



A CMI INSTITUTION

**CHRIST COLLEGE OF ENGINEERING
(AUTONOMOUS)**

DEPARTMENT OF CIVIL ENGINEERING

**CURRICULUM AND SYLLABUS
2026 REGULATION**

M.TECH.

**STRUCTURAL ENGINEERING AND
CONSTRUCTION MANAGEMENT**





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DEPARTMENT OF CIVIL ENGINEERING CURRICULUM AND SYLLABUS (2026 REGULATION)

M.TECH. STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT

Approved by BoS meeting held on 17-06-2026

Approved by Academic Council Meeting held on 23-06-2026

BoS Chairperson

Dr. Sherjah P. Yusuf Ali

CHAIRPERSON
Board of Studies
B.Tech Civil Engineering
Christ College of Engineering
(Autonomous)
Irinjalakuda, Kerala

Director of Academics

Dr. Manoj George

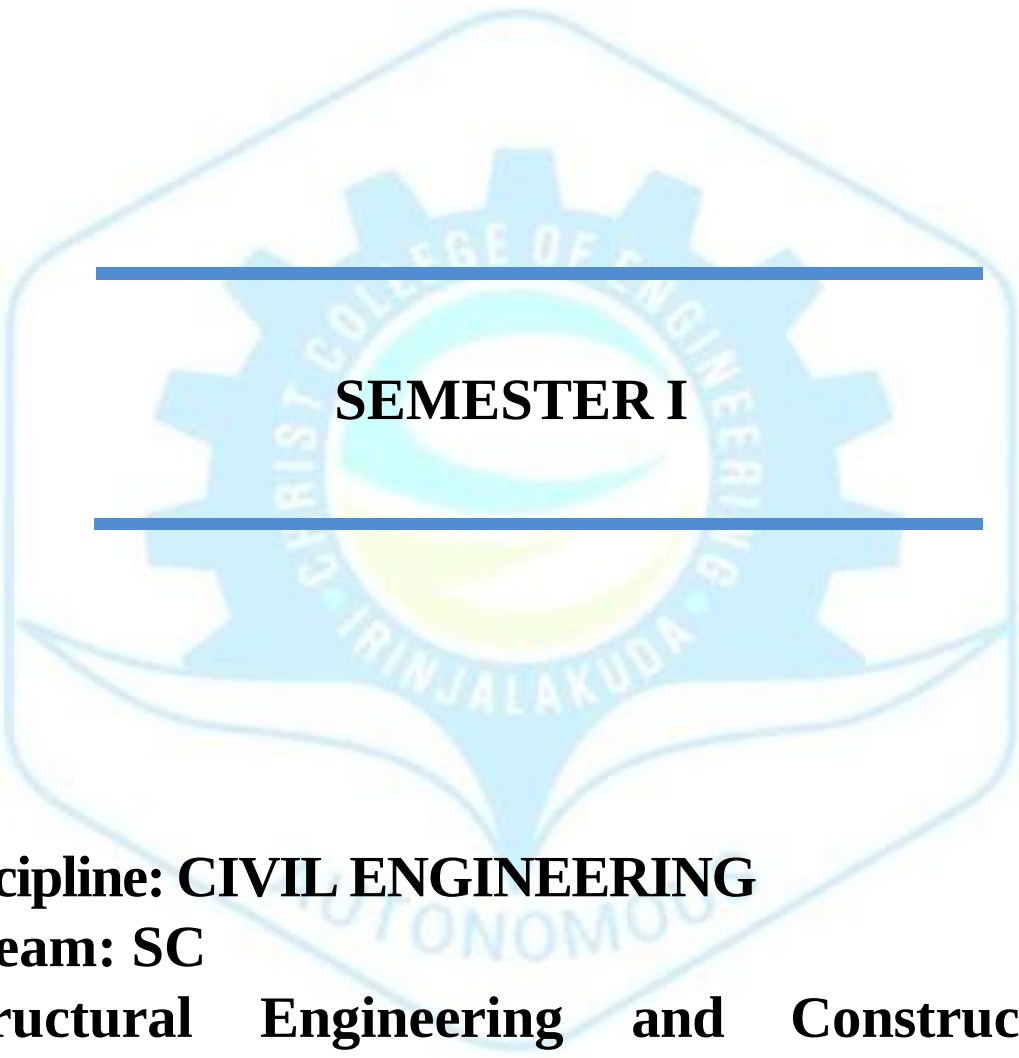


Principal

Dr. Solomon P.A.



M.Tech. Structural Engineering and Construction Management

The logo of Christ College of Engineering (Autonomous) Irinjalakuda is a circular emblem. It features a blue gear-like outer ring with the text 'CHRIST COLLEGE OF ENGINEERING' at the top and 'IRINJALAKUDA' at the bottom. Inside the gear is a yellow sun-like shape with a green crescent moon. The entire logo is set against a light blue background with a faint gear pattern.

SEMESTER I

**Discipline: CIVIL ENGINEERING
Stream: SC
(Structural Engineering and Construction
Management)**



**FIRST SEMESTER: STRUCTURAL ENGINEERING & CONSTRUCTION MANAGEMENT
CIVIL ENGINEERING**

Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./Week
						L	T	P	R		CAE	ESE		
THEORY														
1	A	C26SCT101	BS	DC	Numerical methods and Statistics	2	1	0	0	3.5	40	60	3	3
2	B	C26SCT102	PC	PC	Structural Dynamics	2	1	0	0	3.5	40	60	3	3
3	C	C26SCT103	PC	PC	Construction Planning Scheduling & Control	3	0	0	0	4.5	40	60	3	3
4	D	C26SCT1X4	PE	PE	Program Elective I	3	0	0	0	4.5	40	60	3	3
5	E	C26SCT1X5	PE	PE	Program Elective II	3	0	0	0	4.5	40	60	3	3
6	F	G26RMT106	GC	GC	Research Methodology & IPR	2	0	0	0	3	40	60	2	2
PRACTICALS														
7	G	C26SCP107	PC	PC	Advanced Structural Engineering Laboratory	0	0	2	0	1	100	0	1	2
Total										24.5			18	19

Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./Week
						L	T	P	R		CAE	ESE		
PROGRAM ELECTIVE-I (SEMESTER I)														
1	C	C26SCT114	PE	PE1	Mechanics of composite Materials	3	0	0	0	4.5	40	60	3	3
2	C	C26SCT124	PE	PE1	Theory of Elasticity & Plasticity	3	0	0	0	4.5	40	60	3	3
3	C	C26SCT134	PE	PE1	Finite Element Method	3	0	0	0	4.5	40	60	3	3
4	C	C26SCT144	PE	PE1	High Rise Structures	3	0	0	0	4.5	40	60	3	3
PROGRAM ELECTIVE-II (SEMESTER I)														
5	D	C26SCT115	PE	PE2	Construction Management and Engineering Economics	3	0	0	0	4.5	40	60	3	3
6	D	C26SCT125	PE	PE2	Advanced Construction Techniques	3	0	0	0	4.5	40	60	3	3
7	D	C26SCT135	PE	PE2	Modern Construction Materials	3	0	0	0	4.5	40	60	3	3
8	D	C26SCT145	PE	PE2	Construction Contract Methods and Equipment	3	0	0	0	4.5	40	60	3	3

SEMESTER 1
C26SCT101- NUMERICAL METHODS AND STATISTICS

COURSE CODE	C26SCT101	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	2:1:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Discipline Core (Theory)

Course Objectives:

1. To expose the students to the fundamental concepts of probability and statistics.
2. To equip the students to find solutions for many real-world civil engineering problems
3. To understand basic data analysis tools by applying the principles of statistics.

Course Outcomes: After the completion of the course, the student will be able to

Course Outcomes		Bloom's Knowledge Level (KL)
CO 1	To create an awareness of the concepts of statistics and probability distributions	K2
CO 2	To formulate and test hypotheses for civil engineering problems	K4
CO 3	To apply statistical data analysis tools such as ANOVA and experimental designs	K3
CO 4	Obtain the solution of simultaneous Linear system of equations	K4
CO5	Apply the concept of finite element method	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2		3			2
CO 2	3	2	2	3	3		2
CO 3	3	2	2	3	3		2

CO 4	3	2	2	3	3		2
CO 5	2	2	2	3	3		

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	15
Apply	25
Analyse	20
Evaluate	
Create	

Mark Distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE):			60 Marks	
Total Marks:			100 Marks	
ESE Duration:			2 Hrs 30 Mins	
CAE			ESE	
Micro project/ Course based project	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
20	10	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Introduction to probability distributions Random Variables–discrete and continuous random variables, Probability mass functions and probability density functions. Cumulative distribution functions, Mathematical Expectations, mean and variance. Standard discrete distributions-Binomial and Poisson distribution. Standard continuous distributions –Exponential and Normal distribution, Mean and variance (derivation is not required). Computing probability using the above distributions	7
2	Statistical Inference Populations and samples. Sampling distribution of the mean (sigma known and unknown), Sampling distribution of the variance (sigma known and unknown). Interval estimation:- Confidence interval for mean and variance.-Tests of hypotheses:-Null hypothesis and alternative hypothesis, Type I and Type II errors.-Test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi- square test of goodness of fit (viii) Chi-square test for independence Analysis of variance Analysis of variance. Completely randomized designs and randomized block designs.- Latin square designs	10
3	Correlation and regression models Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, correlation coefficient- Multiple linear regression, normal equations -Principal components (brief overview only)	8
4	Solutions of simultaneous Linear Systems of Equations- Solution of linear systems – Direct methods, Gauss-Jordan Method. Solution by matrix decomposition Iterative methods: Jacobi, Gauss-Siedel iteration for ordinary and parse systems, Convergence of iterative solution schemes with examples.	10

