide for Architects, Constructors, Real Estate, Asset Managers”, Dana K. Smith, Michael Tardif, John Wile& Sons. Inc. Publishers
3. Construction Manger’s BIM Handbook, John Eynon, Wiley Blackwel publication, 2016
4. ISO – 19650 – 2018; Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling (Part 1 to 5)

7. Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1.0	**BIM Introduction**		CO1
1.1	Evolution of BIM - Dimensions of BIM	1	
1.2	LOD – LOI – BIM New tools and Process	1	
1.3	Federated Model – Challenges with Collaboration	2	
2.0	**BIM Standards**		CO2
2.1	ISO 19650 - CDE - Information Exchange	2	
2.2	Information Requirement (OIR, EIR, PIR, AIR)	2	
2.3	BIM workflow - Comparison of Traditional and BIM workflow	1	
2.4	Data Exchange methods	2	
3.0	**Collaboration and Interoperability**		CO3
3.1	Supports for Standardization – File based exchanges	1	
3.2	IFC – COBIE	2	
3.3	BIM for Owners and Facility Mangers	2	
3.4	BIM for Architects and Engineers – BIM for Sub-contractors and Fabricators	2	
4.0	**BIM Adoption and Implementation**		CO4
4.1	BIM road maps – Maturity models and measures	1	
4.2	BIM guides by region and organization – Cybersecurity for BIM	1	
4.3	BIM in sustainable building design	2	
	Model Production Delivery Table (MPDT) - Task Information Delivery Plan (TIDP)	3	
5.0	**BIM in Construction Operation**		CO5
5.1	Clash – Types	1	
5.2	Clash detection matrix	2	
5.3	BIM Execution Plan(BEP) – role of BIM in asset operation and maintenance – challenges in integration	2	
5.4	AIM – BIM in Practice – BIM approaches and protocols using case studies – Organizational Information requirement	2	
6.0	**Field BIM**		CO6
6.1	Introduction – LOIN Matrix - concept of 4D BIM	1	
6.2	Scan to BIM – 5D BIM – QTO – Cost – EVM	1	
6.3	Asset Information Model – Concept of Industrialization – IoT – Big Data – Case Studies	1	
6.4	Data Analytics and their application in BIM – Digital Twin – Augmented and Virtual Reality – Case Studies	1	
	Total Hrs.	36	

8. Course Designer(s):

1. Mr. B. Dinesh Kumar, Assistant Professor, Department of Civil Engineering bdkciv@tce.edu
2. Ms. M. Aruna, Assistant Professor, Department of Civil Engineering maciv@tce.edu

26PBCD0	PROJECT FORMULATION AND IMPLEMENTATION	Category	L	T	P	Credits	TE
		PCC	2	0	2	3	TCP-T

1Preamble

This theory cum practical course is designed to give an exposure on the theoretical concepts of project formulation, appraisal, finance and implementation of infrastructure projects. This course also aims to apply the theoretical knowledge to practical problems. It also gives an overview on planning, estimating project cost, assessment methods, analyse risk and private sector participation in infrastructure development projects. .

2.Prerequisite

Nil

3.Course Outcomes

On the successful completion of the course, students will be able to

No.	Course Outcome	TCE Proficiency Scale	CO Weightage (%)	SDG Addressed	SDG Level
CO1	Apply principles of project formulation to identify, screen, and develop infrastructure projects through preparation of ISR, feasibility studies, techno-economic reports, and detailed project reports considering statutory and environmental clearances.	TPS 3	15	9	1
CO2	Analyse project viability and performance using economic and financial appraisal techniques such as NPV, IRR, BCR, ARR, payback period, and international investment appraisal practices for infrastructure decision-making.	TPS 4	25	12	1
CO3	Apply project financing concepts, financial institutions' mechanisms, leverage principles, subsidies, and financial indicators to evaluate suitable financing strategies for construction and infrastructure projects.	TPS 3	20	12	1
CO4	Analyse project risks using quantitative and qualitative risk assessment techniques including sensitivity analysis, scenario analysis, break-even analysis, simulation models, Hillier model, and decision tree analysis for project selection under uncertainty.	TPS 4	25	11	1
CO5	Apply project implementation procedures involving tendering, bidding, contract administration, PPP frameworks, and contractual provisions for effective execution and management of infrastructure projects.	TPS 3	15	11	1
CO for PRACTICAL Components:					