	Solving Ordinary Differential Equations- The Elementary Theory of Initial-Value Problems -Euler's Method- Higher-Order Taylor Methods.	
5	Concept of Finite Element Method- Concept of Nodes, elements, Generalised coordinates and Natural coordinates in FEA. Shape functions – Polynomials - Lagrangian and Hermitian Interpolation — Compatibility - C0 and C1 elements - Convergence criteria - Conforming & nonconforming elements. Development of element matrices for one dimensional elements.	7

COURSE PLAN

No	Topic	No. of Lectures
1	Introduction to probability distributions	
1.1	Sample Space and Events, Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence.	1
1.2	Random Variables—discrete and continuous random variables, Probability mass functions and probability density functions. Cumulative distribution functions, Mathematical Expectations, mean and variance.	2
1.3	Standard discrete distributions-Binomial and Poisson distribution. Standard continuous distributions –Exponential and Normal distribution, Mean and variance (derivation is not required). Computing probability using the above distributions	4
2	Statistical Inference	
2.1	Populations and samples. Sampling distribution of the mean(sigma known and unknown), Sampling distribution of the variance(sigma known and unknown).Interval estimation:- Confidence interval for mean and variance.	2
2.2	Tests of hypotheses:-Null hypothesis and alternative hypothesis, Type I and Type II errors.	2

2.3	Test of significance of (i) Mean (ii) Mean of two samples (iii) Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi-square test of goodness of fit (viii) Chi-square test for independence	3
2.4	Analysis of variance. Completely randomized designs and randomized block designs.	2
2.5	Latin square designs	1
3	Correlation and regression models	
3.1	Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, correlation coefficient	4
3.2	Multiple linear regression, normal equations	2
3.3	Principal components (brief overview only)	2
4	Linear Systems of Equations	
4.1	Solutions of simultaneous Linear Systems of Equations-Solution of linear systems – Direct methods, Gauss-Jordan Method.	3
4.2	Solution by matrix decomposition Iterative methods: Jacobi, Gauss-Siedel iteration for ordinary and sparse systems, Convergence of iterative solution schemes with examples.	3
4.3	Solving Ordinary Differential Equations- The Elementary Theory of Initial-Value Problems -Euler's Method- Higher-Order Taylor Methods.	4
5	Finite Element Method	
5.1	Concept of Finite Element Method- Concept of Nodes, elements, Generalised coordinates and Natural coordinates in FEA.	2
5.2	Shape functions – Polynomials - Lagrangian and Hermitian Interpolation – Compatibility	2
5.3	C0 and C1 elements - Convergence criteria - Conforming & nonconforming elements.	1
5.4	Development of element matrices for one dimensional elements.	2
	Total	42

Reference Books

Sl. No.	Title of the Book	Name of Authors	Publisher & Edition
1	<i>Fundamentals of Mathematical Statistics</i>	Gupta. S. C. and Kapoor. V. K	Sultan Chand and Sons, 2020
2	<i>Probability, Statistics and Decision for Civil Engineers</i>	Benjamin, Jack.R and Comell.C, Allin	Mc- McGraw-Hill
3	<i>Response Surface Methodology: Process and Product Optimization Using Designed Experiments</i>	Raymond H. Myers, Douglas C. Montgomery, Christine M.	4th Edition , Anderson-Cook ISBN: 978-1-118-91601-8 February 2016.
4	<i>Introduction to Time Series Analysis and Forecasting</i>	Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci	John Wiley & Sons, 2015
5	<i>Numerical Methods for Engineers</i>	S. K. Gupta	Wiley Eastern, New Delhi
6	<i>Concepts and Applications of Finite Element Analysis</i>	R. D. Cook	Wiley
7	<i>Linear Algebra and Its Applications</i>	Gilbert Strang	Wellesley-Cambridge Press, 4th Edition, 2009
8	<i>Applied Numerical Methods</i>	A. Gourdin & M. Boumhrat	Prentice Hall India, New Delhi
9	<i>Numerical Methods for Engineers</i>	S. C. Chopra & R. P. Canale	McGraw Hill
10	<i>Finite Element Analysis – Theory and Programming</i>	C. S. Krishnamoorthy	Tata McGraw Hill, New Delhi
11	<i>Finite Element Analysis</i>	S. S. Rao	Elsevier Butterworth-Heinemann

SEMESTER 1
C26SCT102- STRUCTURAL DYNAMICS

COURSE CODE	C26SCT102	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	2:1:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Core (Theory)

Course Objectives:

1. To study the basic concepts of structural dynamics and the theoretical background to perform dynamic analysis of structures.
2. To analyse single-degree-of-freedom systems and multi-degree-of-freedom systems

Outcomes: After the completion of the course, the student will be able to:

Course Outcomes		Bloom's Knowledge Level(KL)
CO 1	Model single and multi-degree freedom systems for dynamic analysis and develop equations of motion	K4
CO 2	Perform dynamic analysis of single degree freedom systems	K3
CO 3	Perform dynamic analysis of multi - degree freedom systems	K4
CO 4	Analyse and design vibration isolation systems	K4
CO 5	Apply numerical techniques to solve vibratory systems and perform dynamic analysis using software	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6-Create
CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1	2			
CO 2	2		2	2	1		
CO 3	2		2	2	2		
CO 4	2		2	3	2		
CO 5	3		3	3	2		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	15
Apply	25
Analyse	20
Evaluate	-

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Micro project/ Course based project	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
20	10	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Vibration studies and its importance to structural engineering applications – Types of dynamic loading – Systems with single degree of freedom – Elements of a vibratory system – Mathematical model for single degree of freedom systems -	9

	Equation of motion. Undamped and damped free vibration of single degree of freedom system. Measurement of damping from free vibration response - Logarithmic decrement.	
2	Response of single degree of freedom systems to harmonic loading, Measurement of damping from forced response – Half power band width method. Impulse response function, Response of single degree of freedom systems subjected to impulse, periodic and general loading- Duhamel integral. Single degree freedom subjected to support motion. Numerical solution of single degree of freedom systems – Central Difference Method - Newmark – β method. Vibration isolation – Transmissibility. Concept of tuned mass damper.	9
3	Multi-degree of freedom (MDOF) systems – Equation of motion. Shear building concept and models for dynamic analysis – Evaluation of natural frequencies and mode shapes by solution of characteristic equation. Co-ordinate coupling - Orthogonality of normal modes. Mode superposition method of analysis, Free vibration response of MDOF systems due to initial conditions.	9
4	Forced vibration analysis of multi-degree of freedom systems, Response of multi degree of freedom systems to support motion. Introduction to earthquake analysis, Response spectrum – concept.	7
5	Distributed mass (continuous) systems – differential equation of motion – Axial vibration of rods. Flexural vibration of beams, natural frequencies and mode shapes of simply supported beam. Evaluation of frequencies and mode shapes of cantilever beam and fixed beam (formulation only), Variational formulation of the equation of motion – Hamilton's principle - Lagrange's equation.	6

COURSE PLAN

No	Topic	No. of Lectures
Module I (9)		
1.1	Vibration studies and its importance to structural engineering applications – Types of dynamic loading – Systems with single degree of freedom – Elements of a vibratory system – Mathematical model for single degree of freedom systems - Equation of motion.	4
1.2	Undamped and damped free vibration of single degree of freedom system.	4
1.3	Measurement of damping from free vibration response - Logarithmic decrement.	1
Module II (9)		
2.1	Response of single degree of freedom systems to harmonic loading, Dynamic Magnification Factor. Measurement of damping from forced response – Half power band width method.	3
2.2	Impulse response function, Response of single degree of freedom systems subjected to step loading, rectangular and triangular impulses. Response to general loading- Duhamel integral.	3
2.3	Numerical solution of single degree of freedom systems – Central Difference Method - Newmark – β method.	3
Module III (9)		
3.1	Single degree of freedom system subjected to support motion. Vibration isolation –Transmissibility. Tuned mass damper.	2
3.2	Multi-degree of freedom systems – Equation of motion.	2
3.3	Shear building concept and models for dynamic analysis – Evaluation of natural frequencies and mode shapes by solution of characteristic equation.	3
3.4	Co-ordinate coupling –Orthogonality of normal modes.	1
3.5	Mode superposition method of analysis – free vibration response of MDOF systems.	1
Module IV (7)		
4.1	Forced vibration analysis of multi-degree of freedom systems.	4
4.2	Response of multi degree of freedom systems to support motion.	2
4.3	Introduction to earthquake analysis, Response spectrum – Concept.	1

Module V (6)		
5.1	Distributed mass (continuous) systems – differential equation of motion – Axial vibration of rods.	1
5.2	shapes of simply supported beam. Evaluation of frequencies and mode shapes of cantilever beam and fixed beam (formulation only).	3
5.3	Variational formulation of the equation of motion – Hamilton's principle - Lagrange's equation.	2
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Authors	Publisher
1	<i>Dynamics of Structures</i>	R. W. Clough & J. Penzien	McGraw Hill, New Delhi
2	<i>Introduction to Structural Dynamics</i>	J. M. Biggs	McGraw Hill, New Delhi
3	<i>Structural Dynamics – Theory and Computation</i>	Mario Paz	CBS Publishers and Distributors, Delhi
4	<i>Structural Dynamics – Vibrations and Systems</i>	M. Mukhopadhyay	Ane Books India, Delhi
5	<i>Dynamics of Structures</i>	J. Humar	CRC Press, Netherlands
6	<i>Dynamics of Structures – Theory and Application to Earthquake Engineering</i>	Anil K. Chopra	Pearson Education, New Delhi
7	<i>Structural Dynamics – An Introduction to Computer Methods</i>	Roy R. Craig	John Wiley & Sons, New York
8	<i>Theory of Vibration with Applications</i>	W. T. Thomson	Pearson Education, New Delhi
9	<i>Vibration Problems in Engineering</i>	W. Weaver, S. P. Timoshenko & D. H. Young	John Wiley & Sons, USA