CO6	Prepare a Initial Screening Report, Feasibility, SWOT analysis reports for identified Infrastructure Project	TPS 3	20	9	1
CO7	Prepare a Detailed Project Report for the Identified Infrastructure Project	TPS 3	20	9	1
CO8	Analyse the Economic feasibility and Financial Feasibility for the identified Project	TPS 4	20	9	1
CO9	Analyse the Risk uncertainty for the identified Infrastructure Project	TPS 4	20	11	1
CO10	Prepare Tender and Contract Document for the Selected Infrastructure project	TPS 3	20	16	1

4Assessment Pattern

CO	**Theory**		**Practical**		**Terminal Exam**
	CAT1	**CAT2**	**OCR/Continuous Assessment**	**Model Test CO-wise**	
	% of Marks	**% of Marks**	**% of Marks**	**% of Marks**	**% of Marks**
CO1	30	-	-	-	15
CO2	50	-	-	-	25
CO3	20	-	-	-	20
CO4	-	60	-	-	25
CO5	-	40	-	-	15
CO6	-	-	20	**100**	-
CO7	-	-	20		-
CO8	-	-	20		-
CO9	-	-	20		-
CO10	-	-	20		-
Total	100	100	100	100	100

(i). Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	S	M	L	-	-	L	M	L	-	L	L	M	L
CO2	S	M	L	-	-	L	M	L	-	L	L	M	L
CO3	S	M	L	-	-	L	M	L	L	L	L	M	L
CO4	S	M	L	-	-	L	M	L	L	L	L	M	L
CO5	S	M	L	-	-	L	M	L	L	L	L	M	L
CO6	S	M	L	-	-	L	M	L	L	M	L	M	L
CO7	S	M	L	-	-	L	M	L	-	L	L	M	L
CO8	S	M	L	-	-	L	M	L	-	L	L	M	L
CO9	S	M	L	-	-	L	M	L	L	L	L	M	L
CO10	S	M	L	-	-	L	M	L	L	L	L	M	L

Assessment Pattern: Practical Component

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester
Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Rubrics covering all Domains of learning
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	Rubrics covering all Domains of learning

5. Syllabus

Project Formulation: Introduction to various Infrastructure Sectors, Project – Concepts – Project Identification – Preparation of Initial Screening Report (ISR) – Approval of ISR and Project by Government / Owner / Statutory Authorities – Project Development Studies - Preliminary Analysis, SWOT analysis, Market, Technical, Financial, Economic and Ecological – Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.

Project Performance and Appraisal: Role of depreciation in cash flow Economic evaluation, NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of various methods, Indian Practice of Investment Appraisal, International Practice of Appraisal.

Project Financing: Project Financing – Means of Finance – Financial Institutions – Special Schemes – Government Subsidies – Leverage – Key Financial Indicators and Ratios.

Analysis of Risk – Different Methods of Analysis of Risk, Sensitivity analysis, Scenario analysis, Break even analysis, Hillier Model, Simulation analysis, Decision tree analysis, Project selection under risk – Selection of a Project and Risk Analysis in Practice.

Project Implementation: Tender Document – Terms and Conditions – Bidding Process – Contracts – Terminology in Contracts – Types of Contracts – Public Private Partnership in Projects.

6.1 Text Book

1. Chandra, P. (2023). Projects: Planning, analysis, selection, financing, implementation and review. McGraw Hill Education.

6.2 Reference Books& web resources

1. Machiraju, H. R. (2019). Introduction to project finance. Vikas Publishing House.
2. Agarwal, N. P., & Mishra, B. K. (2021). Project appraisal and financing. Himalaya Publishing House.
3. Esty, B. C. (2020). Modern project finance: A casebook. John Wiley & Sons. 5. United Nations Industrial Development Organization (UNIDO). (2018). Manual for the preparation of industrial feasibility studies. UNIDO.

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7. Course Contents and Lecture Schedule

Module No	Topics	No of Periods	**Course Outcomes**

1	**Project Formulation**:		
1.1	Introduction to various Infrastructure Sectors, Project – Concepts – Project Identification	1	CO1
1.2	Preparation of Initial Screening Report (ISR) – Approval of ISR and Project by Government / Owner / Statutory Authorities	1	
1.3	Project Development Studies - Preliminary Analysis, SWOT analysis, Market, Technical, Financial, Economic and Ecological	2	
1.4	Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report	1	
1.5	Detailed Project Report – Different Project Clearances required.	1	
2.0	**Project Performance and Appraisal**:		
2.1	Role of depreciation in cash flow Economic evaluation,	1	CO2
2.2	NPV – BCR – IRR – ARR – Urgency – Pay Back Period –	2	
2.3	Assessment of various methods, Indian Practice of Investment Appraisal, International Practice of Appraisal	1	
3.0	**Project Financing**:		
3.1	Project Financing – Means of Finance – Financial Institutions – Special Schemes – Government Subsidies – Leverage	1	CO3
3.2	Key Financial Indicators and Ratios.	1	
4.0	**Analysis of Risk** –,		
4.1	Different Methods of Analysis of Risk, Sensitivity analysis, Scenario analysis	2	CO4
4.2	Break even analysis, Hillier Model, Simulation analysis, Decision tree analysis	2	
4.3	, Project selection under risk – Selection of a Project and Risk Analysis in Practice	2	
5.0	**Project Implementation**:		
5.1	Tender Document – Terms and Conditions – Bidding Process —-	2	CO5
5.2	Contracts – Terminology in Contracts – Types of Contracts	2	
5.3	Public Private Partnership in Projects	2	
	Total Number of Periods	***24***	

List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	COs Addressed
1	Preparation of Initial Screening Report (ISR) for a selected infrastructure project.	2	6
2	SWOT Analysis and Preliminary Feasibility Study for an identified construction/infrastructure project.	2	6
3	Preparation of Pre-Feasibility Report (PFR) including market, technical, economic, ecological, and financial analysis.	2	6
4	Preparation of Detailed Project Report (DPR) with project estimates, implementation schedule, approvals, and statutory clearances.	2	7

5	Economic Appraisal Exercise involving computation and comparison of NPV, IRR, BCR, ARR, and Payback Period using spreadsheet tools.	2	8
6	Project Financing Case Study involving means of finance, leverage analysis, government subsidies, and evaluation of financial ratios.	2	8
7	Sensitivity and Scenario Analysis for varying project cost, revenue, and interest rate conditions using spreadsheet simulation.	2	9
8	Risk Analysis using Decision Tree and Simulation Models for project selection under uncertainty.	2	9
9	Preparation and Analysis of Tender Documents including notice inviting tender, conditions of contract, technical specifications, and bid evaluation criteria.	2	10
10	Comparative Study of Contract Types and PPP Models through analysis of real-life infrastructure project case studies.	2	10

8.Course Designer(s):

1. Mr. B. Dinesh Kumar, Assistant Professor, Department of Civil Engineering bdkciv@tce.edu
2. Ms. M. Aruna, Assistant Professor, Department of Civil Engineering maciv@tce.edu

26PBCE0	BUILDING INFORMATION MODELING LABORATORY	Category	L	T	P	Credits
		PCC	0	0	4	2

1Preamble

The course is concerned specifically with the utilization of Building Information Modelling (BIM) This course introduces the fundamental concepts, workflows, and applications of Building Information Modelling in the Architecture, Engineering, and Construction (AEC) industry.