SEMESTER 1**C26SCT103 – CONSTRUCTION PLANNING, SCHEDULING AND CONTROL**

COURSE CODE	C26SCT103	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Core (Theory)

Course Objectives:

1. To provide the concept of planning, scheduling and controlling techniques necessary for construction projects.

Course Outcomes: After the completion of the course the student will be able to

Course Outcomes		Bloom's Knowledge Level(KL)
CO 1	Explain the basic concepts of construction planning, selection of construction technology and methods, work task definition, precedence relationships, activity duration estimation, resource estimation, and coding systems used in construction projects.	K2
CO 2	Develop and analyze construction schedules using Critical Path Method (CPM), Activity-on-Arrow (AOA) networks, PERT techniques, activity float calculations, and probabilistic scheduling methods	K4
CO 3	Apply time-cost optimization techniques, crashing methods, and resource-oriented scheduling approaches for effective management of construction projects under resource constraints.	K3
CO 4	Evaluate project progress and performance using schedule updating techniques, S-curves, Management Information Systems (MIS), Earned Value Analysis (EVA), and performance measurement indicators.	K5
CO 5	Apply and demonstrate practical skills in construction project scheduling software including Microsoft Project and Primavera P6 for project creation, activity linking, milestone development, CPM scheduling, resource and cost loading, S-curve generation, and project reporting.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		2	2			
CO 2	2		3	2			
CO 3	3		2				
CO 4			3				
CO 5			2	2			

(1-Weak, 2-M edium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	15
Apply	25
Analyse	20

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Micro project/ Course based project	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
20	10	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTON	CONTACT HOURS
1	Basic concepts in the development of construction plans choice of technology and construction method - Defining work tasks – Defining precedence relationships among activities -Estimating activity duration. Estimating resource requirements for work activities - Coding Systems.	6
2	Relevance of construction schedules. The Critical Path Method -Presenting project schedules with Activity - on - Node diagrams – Leads and Lags - Calculations for critical path scheduling -Activity floats and schedules -Scheduling with uncertain duration - Programme Evaluation and Review Technique .	9
3	Crashing and Time / Cost Tradeoffs - Resource oriented scheduling - Scheduling with resource constraints.	8
4	Updating construction schedules – S curves – Management Information Systems. Earned Value Analysis - Measures of performance	7
5	Use of advanced scheduling techniques with awareness on scheduling software- Project and PRIMAVERA P6 basic Settings, Project Scope Loading, Activities Loading Linkup, Developing Project Milestones, Time Management And CPM Development ,Resources And Cost Loading, Resources Assignment, Generate Project S Curves and Project Report.	9

COURSE PLAN

No	Topic	No. of Lectures
1	MODULE I (6 hours)	
1.1	Basic concepts in the development of construction plans choice of technology and construction method	1
1.2	Defining work tasks – Defining precedence relationships among Activities	2

1.3	Estimating activity duration	1
1.4	Estimating resource requirements for work activities -coding systems	2
2	MODULE II (9 hours)	
2.1	Relevance of construction schedules. The Critical Path Method	2
2.2	Presenting project schedules with Activity - on - Node diagrams, Leads and Lags	2
2.3	Calculations for critical path scheduling	1
2.4	Activity Float and Schedules	2
2.5	Scheduling with uncertain duration - Programme Evaluation and Review Technique	2
3	MODULE III (8 hours)	
3.1	Crashing and Time / Cost Tradeoffs	2
3.2	Resource oriented scheduling	3
3.3	Scheduling with resource constraints	3
4	MODULE IV (7 hours)	
4.1	Updating construction schedules	2
4.2	S curves	1
4.3	Management Information Systems	2
4.4	Earned Value Analysis - Measures of performance, Updating construction schedules	2
5	MODULE V (9 hours)	
5.1	Earned Value Analysis - Measures of performance	3
5.2	Project and PRIMAVERA P6 Basic Settings, Project Scope Loading, Activities Loading Linkup, Developing Project Milestones, Time Management And CPM Development ,Resources And Cost Loading, Resources Assignment, Generate Project S Curves and Project Report	6
Total		39

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>Construction Project Management: Planning, Scheduling and Control</i>	K. K. Chitkara	Tata McGraw Hill Publishing Company, New Delhi
2	<i>Project Planning, Scheduling and Control in Construction: An Encyclopaedia of Terms and Applications</i>	Calin M. Popescu and Chotchal Charoenngam	Wiley, New York
3	<i>Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects and Builders</i>	Chris Hendrickson and Tung Au	Prentice Hall, Pittsburgh
4	<i>Project Management with CPM, PERT and Precedence Diagramming</i>	J. Moder, C. Phillips and E. Davis	Van Nostrand Reinhold Company, Third Edition
5	<i>Financial and Cost Concepts for Construction Management</i>	D. W. Halpin	John Wiley & Sons, New York



SEMESTER 1**G26RMT106 - RESEARCH METHODOLOGY & IPR**

COURSE CODE	G26RMT106	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	2:0:0:0	ESE Marks	60
Credits	2	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	General Course (Theory)

Course Objectives:

1. To develop research aptitude by fostering creativity, problem identification through literature survey, and adoption of suitable methodologies for solving engineering problems.
2. To enhance professional skills by delivering effective technical presentations, preparing quality technical reports, and disseminating research outcomes through publications or patents.

Course Outcomes: After the completion of the course the student will be able to

Course Outcome		Bloom's Knowledge Level (KL)
CO 1	Apply creative thinking and research aptitude in the selection of research topics.	K3
CO 2	Analyze scholarly literature to define and refine research problems.	K4
CO 3	Apply suitable research methodologies for problem-solving and investigation.	K3
CO 4	Communicate research findings effectively through technical reports and presentations.	K3
CO 5	Evaluate and disseminate research outcomes through publications and intellectual property protection.	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2	2		3		2	
CO 2	2	2		3		2	
CO 3	2	2		2		2	
CO 4	2	2		3		2	
CO 5	2	2		3		2	2

(1-Weak, 2-Medium, 3- Strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	15
Apply	25
Analyse	20
Evaluate	
Create	

Mark Distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			6 questions with 1 question each from module 1 to 4 and 2 questions from module 5 (5 Marks each) Students shall answer all questions.	1 question based on a research article from the respective discipline and carries 30 marks.
20	10	10	6×5=30	1×30=30
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Introduction: Meaning and significance of research, Skills, habits and attitudes for research, Types of research, Characteristics of good research, Research process Motivation for research: Motivational talks on research: "You and Your Research"- Richard Hamming. Thinking skills: Levels and styles of thinking, common sense and scientific thinking, examples, logical thinking, division into sub-problems, verbalization and awareness of scale. Creativity: Some definitions, illustrations from day to day life, intelligence versus creativity, creative process, requirements for creativity	6
2	Literature survey and Problem definition: Information gathering – reading, searching and documentation, types of literature. Integration of research literature and identification of research gaps. Attributes and sources of research problems, problem formulation, Research question, multiple approaches to a problem. Problem solving strategies – reformulation or rephrasing, techniques of representation, Importance of graphical representation, examples. Analytical and analogical reasoning, examples, Creative problem solving using Triz, Prescriptions for developing creativity and problem solving.	6
3	Experimental and modelling skills: Scientific method, role of hypothesis in experiment, units and dimensions, dependent and independent variables, control in experiment, precision and accuracy, need for precision, definition, detection, estimation and reduction of random errors, statistical treatment of data, definition, detection and elimination of systematic errors, Design of experiments, experimental logic, documentation. Types of models, stages in modelling, curve fitting, the role of approximations, problem representation, logical reasoning, mathematical skills. Continuum/meso/micro scale approaches for numerical simulation, Two case studies illustrating experimental and modelling skills.	5
4	Effective communication - oral and written: Examples illustrating the importance of effective communication, stages and dimensions of a communication process. Oral communication – verbal and non-verbal, casual, formal and informal communication, interactive communication, listening, form, content and delivery, various contexts for speaking- conference, seminar etc. Guidelines	5

	for preparation of good presentation slides. Written communication – Rules of scientific writing, form, content and language, layout, typography and illustrations, nomenclature, reference and citation styles, contexts for writing – paper, thesis, reports etc. Tools for document preparation-LaTeX. Common errors in typing and documentation	
5	Publication and Patents: Relative importance of various forms of publication, Choice of journal and reviewing process, Stages in the realization of a paper. Research metrics- Journal level, Article level and Author level, Plagiarism and research ethics. Introduction to IPR, Concepts of IPR, Types of IPR. Common rules of IPR practices, Types and Features of IPR Agreement, Trademark. Patents- Concept, Objectives and benefits, features, Patent process – steps and procedures	6

COURSE PLAN

No	Topic	No. of Lectures
1	Introduction	
1.1	Meaning and significance of research, Skills, habits and attitudes for research, Types of research,	1
1.2	Characteristics of good research, Research process	1
1.3	Motivation for research: Motivational talks on research: "You and Your Research"- Richard Hamming	1
1.4	Thinking skills: Levels and styles of thinking, common sense and scientific thinking, examples, logical thinking, division into sub-problems, verbalization and awareness of scale.	1
1.5	Creativity: Some definitions, illustrations from day to day life, intelligence versus creativity, creative process, requirements for creativity	1
2	Literature survey and Problem definition	
2.1	Information gathering – reading, searching and documentation, types of literature.	1
2.2	Integration of research literature and identification of research gaps	1