2Prerequisite

NIL

3Course Outcomes

On the successful completion of the course, students will be able to

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	**Apply** BIM concepts, dimensions, standards, workflows, and information management principles in Open Building Designer.	TPS 3	10	9	1
CO2	**Use** BIM Modelling application for the residential building with all essential parameters and also collaboration processes, interoperability methods, and data exchange standards such as IFC and COBIE for coordinated project delivery.	TPS 3	20	9	1
CO3	**Implement** BIM execution strategy BEP, and also perform energy analysis on the constructed model.	TPS	20	9	1
CO4	**Apply** BIM tools and techniques for clash detection, and resolve the clashes and represent with clash detection matrix	TPS	20	9	1
CO5	Use IFC standards and link the 3D model to Synchro 4D scheduling, and compare the planned and actual sequence of construction	TPS	20	9	1
CO6	Use IFC standards and perform Cost calculation with the progress report, Tracking of projects as well developing the real time workflow through animation	TPS	10	9	1

4Assessment Pattern: Cognitive Domain

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester

Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Mid/End semester internal test
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	As directed by COE or as per curriculum

5 Mapping with Programme Outcomes and Programme Specific Outcomes

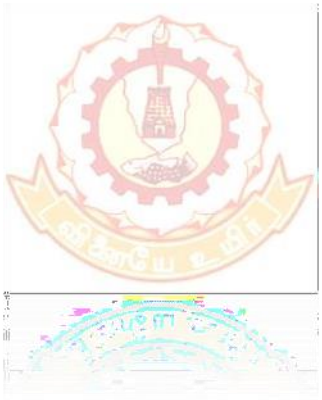
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	S	M	L	-	-	L	M	L	-	L	L	M	L
CO2	S	M	L	-	-	L	M	L	-	L	L	M	L
CO3	S	M	L	L	-	L	M	L	L	L	L	M	L
CO4	S	M	L	L	-	L	M	L	L	L	L	M	L
CO5	S	M	L	L	-	L	M	L	L	L	L	M	L
CO6	S	M	L	L	-	L	M	L	L	M	L	M	L

6 List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	COs Addressed
1.	Introduction to BIM application – LOD, Essentials of BIM and tool demonstration	01	CO1, 3, 4, 5
2.	Graphical User Interface of Open Building Designer – Architecture and Structure Panel	02	CO1, 2
3.	Graphical User Interface of Open Building Designer – Mechanical, Electrical and Plumbing Panels	01	CO1, 2
4.	Graphical User Interface of Open Building Designer – Visualization, Schedule, Energy Analysis and Quantity Estimation	03	CO1, 2
5.	Prepare the 3D model for G+1 building incorporating Architecture, Structure, Electrical sequencing	03	CO2, 3, 4, 5
6.	Prepare the 3D model for tall structure building incorporating Architecture, Structure, Electrical, Mechanical and Plumbing sequencing	03	CO2, 3, 4, 5
7.	Perform the Clash Detection and make clash detection matrix for the developed 3D models	03	CO2, 3, 4, 5
8.	Prepare Quantity Estimation, Schedules and Sectional views, BEP along with report for developed 3D models.	01	CO2, 3, 4, 5
9.	Introduction to Synchro 4D and Synchro 5D - Graphical User Interface	01	CO2, 3, 4, 5
10.	Use the 3D model with IFC format and import the model into Synchro,	03	CO2, 3, 4, 5, 6
11.	Develop the as planned schedule and compare as planned with built up schedule for developed 3D model	01	CO2, 3, 4, 5, 6
12.	Perform the Walkthrough, Tracking the process, prepare the animation sequencing for the developed model and	01	CO2, 3, 4, 5, 6

7. Course Designer(s):

1. Dr. V. Ravisankar, Associate Professor, Department of Civil Engineering — environmentengr@tce.edu
2. Mr. B. Dinesh Kumar, Assistant Professor, Department of Civil Engineering — bdkciv@tce.edu
3. Ms. M. Aruna, Assistant Professor, Department of Civil Engineering — maciv@tce.edu



26PBPA0	SUBSURFACE EXPLORATION AND FIELD TESTING

Category	L	T	P	Credit
PEC	3	0	0	3

Preamble

This course offers the methods for assessing the subsurface condition at the construction site during detailed site investigation. Students are exposed to various field and in-situ penetration tests for determining the soil and foundation parameters. Also, knowledge on appropriate ground improvement and soil stabilization techniques are imparted to overcome the challenges posed due to poor ground conditions at the site.

Prerequisite

Knowledge on Soil Mechanics and Foundation Engineering

Course Outcomes

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

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	Examine the subsoil condition at a site by suitable boring and sampling techniques	3	16%	11	1
CO2	Explain the significance of the results obtained from geophysical test methods	2	12%	11	1
CO3	Suggest suitable field test and predict the soil and foundation parameters	3	18%	11	1
CO4	Recommend appropriate in-situ penetration test based on the soil conditions at the site	3	18%	11	1
CO5	Recommend relevant ground improvement technique to mitigate adverse geotechnical conditions	3	18%	9	1
CO6	Decide the suitable soil stabilization technique to enhance soil bearing capacity and stability	3	18%	9	1

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	M	M	M	-	-	M	L	M	L	M	M	M	L
CO2	M	M	M	-	-	M	L	M	L	-	M	M	L
CO3	S	M	M	-	-	M	L	M	L	-	M	M	L
CO4	S	M	M	-	-	M	L	M	L	-	M	M	L
CO5	S	M	M	-	-	M	L	M	L	M	M	M	L
CO6	S	M	M	-	-	M	L	M	L	M	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	**35**	**35**			**16**
CO2	**25**	**25**			**14**
CO3	**40**	**40**			**20**
CO4			**35**	**35**	**20**

CO5			**35**	**35**	**15**
CO6			**30**	**30**	**15**
Total	**100**	**100**	**100**	**100**	**100**

Syllabus

Module 1: Introduction to site investigation

Necessity of site investigation – Stages and Planning of site investigation – Depth and Lateral extent of Investigation for different types of structures – Methods of site investigation - Modern methods of boring and sampling – Samplers for disturbed and undisturbed sampling - Different disturbances in soil sampling - Preservation and transportation of samples.

Module 2: Geophysical Exploration

Electrical Resistivity method – Seismic Reflection and Seismic Refraction methods - Analysis and interpretation of test data – Limitations of Electrical Resistivity and Seismic methods.

Module 3: Field Tests

Plate Load Test – Pile load test – Field Vane Shear test – Field Permeability test – Field CBR Test - Analysis and interpretation of field test data.

Module 4: In-situ Penetration Tests

Standard penetration test – Static and Dynamic Cone penetration tests – Correlation of geotechnical parameters of soil with test results – Pressure meter test - Soil Profiling – Bore log - Report Preparation - Challenges in Field and In-situ Penetration tests

Module 5: Ground Improvement Techniques

Requirements of ground improvement – Ground improvement methods - Selection of appropriate ground improvement method - Shallow compaction and deep compaction methods - Vibro compaction - Stone column - Preloading with sand drains - Application of Geosynthetics

Module 6: Soil Stabilization

Stabilization of problematic soil - Chemical methods – Stabilization with lime and cement - Grouting - Deep soil mixing - Stabilization by thermal and freezing technique - Case Studies on Ground Improvement and Soil Stabilization methods

6. Learning Resources

6.1 Text Book

1. Das, B.M., “Principles of Foundation Engineering”, Cengage India Private Limited, Eighth Edition, India Edition, 2017.

6.2 Reference Books & Web resources

1. Tomlinson, M.J., “Foundation Design and Construction”, Prentice Hall, Seventh Edition, CBS Publishers & Distributors, Pvt., Ltd., 2010.
2. Murthy, V.N.S., “Advanced Foundation Engineering”, CBS Publishers & Distributors, New Delhi, 2015.
3. Purushothama Raj. P, “Ground Improvement Techniques”, Laxmi Publications (P) Ltd, New Delhi, 2019.
4. NPTEL Material: https://nptel.ac.in/courses/105108075/