2.3	Attributes and sources of research problems, problem formulation, Research question, multiple approaches to a problem	1
2.4	Problem solving strategies – reformulation or rephrasing, techniques of representation, Importance of graphical representation, examples.	1
2.5	Analytical and analogical reasoning, examples, Creative problem solving using Triz, Prescriptions for developing creativity and problem solving.	1
3	Experimental and modelling skills	
3.1	Scientific method, role of hypothesis in experiment, units and dimensions, dependent and independent variables, control in experiment	1
3.2	precision and accuracy, need for precision, definition, detection, estimation and reduction of random errors, statistical treatment of data, definition, detection and elimination of systematic errors	1
3.3	Design of experiments, experimental logic, documentation	1
3.4	Types of models, stages in modelling, curve fitting, the role of approximations, problem representation, logical reasoning, mathematical skills.	1
3.5	Continuum/meso/micro scale approaches for numerical simulation, Two case studies illustrating experimental and modelling skills.	1
4	Effective communication - oral and written	
4.1	Examples illustrating the importance of effective communication, stages and dimensions of a communication process	1
4.2	Oral communication –verbal and non-verbal, casual, formal and informal communication, interactive communication, listening, form, content and delivery, various contexts for speaking- conference, seminar etc	1
4.3	Guidelines for preparation of good presentation slides	1
4.4	Written communication – Rules of scientific writing, form, content and language, layout, typography and illustrations, nomenclature, reference and citation styles, contexts for writing – paper, thesis, reports etc. Tools for document preparation-LaTeX.	1
4.5	Common errors in typing and documentation	
5	Publication and Patents	
		1

5.1	Relative importance of various forms of publication, Choice of journal and reviewing process, Stages in the realization of a paper.	1
5.2	Research metrics-Journal level, Article level and Author level, Plagiarism and research ethics	1
5.3	Introduction to IPR, Concepts of IPR, Types of IPR	1
5.4	Common rules of IPR practices, Types and Features of IPR Agreement, Trademark	1
5.5	Patents- Concept, Objectives and benefits, features, Patent process – steps and procedures	2
Total		28

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher
1	<i>How to Get a PhD: A Handbook for PhD Students and Their Supervisors</i>	E. M. Phillips & D. S. Pugh	Viva Books Pvt. Ltd.
2	<i>Practical Physics</i>	G. L. Squires	Cambridge University Press
3	<i>Handbook of Science Communication</i>	Antony Wilson, Jane Gregory, Steve Miller & Shirley Earl	Overseas Press India Pvt. Ltd., New Delhi, 1st Edition, 2005
4	<i>Research Methodology</i>	C. R. Kothari	New Age International, 2004
5	<i>Research Methodology</i>	Panneerselvam	Prentice Hall of India, New Delhi, 2012
6	<i>Practical Research: Planning and Design</i>	P. D. Leedy	McMillan Publishing Co.
7	<i>How to Write and Publish a Scientific Paper</i>	R. A. Day	Cambridge University Press, 1989
8	<i>Elements of Style</i>	William Strunk Jr.	Fingerprint Publishing, 2020
9	<i>Advice to Young Scientists</i>	Peter Medawar	Alfred P. Sloan Foundation Series, 1979
10	<i>Letters to a Young Scientist</i>	E. O. Wilson	Liveright, 2014

SEMESTER 1**C26SCP107- ADVANCED STRUCTURAL ENGINEERING LABORATORY**

COURSE CODE	C26SCP107	CAE Marks	50
Teaching Hours/ Week (L:T:P:R)	0:0:2:0	ESE Marks	50
Credits	1	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	General Course (Theory)

Course Objectives:

1. To familiarize the students with the different sophisticated instrumentations used in the laboratory and field for testing materials and structural components.
2. To familiarize on design of buildings, preparation of design drawings and scheduling construction projects.

Course Outcomes: After the completion of the course, the student will be able to:

Course Outcomes		Bloom's Knowledge Level(KL)
CO 1	Perform basic test for the constituent materials of concrete	K3
CO 2	Perform mix design for various types of concrete as per IS guidelines	K4
CO 3	Calibrate the instruments used in the lab .	K3
CO 4	Analyse the behaviour of steel and reinforced concrete structural elements	K4
CO 5	Perform scheduling of construction projects, drawings and lab reports	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2			2			
CO 2		2	3				2
CO 3	2						
CO 4	2		3	2			

CO 5			2				2
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Mark Distribution

Continuous Assessment and Evaluation (CAE):					50 Marks	
End Semester Exam (ESE)					50 Marks	
Total Marks:					100 Marks	
ESE Duration					2 Hrs 30 Mins	
CAE			ESE			
Preparation/ Pre-lab work, Viva and timely lab reports for each experiment	Internal Examination	Procedure/ preparatory work/ design or algorithm	Conduct of experiment/ execution/ troubleshooting/ programming	Result with valid inference	Viva Voce	Record
30	20	10	15	10	10	5
Total	50		50			

Final assessment in End Semester Examination shall be done by two examiners; one examiner will be a senior faculty from the same department.

LIST OF EXPERIMENTS

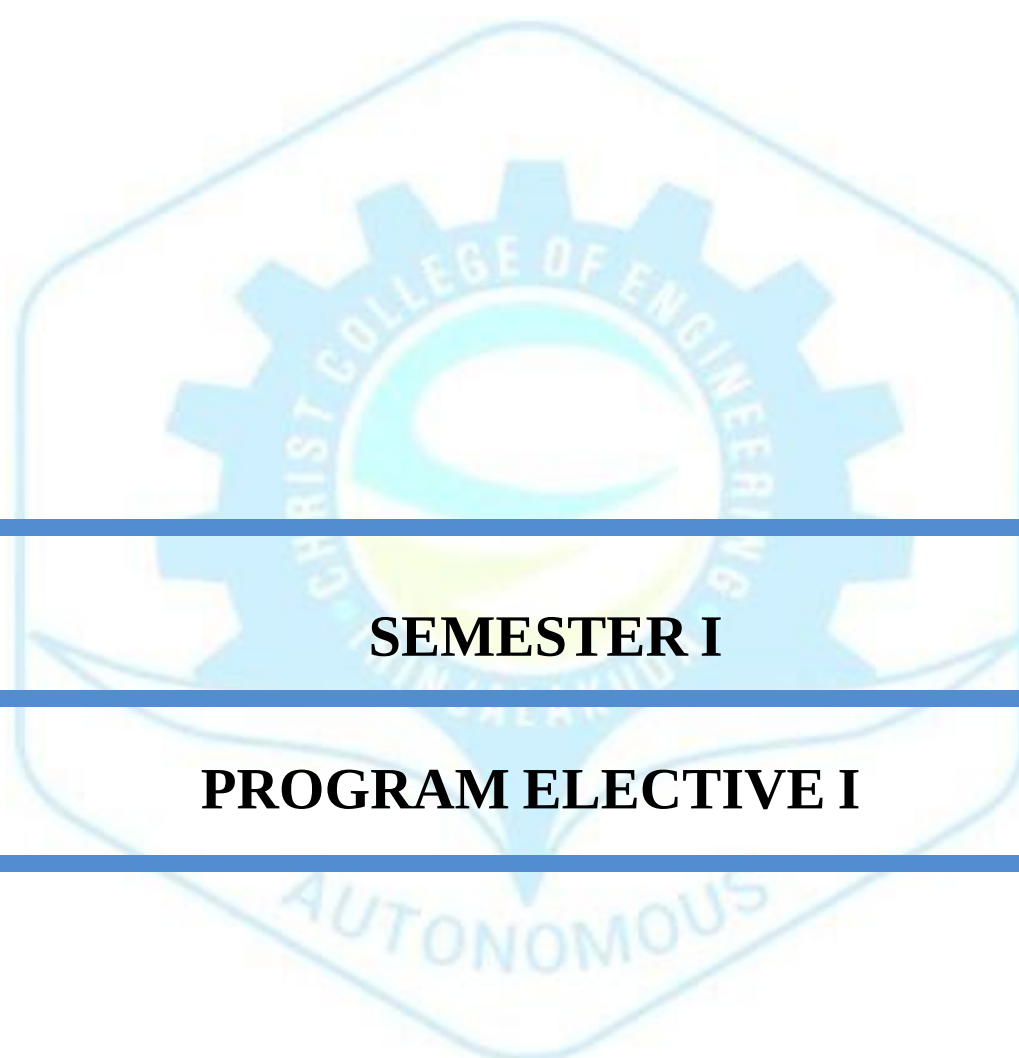
Sl. No.	Category	Experiment / Study
1	Study of Instruments	Study of various instruments used for determining the material properties of concrete, steel, self-compacting concrete (SCC), etc.
2	Study of Instruments	Study of instruments used for determining the durability of materials.
3	Study of Instruments	Calibration of various instruments and equipment used in the laboratory.
4	Material Testing and Mix Design	Review of testing methods of cement, coarse aggregate, and fine aggregate as per Indian Standards.
5	Material Testing and Mix Design	Design of concrete mixes.