7. Course Contents and Lecture Schedule

Module No	Topics	No. of Periods
1	Necessity of site investigation, Stages and Planning of site investigation	2
	Depth and Lateral extent of Investigation for different types of structures	1
	Methods of site investigation, Modern methods of boring and sampling	2
	Samplers for disturbed and undisturbed sampling	1
	Different disturbances in soil sampling, Preservation and transportation of samples.	1
2	Electrical Resistivity method	1
	Seismic Reflection and Seismic Refraction methods	2
	Analysis and interpretation of test data	1
	Limitations of Electrical Resistivity and Seismic methods	1
3	Plate Load Test	1
	Pile Load Test	1
	Field Vane Shear Test	1
	Field Permeability Test	1
	Field CBR Test	1
	Analysis and interpretation of field test data	1
4	Standard Penetration Test	1
	Static and Dynamic Cone Penetration Tests	2
	Correlation of geotechnical parameters of soil with test results	1
	Pressure Meter Test	1
	Bore log, Report Preparation, Challenges in Field and In-situ Penetration tests	1
5	Requirements of ground improvement, Ground improvement methods	1
	Selection of appropriate ground improvement method - Shallow compaction methods	1
	Deep compaction methods	1
	Vibro compaction, Stone column	1
	Preloading with sand drains	1
	Application of Geosynthetics	1
6	Stabilization of problematic soil - Chemical methods	1
	Stabilization with lime and cement	2
	Grouting - Deep soil mixing	2
	Stabilization by thermal and freezing technique	1
	Case Studies on Ground Improvement and Soil Stabilization methods	1
	Total Periods	36

8. Course Designer(s):

Dr.R. Sanjay Kumar, Associate Professor, Civil Engineering sanjaykumar@tce.edu

22PBPB0	MODERN CONSTRUCTION MATERIALS

Category*	L	T	P	Credit
PEC	3	0	0	3

1. Preamble

This course provides knowledge on modern construction materials used in sustainable and advanced infrastructure development. It focuses on the properties, applications, performance, and management aspects of innovative construction materials. The course enables students to select suitable materials for improving durability, productivity, quality, and sustainability in construction projects.

2. Prerequisite

NIL

3. Course Outcomes

After the successful completion of the course, students will:

No.	Course Outcome	TPS Level	CO Weightage	SDG addressed	SDG Level
CO1	**Apply** the properties and selection criteria of structural construction materials for modern construction applications.	TPS 3	10	9,11,12,13	1
CO2	**Use** coatings, waterproofing systems, polymer finishes, acoustic materials, and dry wall systems in building construction and finishing works.	TPS 3	20	9,11,12,13	1
CO3	**Apply** composite materials, reinforced polymers, FRP systems, plastics, and bituminous materials in structural strengthening and infrastructure applications.	TPS 3	20	9,11,12,13	1
CO4	**Demonstrate** sustainable and green construction materials including recycled materials, industrial by-products, and insulation materials for environmentally responsible construction practices.	TPS 3	20	9,11,12,13	1
CO5	**Implement** special concretes such as high-performance concrete, fibre reinforced concrete, self-compacting concrete, and geopolymer concrete in construction projects.	TPS3	20	9,11,12,13	1
CO6	**Demonstrate** the application of smart and intelligent materials, Nano-concrete, and nanotechnology concepts in advanced construction engineering practices through case studies.	TPS3	10	9,11,12,13	1

4. Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	S	M	M	-	-	L	M	L	-	L	L	M	L
CO2	M	M	S	-	-	L	M	L	-	L	L	M	L

CO3	S	M	S	L	-	L	M	L	L	L	L	M	L
CO4	M	M	M	L	-	L	M	L	L	L	L	M	L
CO5	S	M	M	L	-	L	M	L	L	L	L	M	L
CO6	M	M	M	L	-	L	M	L	L	M	L	M	L

S-Strong;M-Medium;L-Low

5. Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	**35**	**35**	**-**	**-**	**20**
CO2	**30**	**30**	-	-	**10**
CO3	**35**	**35**	**-**	**-**	**20**
CO4	**-**	**-**	**35**	**35**	**20**
CO5	-	-	35	35	20
CO6	**-**	**-**	**30**	**30**	**10**
Total	**100**	**100**	**100**	**100**	**100**

6. Syllabus

Structural Materials:
Wood and Wood Product, Metals, Types of Steels, Manufacturing process of steel, Advantages of new alloy steels, Properties and advantages of aluminum and its products, Types of Coatings & Coatings to reinforcement, Applications of Coatings.

Non-Structural Materials:
Accessories and Finishes: Introduction of Non-Structural Materials and Criteria for Selection, Types and properties of Water Proofing Materials, Types of Non-weathering Materials and its uses, Types of Polymer Floor Finishes, Paint, Tiles, Acoustic Treatment materials, Dry Walls, Anchors.