6	Tests on Fresh Properties of Self-Compacting Concrete	L-Box test, V-funnel test, and U-box test.
7	Testing of Concrete and Structural Members	Experimental study of the behaviour of: (a) RCC structural elements and (b) steel structural elements.
8	Testing of Concrete and Structural Members	Accelerated curing experiments for concrete.
9	Testing of Concrete and Structural Members	Non-destructive/semi-destructive testing of concrete: (a) Rebound hammer, (b) Core cutting, (c) Ultrasonic pulse velocity, (d) Pullout test, and (e) Detection of embedded reinforcements.
10	Building Design	Analysis and design of a multi-storied building using suitable software.
11	Building Design	Preparation of detailed structural drawings of multi-storied structures using suitable CAD software.
12	Building Design	Development of a 3D digital model using BIM for visualization.

General Instructions to Faculty:

Any 8 of the 12 experiments included in the list of experiments need to be performed mandatorily.





SEMESTER I

PROGRAM ELECTIVE I



SEMESTER 1**C26SCT114 – MECHANICS OF COMPOSITE MATERIALS**

COURSE CODE	C26SCT114	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective - I

Course Objectives: Fibre reinforced plastic composite materials are finding wide range of applications in the field of aerospace structures, automobile engineering, offshore structures, maritime structures, ships and civil engineering structures presently due to its outstanding material capabilities such as High strength, low weight, high corrosion resistance, high fatigue strength and faster assembly. The everyday applications of composites in the commercial markets and hence the job opportunities in this field are drastically increasing nowadays. This course will equip the students with the specialist knowledge and skills required by the leading employers in aerospace, marine, automobile, construction and renewable energy industries to design and develop next generation environmental-friendly and structural-efficient advanced lightweight composite materials and components.

Course Outcomes:

After the completion of the Advanced Composite Structures course the student will be able to

Course Outcomes		Bloom's Knowledge Level(KL)
CO 1	Analyze the properties of fibre and matrix materials used in commercial composites and examine the suitability of various manufacturing techniques.	K4
CO 2	Analyze the principles of linear elasticity and distinguish the behavior of layered composite materials from isotropic materials.	K4
CO 3	Analyze the constitutive equations of composite materials and their influence on mechanical behavior at micro and macro levels.	K4

CO 4	Analyze the failure modes and strength characteristics of laminated composite structures under different loading conditions.	K4
CO 5	Analyze the application of composite materials in diverse engineering fields based on their structural and functional performance.	K4

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			3	3	2		
CO 2			3	3	2		
CO 3			3	3	2		
CO 4			3	3	2		
CO 5			3	3	2		

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	15
Apply	25
Analyse	20
Evaluate	-
Create	-

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Introduction to Composite Materials (6) Definition of composites, Objectives, constituents and Classification of composites. Basic terminology used in fibre reinforced composite materials- Lamina, Laminates , General Characteristics of reinforcement and classifications, Characteristics of matrix- Polymer matrix, Thermoplastics and thermosetting resins, Glass transition temperature , Structural applications of Composite Materials, Processing of Composites Processing of Composites	6
2	Macro mechanical behaviour of a composite lamina (9) Review of Basic Equations of Mechanics and Materials, Hooke's law for different types of materials- Anisotropic, orthotropic, isotropic,	9

	monoclinic and Transversely isotropic materials. Stress-Strain relations for a Two dimensional unidirectional and orthotropic lamina, lamina of arbitrary orientation, Transformations of stress and strain Relationship of Compliance and stiffness matrix to elastic constants of a lamina, Strength and Failure theories of Continuous Fibre-reinforced orthotropic Lamina- Failure envelopes, Maximum stress/strain criteria, Tsai-Hill and Tsai-Wu criterion. Hygrothermal stresses and strains in a lamina – unidirectional and angle lamina	
3	Micromechanical Behaviour of a Lamina (6) Volume and Mass fractions, density and void content Effective Moduli of a continuous fibre-reinforced lamina – Models based on mechanics of materials, theory of elasticity and experimental methods, Mechanics of materials approach to strength, Numerical Examples, Ultimate Strengths of unidirectional Lamina- longitudinal and transverse tensile and compressive strengths Coefficients of moisture and thermal expansion	6
4	Macro mechanical behaviour of Laminates (10) Classical Lamination Theory-Laminae Stress-strain behaviour, In-plane forces, stress-strain variation in a laminate, resultant laminate stresses and strains, Special cases of laminate stiffnesses-symmetric and antisymmetric laminates, cross ply and angle ply laminates, quasi-isotropic laminates Inplane and flexural modulus of a laminate, Effects of stacking sequence-Laminate code Free-Edge Interlaminar Effects, Hygro-thermal effects and warpage in a laminate	10
5	Strength and Design of Laminates (9) Determination of laminae stresses and strains, numerical Examples Laminate strength analysis procedure, Failure envelopes Analysis of laminates after initial failures, Progressive failure Analysis. Numerical Examples Composite mechanical design	9

	issues-Long-term environmental effects, impact resistance, fracture resistance, fatigue resistance	
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COURSE PLAN

No	Topic	No. of Lectures
1	Introduction to Composite Materials (6)	
1.1	Definition of composites, Objectives, constituents and Classification of composites. Basic terminology used in fibre reinforced composite materials- Lamina, Glass transition temperature	2
1.2	Laminates , Characteristics of matrix- Polymer matrix, Thermoplastics and thermosetting resins,	2
1.3	Structural applications of Composite Materials, Processing of Composites Processing of Composites, General Characteristics of reinforcement and classifications,	2
2	Macro mechanical behaviour of a composite lamina (9)	
2.1	Review of Basic Equations of Mechanics and Materials, Hooke's law for different types of materials- Anisotropic, orthotropic, isotropic, monoclinic and Transversely isotropic materials.	2
2.2	Stress-Strain relations for a Two dimensional unidirectional and orthotropic lamina, lamina of arbitrary orientation, Transformations of stress and strain	3
2.3	Relationship of Compliance and stiffness matrix to elastic constants of a lamina	1
2.4	Strength and Failure theories of Continuous Fibre-reinforced orthotropic Lamina- Failure envelopes, Maximum stress/strain criteria, Tsai-Hill and Tsai-Wu criterion.	2
2.5	Hygrothermal stresses and strains in a lamina –unidirectional and angle lamina	1
3	Micromechanical Behaviour of a Lamina (6)	
3.1	Volume and Mass fractions, density and void content	1

3.2	Effective Moduli of a continuous fibre-reinforced lamina – Models based on mechanics of materials, theory of elasticity and experimental methods, Mechanics of materials approach to strength, Numerical Examples	2
3.3	Ultimate Strengths of unidirectional Lamina- longitudinal and transverse tensile and compressive strengths	2
3.4	Coefficients of moisture and thermal expansion	1
4	Macro mechanical behaviour of Laminates (10)	
4.1	Classical Lamination Theory-Laminae Stress-strain behaviour, In-plane forces, stress-strain variation in a laminate, resultant laminate stresses and strains,	3
4.2	Special cases of laminate stiffnesses-symmetric and antisymmetric laminates, cross ply and angle ply laminates, quasi-isotropic laminates	3
4.3	Inplane and flexural modulus of a laminate	1
4.4	Effects of stacking sequence-Laminate code	1
4.5	Free-Edge Interlaminar Effects, Hygro-thermal effects and warpage in a laminate	2
5	Strength and Design of Laminates (9)	
5.1	Determination of laminae stresses and strains, numerical Examples	2
5.2	Laminate strength analysis procedure, Failure envelopes	3
5.3	Analysis of laminates after initial failures, Progressive failure Analysis. Numerical Examples	2
5.4	Composite mechanical design issues-Long-term environmental effects, impact resistance, fracture resistance, fatigue resistance	2
Total		40

Text Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher	Edition / Year
1	<i>Mechanics of Composite Materials</i>	Jones M. Roberts	Taylor and Francis, 1998	1998
2	<i>Mechanics of Laminated Composite Plates: Theory and Analysis</i>	J. N. Reddy	CRC Press, 2003	2003

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>Analysis of Laminated Composite Structures</i>	L. R. Calcote	Van Nostrand, 1969
2	<i>Composite Materials and Their Use in Structures</i>	J. R. Vinson & P. C. Chou	Applied Science Publishers Ltd., London, 1975
3	<i>Analysis and Performance of Fibre Composites</i>	B. D. Agarwal & L. J. Broutman	—



SEMESTER 1**C26SCT124 – THEORY OF ELASTICITY & PLASTICITY**

COURSE CODE	C26SCT124	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective - I

Course Objectives:

1. To study advanced concepts of strength of materials.
2. To solve two- and three-dimensional problems in rectangular and polar coordinate systems to describe stress and strain in an elastic continuum.
3. To familiarize students about the concept of plasticity.

Course Outcomes: After the completion of the course the student will be able to

Course Outcomes		Bloom's Knowledge Level(KL)
CO 1	Develop the concept of stress-strain tensors and their relationships in 3D continuum problems.	K5
CO 2	Idealize physical problems into plane stress and plane strain problems and solve them using stress functions.	K3
CO 3	Describe the state of stress and strain developed in solids due to applied loads	K3
CO 4	Compute the effect of torsion in thin-walled and irregular closed/open sections.	K4
CO 5	Apply various failure criteria for general stress states at points.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		1				
CO 2	2		2		2		
CO 3	2		1		2		
CO 4	3		3		2		
CO 5	2						

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	15
Apply	25
Analyse	20
Evaluate	
Create	

Mark Distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Basic concepts– Body force–Surface traction–Stresses and strains, Three dimensional stresses and strains – analysis, Transformation equations of 3D stresses & strains, Principal stresses & strains, States of stresses & strain, Equilibrium equations.	8
2	Plane stress and plane strain– Analysis, Transformation equations, stress–strain relations, Equilibrium equations in Cartesian and polar coordinates, Airy’s stress function– Biharmonic Equilibrium, Saint Venant’s principle, 2D problems in Cartesian coordinate, Cantilever with concentrated load at free end, Cantilever with moment at free end.	8
3	Strain Energy Density, Complementary Internal Energy Density, Elasticity and Strain Energy Density, Elasticity and Complementary Internal Energy Density, Generalized Hooke’s Law, Anisotropic Elasticity, Isotropic Elasticity, Displacements-strains and compatibility equations, Equilibrium equations and boundary conditions	8
4	Torsion of prismatic bar– General solution, warping function approaches Saint Venant’s theory, warping function approaches Prandtl’s stress function, Membrane analogy- torsion of irregular cross sections, Torsion of narrow rectangular cross sections, Torsion of multi celled thin wall open and closed sections.	8
5	Introduction to plasticity – General concepts, Stress – Strain curve, Ideal plastic body – Plastic flow conditions, Theories of failure, Yield criteria – Simple applications, Elasto – plastic analysis for bending and torsion of bars, Residual stresses in bending and torsion.	8

COURSE PLAN

No	Topic	No. of Lectures
1	Module I : Elasticity (8)	
1.1	Basic concepts– Body force–Surface traction–Stresses and strains	1
1.2	Three dimensional stresses and strains – analysis	1
1.3	Transformation equations of 3D stresses& strains	2
1.4	Principal stresses & strains	2
1.5	States of stresses & strain	1
1.6	Equilibrium equations	1
2	Module II: Two-dimensional stress–strain problems (8)	
2.1	Plane stress and plane strain– Analysis	1
2.2	Transformation equations, stress–strain relations	1
2.3	Equilibrium equations in Cartesian and polar coordinates	1
2.4	Airy’s stress function– Biharmonic Equilibrium	2
2.5	Saint Venant’s principle, 2D problems in Cartesian coordinate	1
2.6	Cantilever with concentrated load at free end	1
2.7	Cantilever with moment at free end.	1
3	Module III: Elements of Theory of Elasticity (8)	
3.1	Strain Energy Density	1
3.2	Complementary Internal Energy Density	1
3.3	Elasticity and Strain Energy Density, Elasticity and Complementary Internal Energy Density	2
3.4	Generalized Hooke’s Law	1
3.5	Anisotropic Elasticity, Isotropic Elasticity	1
3.6	Displacements-strains and compatibility equations	1
3.7	Equilibrium equations and boundary conditions	1

4	Module IV: Torsion (8)	
4.1	Torsion of prismatic bar– General solution	1
4.2	Warping function approaches Saint Venant’s theory.	1
4.3	Warping function approaches Prandtl’s stress function	1
4.4	Membrane analogy-torsion of irregular cross sections	2
4.5	Torsion of narrow rectangular cross sections.	1
4.6	Torsion of multi celled thin wall open and closed sections.	2
5	Module V: Plasticity (8)	
5.1	Introduction to plasticity – General concepts, Stress – Strain curve	1
5.2	Ideal plastic body – Plastic flow conditions	1
5.3	Theories of failure	1
5.4	Yield criteria – Simple applications	1
5.5	Elasto –plastic analysis for bending and torsion of bars	2
5.6	Residual stresses.	2
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>Theory of Elasticity</i>	S. P. Timoshenko & J. N. Goodier	Tata McGraw-Hill
2	<i>Theory of Plasticity</i>	Sadhu Singh	Khanna Publishers, Delhi
3	<i>Advanced Mechanics of Solids</i>	L. S. Srinath	Tata McGraw-Hill Publishing Company Ltd., New Delhi
4	<i>Applied Elasticity</i>	T. G. Seetharam & L. Govinda Raju	—
5	<i>Advanced Mechanics of Materials</i>	Arthur P. Boresi & Omar M. Sidebottom	John Wiley & Sons
6	<i>Mathematical Theory of Elasticity</i>	Sokolnikoff	McGraw-Hill Inc., USA



SEMESTER 1**C26SCT134 – FINITE ELEMENT METHOD**

COURSE CODE	C26SCT134	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective - I

Course Objectives:

1. To give a fundamental knowledge on finite element method.
2. To able the student to comprehend FEM as a numerical technique to solve partial differential equations representing various problems in structural mechanics.

Course Outcomes: After the completion of the course the student will be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO 1	Analyse the structures using energy principles and variational formulation	K4
CO 2	Explain the procedure of finite element method and derive the shape functions of various elements	K2
CO 3	Derive the stiffness matrix of various elements used for the analysis of structures	K5
CO 4	Analyse of structures using finite element techniques	K4
CO 5	Analyze plate and shell structures using plate theories, stiffness matrix assembly, and finite element software.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2	2		2				
CO 3	2		2				

CO 4	2		3	2	2		
CO 5			2	2	2		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	15
Apply	25
Analyse	20
Evaluate	
Create	

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Introduction to Finite Element Method – Historical development – Advantages – disadvantages – Outline of the FE procedure Basics of elasticity - Equations of equilibrium – Strain - displacement relation – stress - strain (constitutive) relation- Plane stress and plane strain problems Energy principles -Principle of virtual work - Approximate methods – Rayleigh Ritz method – Weighted Residual Method	8
2	Displacement functions - convergence and compatibility requirements -- Types of finite elements - Degree of continuity– C0 and C1 elements Shape functions – General coordinates – Natural coordinates - Development of shape functions for truss, CST, LST and beam elements, Shape functions of beam element using Hermitian interpolation Lagrange and Serendipity elements – Shape functions using Lagrange interpolation	8
3	Development of stiffness matrix for bar element, beam elements and triangular elements Development of consistent nodal load vector- patch test - static condensation. Analysis of assembly of 2D truss elements, plane frames using finite element techniques	8
4	Numerical integration - Gauss quadrature technique, Concept of isoparametric formulation- Plane bilinear element- Subparametric and superparametric elements	8
5	Analysis of plate bending – Basic equation of thin plate theory- Reissner-Mindlin theory – plate elements and applications Introduction to shell elements, Assembly procedure and storage techniques of stiffness matrix- Band width minimization – Gauss elimination, Discussion of modelling and analysis using recent finite element software packages	8

COURSE PLAN

No	Topic	No. of Lectures
1	Module I : Total lecture hours : 8	
1.1	Historical development of FEA – Advantages and disadvantages	1
1.2	Outline of Finite Element Procedure	1
1.3	Basics of elasticity	1
1.4	Plane stress and plane strain problems	1
1.5	Energy principles - Principle of virtual work - Principle of stationary potential energy	1
1.6	Rayleigh Ritz method	2
1.7	Weighted residual method – Galerkin method	1
2	Module II : Total lecture hours : 8	
2.1	Convergence and compatibility requirements of displacement Functions	1
2.2	Types of finite elements, Degree of continuity - C0 and C1 elements	1
2.3	General coordinates and Natural coordinates	1
2.4	Development of shape functions for truss elements, CST elements, LST elements	2
2.4	Development of shape functions for beam element using Hermitian interpolation	1
2.5	Lagrange and Serendipity elements, Shape functions of 1D and 2D elements by Lagrange interpolation	2
3	Module III : Total lecture hours : 8	
3.1	Development of stiffness matrix for bar element, beam element	1
3.2	Development of stiffness matrix for triangular elements	1

3.3	Development of consistent nodal load vector	1
3.4	Patch test - Static Condensation.	1
3.5	Analysis of assembly of 2D truss elements using finite element Techniques	2
3.6	Analysis of plane frame using finite element techniques	2
4	Module IV : Total lecture hours : 8	
4.1	Numerical integration - Gauss quadrature technique	2
4.2	Concept of isoparametric formulation,	1
4.3	Isoparametric formulation of Plane bilinear element	2
4.4	Subparametric and superparametric elements	1
4.5	Numerical problems on Isoparametric formulation	2
5	Module V : Total lecture hours : 8	
5.1	Analysis of plate bending – Basic equation of thin plate theory-Reissner-Mindlin theory – plate elements and applications	3
5.2	Introduction to shell elements	1
5.3	Assembly procedure and storage techniques of stiffness matrix-Band width minimization	2
5.4	Gauss Elimination	1
5.4	Discussion of modelling and analysis using recent finite element software packages	1
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>Concepts and Applications of Finite Element Analysis</i>	R. D. Cook et al.	John Wiley & Sons, Singapore
2	<i>Finite Element Analysis: Theory and Programming</i>	C. S. Krishnamoorthy	Tata McGraw-Hill, New Delhi

3	<i>Finite Element Analysis in Engineering Design</i>	S. Rajasekharan	Wheeler, New Delhi
4	<i>Introduction to Finite Elements in Engineering</i>	T. R. Chandrupatla & A. D. Belegundu	Pearson Education, New Delhi
5	<i>Finite Element Procedures in Engineering Analysis</i>	K. J. Bathe	Prentice Hall, New Delhi
6	<i>The Finite Element Method</i>	O. C. Zienkiewicz & R. W. Taylor	Elsevier Butterworth-Heinemann, UK
7	<i>A First Course in the Finite Element Method</i>	D. L. Logan	Thomson, 2007



SEMESTER 1**C26SCT144 – HIGH RISE STRUCTURES**

COURSE CODE	C26SCT144	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective - I

Course Objectives:

1. To understand the basic principles and necessity of high-rise construction.
2. To analyze various structural systems for high-rise buildings, their suitability for different loads, and design parameters
3. To apply methods of analysis in the design of high-rise structures