Composites:
Types of Plastics, Polymer, and Properties& Manufacturing process, Advantages of Reinforced polymers, Types of FRP, FRP on different structural elements, Applications of FRP, Bituminous Materials, Glass, Closure, Environmental Concerns.

Sustainable and Green Construction Materials:
Recycled and reused construction materials, Industrial by-products: Fly ash, GGBS, Silica fume , Rice husk ash; Energy-efficient materials, Thermal insulation materials, Acoustic materials, Life cycle assessment (LCA) of materials, Environmental Product Declaration (EPD), Circular economy in construction

Special Concretes:
Concretes, Behaviour of concretes, Properties and Advantages of High Strength and High Performance Concrete, Properties and Applications of Fibre Reinforced Concrete, Self-compacting concrete, Geo Polymer Concrete, Alternate Materials to concrete on high performance & high Strength concrete.

Smart and Intelligent Materials: Types & Differences between Smart and Intelligent Materials, Special features, Nano-Concrete, Nano Technology in Construction, Case studies showing the applications of smart & Intelligent Materials.

7. Text Book

1. Construction Materials: Their Nature and Behaviour – J.M. Illston and P.L.J. Domone, CRC Press.
2. Properties of Concrete – A.M. Neville, Pearson Education.

8. Reference Books &Web resources

1. Ashby, M.F. and Jones D.R.H.H. “Engineering Materials
2. An introduction to Properties, applications and designs”, Elsevier Publications, 2005.
3. Santhakumar A.R. “Concrete Technology”, Oxford University press, New Delhi.
4. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
5. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand& Company Ltd., 2005.

9. SDG Alignment

Activities aligned with SDGs addressed:

1. SDG 9-**Case study analysis** on innovative construction materials used in smart infrastructure projects.

2. SDG-11BIM-based material sustainability analysis.

10. Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1.0	**Structural Materials:**		CO1
1.1	Wood and Wood Product	1	
1.2	Metals, Types of Steels, Manufacturing process of steel, Advantages of new alloy steels	2	
1.3	Properties and advantages of aluminum and its products	2	
1.4	Types of Coatings & Coatings to reinforcement, Applications of Coatings.	2	
2.0	**Non-Structural Materials**		CO2
2.1	Introduction of Non-Structural Materials and Criteria for Selection	1	
2.2	Types and properties of Water Proofing Materials, Types of Non-weathering Materials and its uses,	1	
2.3	Types of Polymer Floor Finishes, Paint, Tiles,	1	
2.4	Acoustic Treatment materials, Dry Walls, Anchors.	1	
3.0	**Composites**		CO3
3.1	Types of Plastics, Polymer, and Properties & Manufacturing process, Advantages of Reinforced polymers,	1	
3.2	Types of FRP, FRP on different structural elements,	3	
3.3	Applications of FRP, Bituminous Materials, Glass, Closure, Environmental Concerns.	3	
4.0	**Sustainable and Green Construction Materials**		CO4
4.1	Recycled and reused construction materials	1	
4.2	Industrial by-products: Fly ash, GGBS, Silica fume , Rice husk ash;	2	
4.3	Energy-efficient materials, Thermal insulation materials,	1	
4.4	Acoustic materials, Life cycle assessment (LCA) of materials, Environmental Product Declaration (EPD), Circular economy in construction	3	
5.0	**Special Concretes**		CO5
5.1	Concretes, Behaviour of concretes, Properties and Advantages of High Strength and High Performance Concrete	2	
5.2	Properties and Applications of Fibre Reinforced Concrete, Self-compacting concrete	2	
5.3	Properties and Applications ofGeo Polymer Concrete	2	
5.4	Alternate Materials to concrete on high performance & high Strength concrete.	2	
6.0	**Smart and Intelligent Materials**		CO6

6.1	Types & Differences between Smart and Intelligent Materials, Special features	1	
6.2	Nano-Concrete, Nano Technology in Construction,	1	
6.3	Case studies showing the applications of smart & Intelligent Materials.	1	
	TotalHrs.	36	

11.Course Designer(s):

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