Course Outcomes: After the completion of the course the student will be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO 1	Understanding the evolution, need, influencing factors, design philosophies, and materials associated with tall buildings	K2
CO 2	Analyse the various loadings on tall buildings and apply basic wind and seismic load principles	K4
CO 3	Apply approximate analysis methods to determine drift and structural behaviour in rigid frames.	K3
CO 4	Analyse the behaviour and load-resisting mechanisms of braced frames, infilled frames, shear walls, and wall-frame systems.	K4
CO 5	Select appropriate high-rise structural systems and apply modelling and analysis techniques used in tall building design.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				
CO 2	2		2				
CO 3	2		3	2	2		
CO 4	2		3				
CO 5	2		2				

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	15
Apply	25
Analyse	20

Mark distribution**SYLLABUS**

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

MODULE	DESCRIPTION	CONTACT HOURS
1	Definition and need of tall building - Historic background - factors affecting growth. Design Criteria, Design Philosophy of High-Rise structures, Materials for construction of high rise structures.	8
2	Different types of Loadings – Gravity Loads, Wind Load, Static and Dynamic methods, Wind Tunnel test, Seismic Load, Performance Based Seismic Design	8
3	Structural form, Floor systems, Rigid frame Structures, Portal method, Cantilever method, approximate analysis of drift	8
4	Braced frames, Infilled frames, behaviour of infilled frames Shear wall Structures-behaviour of shear wall structures, Coupled shear walls, Wall frame structures- behaviour of wall frame.	8
5	Tubular structures-framed tube structures-bundled tube structures-braced tube structures, Core structures, Outrigger-Braced Structures, Foundations for tall structures-pile foundation- mat foundation, Modelling for analysis for high rise structures – approximate analysis, accurate analysis and reduction techniques, Discussion of various Finite Element Packages for the analysis of High-Rise Structures.	8

COURSE PLAN

No	Topic	No. of Lectures
Module – 1		
1.1	Definition and need of tall building - Historic background - factors affecting growth	3
1.2	Design Criteria, Design Philosophy of High-Rise structures	2
1.3	Materials for construction of high rise structures.	3

Module – 2		
2.1	Dead and live load, live load reduction techniques	2
2.2	Sequential loading, Impact loading	1
2.3	Wind Loading - Wind Characteristics, Static and Dynamic wind effects - Analytical and wind tunnel experimental method	2
2.4	Seismic Loading - Earthquake loading-equivalent lateral force method, modal analysis, Introduction to Performance based seismic design	3
Module – 3		
3.1	Structural form, Floor systems, Rigid frame Structures, rigid frame behavior	3
3.2	Approximate determination of member forces by gravity loading-two cycle moment distribution	3
3.3	Approximate determination of member forces by lateral loading-Portal method, Cantilever method	2
Module – 4		
4.1	Braced frames- Types of bracings-behaviour of bracings, behaviour of braced bents-method of member force analysis-method of drift analysis	2
4.2	Infilled frames, behaviour of infilled frames-stresses in infill- forces in frame- design of infill and frame (no numerical)- horizontal deflection	2
4.3	Shear wall Structures-behaviour of shear wall structures - proportionate wall systems, non-proportionate wall systems (no analysis required)- horizontal deflection, Coupled shear walls - behaviour of coupled wall structures	2
4.4	Wall frame structures- behaviour of wall frames	2
Module – 5		
5.1	Tubular structures-framed tube structures-bundled tube structures-braced tube structures	1

5.2	Core structures, Outrigger-Braced Structures	1
5.3	Foundations for tall structures-pile foundation-mat foundation	2
5.4	Modelling for analysis for high rise structures – approximate analysis, accurate analysis and reduction technique.	2
5.5	Discussion of various Finite Element Packages for the analysis of High-Rise Structures	2
Total		40

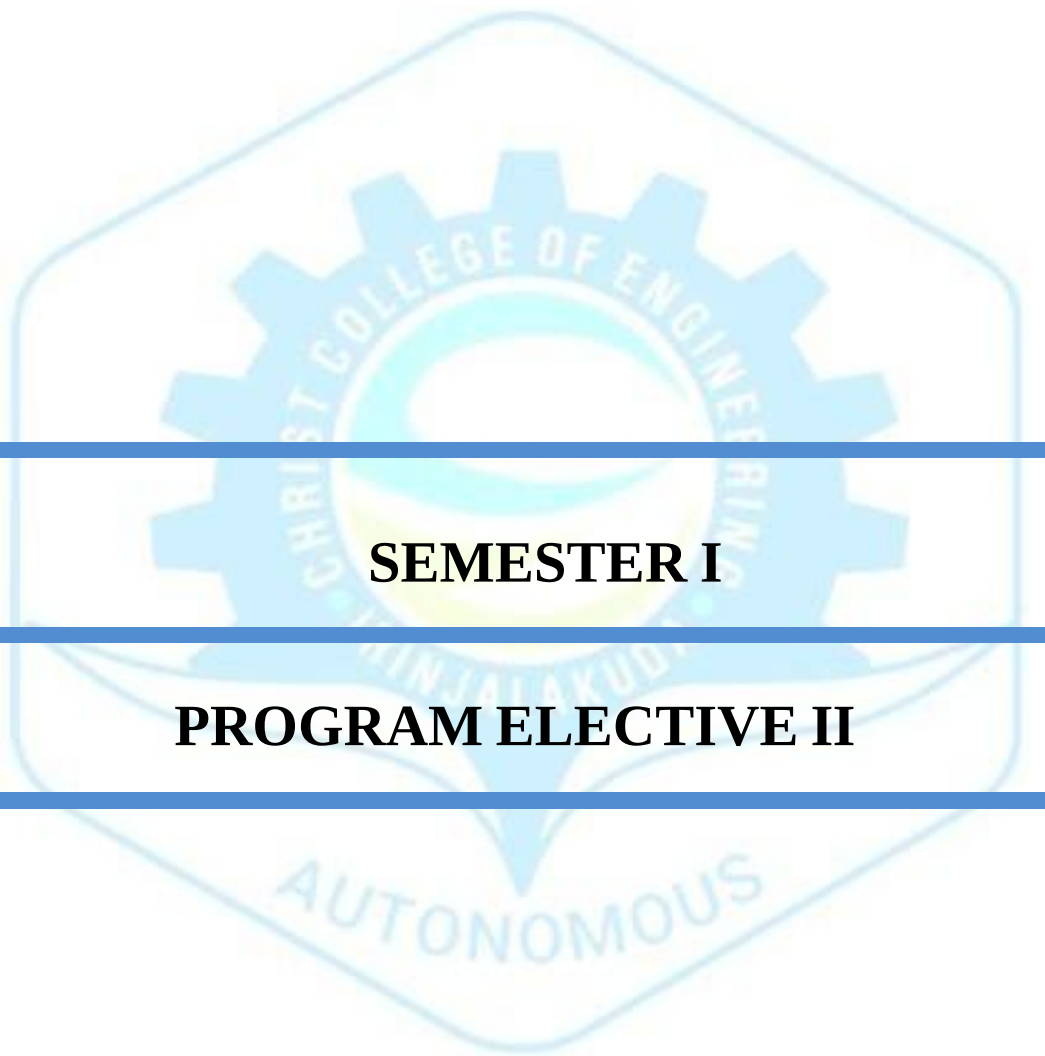
Text Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>Tall Building Structures: Analysis and Design</i>	Bryan Stafford Smith & Alex Coull	Wiley-Interscience, New York, 1991
2	<i>Structural Analysis and Design of Tall Buildings</i>	Bungale S. Taranath	Tata McGraw-Hill, 1988

Reference Books

Sl. No.	Title of the Book / Standard	Name of Author(s)	Publisher & Edition
1	<i>Earthquake Engineering</i>	Robert L. Wiegel	Prentice Hall, 1970
2	<i>Wind Effects on Civil Engineering Structures</i>	V. Kolousek, M. Pimer, O. Fischer & J. Naprstek	Elsevier Publications, 1984
3	<i>IS 16700:2017 – Criteria for Structural Safety for Tall Concrete Buildings</i>	Bureau of Indian Standards (BIS)	BIS, 2017
4	<i>High Rise Building Structures</i>	Wolfgang Schueller	Wiley
5	<i>Planning and Installation of Services in Building Complexes and High Rise Buildings</i>	V. K. Jain	Khanna Publishers, New Delhi
6	<i>High Rise Structures: Design and Construction Practices for Middle Level Cities</i>	Y. P. Gupta	New Age International Publishers, New Delhi



The logo of Christ College of Engineering is a large, light blue watermark in the background. It features a gear-like outer ring with the text 'CHRIST COLLEGE OF ENGINEERING' around the top and 'IRINJALAKUDA' around the bottom. Inside the gear is a circular emblem with a cross and a book. Below the gear, the word 'AUTONOMOUS' is written in a large, light blue font.

SEMESTER I

PROGRAM ELECTIVE II



SEMESTER 1**C26SCT115 – CONSTRUCTION MANAGEMENT AND
ENGINEERING ECONOMICS**

COURSE CODE	C25SCT115	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective – II

Course Objectives:

1. To provide a basic awareness of scientific management thoughts and an in-depth knowledge of projects, the various types and their planning and management.
2. To expose students to the concepts of engineering economics which will facilitate economic decision-making. Students are introduced to systematic knowledge of management information systems in decision-making.

Course Outcomes: After the completion of the course the student will be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO 1	Describe the concept and basic principles of scientific management and the various phases in the planning of construction projects	K3
CO 2	Explain MIS effectiveness, efficiency criteria and failure of MIS	K3
CO 3	Apply the concepts of engineering economics in economic decision making	K3
CO 4	Describe construction accounting and long-term and short-term financing	K3
CO 5	Describe the need for PPP projects and the importance of risk allocation in the projects and compare and contrast the various PPP models	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				2
CO 2			2				2
CO 3			3	2			3
CO 4			2				2
CO 5			2				1

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	15
Apply	20
Analyse	25

Mark Distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Scientific Management: Concept - elements - contributions of pioneers in scientific management - basic principles of management with reference to construction industry - Construction Projects – concepts – types – life cycle of a construction project	8
2	Management information Systems: Definition - evolution - organizational theory - systems approach - computer systems -database management - information systems for decision making - MIS effectiveness and efficiency criteria -failure of MIS.	8
3	Engineering Economics: Definition and scope - cash flow - interest formulas and application - time value of money -bases of comparison - decision making amongst alternatives - rate of return - benefit cost analysis-incremental analysis replacement analysis - break even analysis.	10
4	Capital budgeting - working capital management - construction accounting - long term and short term financing - problems and case studies.	6
5	Private sector participation in Infrastructure Development Projects - PPP models - operation- maintenance, lease, concession (BOT), Private Finance Initiative - Risk identification and allocation in PPP projects - PPP structure and financing	8

COURSE PLAN

No	Topic	No. of Lectures
1	MODULE I (8 hours)	
1.1	Scientific management concept – elements	1
1.2	Contributions of pioneers in scientific management	2

1.3	Basic principles of management with reference to construction industry	2
1.4	Construction Projects – concepts – types	1
1.5	Life cycle of a construction project	2
2	MODULE II (8 hours)	
2.1	Management information Systems Definition	1
2.2	Evolution - organizational theory	2
2.3	Systems approach -computer systems-database management	2
2.4	Information systems for decision making	1
2.5	MIS effectiveness and efficiency criteria- Failure of MIS.	2
3	MODULE III (10 hours)	
3.1	Engineering Economics- Definition and scope - Cash flow	2
3.2	Interest formulas and application- Time value of money	2
3.3	Bases of comparison -Decision making amongst alternatives- rates of return	2
3.4	Benefit cost analysis -Incremental analysis	2
3.5	Replacement analysis - break even analysis	2
4	MODULE IV (6 hours)	
4.1	Capital budgeting – working capital management- construction accounting	2
4.2	Long-term and short-term financing	2
4.3	Problems and case studies	2
5	MODULE V (8 hours)	
5.1	Private sector participation in Infrastructure Development Projects – concept, benefits, limitations	1
5.2	PPP models - operation-maintenance, lease, concession, Private Finance Initiative	4
5.3	Risk identification and allocation in PPP projects	1

5.4	PPP structure and financing	2
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>Construction Project Management: Theory & Practice</i>	Kumar Neeraj Jha	Pearson India Education Services Pvt. Ltd., 2015
2	<i>Engineering Economy</i>	Leland Blank & Anthony Tarquin	McGraw-Hill Education, New York, 2017
3	<i>Managing the Construction Process: Estimating, Scheduling, and Project Control</i>	Frederick E. Gould	Pearson, 2013
4	<i>Total Project Management: The Indian Context</i>	Joy P. K.	Macmillan India Ltd., New Delhi, 1994
5	<i>Projects: Planning, Analysis, Selection, Implementation & Review</i>	Prasanna Chandra	McGraw-Hill Publishing Company Ltd., New Delhi, 2014
6	<i>Construction Project Management: Planning, Scheduling & Controlling</i>	K. K. Chitkara	Tata McGraw-Hill, New Delhi, 1998
7	<i>A Guidebook on Public-Private Partnership in Infrastructure</i>	UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), 2011
8	<i>Principles of Management</i>	Dinkar Pagare	Sultan Chand & Sons, New Delhi
9	<i>Information Systems for Modern Management</i>	Robert G. Murdick, Joel E. Ross & James R. Claggett	PHI Learning Private Limited, New Delhi
10	<i>Engineering Economics</i>	R. Panneerselvam	PHI Learning Private Limited, New Delhi
11	<i>Construction Management and Machinery</i>	B. L. Gupta & Amit Gupta	Standard Pub



SEMESTER 1**C26SCT125 – ADVANCED CONSTRUCTION TECHNIQUES**

COURSE CODE	C26SCT125	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective – II

Course Objectives:

1. To study and understand various advanced construction techniques applied to engineering construction.
2. To study various construction practices for substructure and superstructures of heavy structures.
3. To know construction sequences of various infrastructures and the different repairing techniques used in construction.
4. To understand advanced techniques for demolition and dismantling of structure

Course Outcomes:

After the completion of the course, the student will be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO 1	Describe the construction practices for sub structures and super structures of heavy structures.	K2
CO 2	Apply superstructure construction techniques including concrete paving, formwork, erection, and launching methods.	K3
CO 3	Apply construction sequences for towers, chimneys, silos, skyscrapers, and bridges.	K3
CO 4	Analyse construction repair and strengthening techniques for given site conditions.	K4
CO 5	Analyse demolition methods, hazards, and waste management practices.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2		2		
CO 2			3		2		
CO 3			2		3		
CO 4			2		3		
CO 5			2		3		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	15
Apply	25
Analyse	20

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Sub structure construction- Box jacking and pipe jacking, Under water construction of diaphragm wall and basement, Tunnelling techniques, Piling techniques, Driving well and caissons, Sinking of cofferdams, Large reservoir construction - well points - Dewatering for underground open excavation.	8
2	Super structure construction- Concrete paving technology, Techniques of construction for continuous concreting operations in tall buildings of various shapes and various sections, Suspended formwork, Erection techniques of tall structures, Large span structures, Launching techniques. Ariel transporting.	8
3	Construction sequences - Erecting lattice tower, Construction sequence of cooling towers, chimneys, . silos, skyscrapers, bowstring bridges, Cable stayed bridges. Construction of jetties and break water structures, Support structure for heavy equipment and machinery in heavy Industries	8
4	Construction repair- Strengthening of beams, columns, slab and masonry wall ,Waterproofing on concrete, Protecting sheet piles, Mud jacking and grouting for foundation, micro piling for strengthening floor and shallow profile, subgrade Waterproofing	8
5	Advanced techniques and sequence in demolition and dismantling - Types and methods of demolition, Preparatory operations before demolition and steps, Demolition sequence, Demolition equipment, Demolition waste processing and disposal, Demolition hazards.	8

COURSE PLAN

No	Topic	No. of Lectures
1	Sub Structure Construction (8)	
1.1	Box jacking and pipe jacking	1
1.2	Under water construction of diaphragm wall and basement	1
1.3	Tunnelling techniques	1

1.4	Piling techniques, Driving well and caissons	2
1.6	Sinking of cofferdams	1
1.7	Dewatering	1
1.8	Underground excavation	1
2	Super Structure Construction (8)	
2.1	Concrete paving technology	1
2.2	Techniques of construction for continuous concreting operations in tall buildings of various shapes and various sections	2
2.3	Suspended formwork	1
2.4	Erection techniques of tall structures	1
2.5	Large span structures	1
2.6	Launching techniques	1
2.7	Ariel transporting	1
3	Construction Sequences (8)	
3.1	Erecting lattice tower	1
3.2	Construction sequence of cooling towers and chimneys	2
3.3	Construction sequence of silos	1
3.4	Construction sequence of skyscrapers	2
3.5	Sequence of bowstring bridges	1
3.6	Sequence of cable stayed bridges	1
4	Construction Repair (8)	
4.1	Waterproofing on concrete	2
4.2	Pipeline laying	1
4.3	Protecting sheet piles	1
4.4	Mud jacking grout through slab foundation	1
4.5	Micro piling for strengthening floor and shallow profile	2
4.6	Subgrade waterproofing	1
5	Advanced Techniques And Sequence In Demolition And Dismantling (8)	
5.1	Types and methods of demolition	1
5.2	Preparatory operations before demolition and steps	1
5.3	Demolition sequence	2
5.4	Demolition equipments	2
5.5	Demolition waste processing and disposal	1
5.5	Demolition hazards	1
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher
1	<i>Trenchless Technology: Pipeline and Utility Design, Construction, and Renewal</i>	Mohammad Najafi	McGraw-Hill, 2021
2	<i>Temporary Structures in Construction</i>	Robert T. Ratay	McGraw-Hill, Edition 2012
3	<i>Earth Retention Systems Handbook</i>	Alan Macnab	The McGraw-Hill Companies, Inc., 2002
4	<i>Urban Construction Project Management</i>	Richard Lambeck & John Eschemuller	The McGraw-Hill Companies, Inc., 1st Edition, 2009
5	<i>Concrete: Microstructure, Properties, and Materials</i>	P. Kumar Mehta & Paulo J. M. Monteiro	The McGraw-Hill Companies, Inc., 4th Edition, 2014
6	<i>Forensic Structural Engineering Handbook</i>	Robert T. Ratay	The McGraw-Hill Companies, Inc., 2nd Edition, 2010
7	<i>Tresfjord Bridge – A Human Friendly and Traffic Efficient Structure</i>	Kristian B. Dahl & Aja Anta Magerøy Tønnessen	IOP Publishing, 2017
8	<i>Bridge and Highway Structure Rehabilitation and Repair</i>	Mohiuddin A. Khan	McGraw-Hill Education, 2010
9	<i>Aerial or Wire-Rope Tramways: Their Construction and Management</i>	Alexander James Wallis-Tayler	Andesite Press, 2017
10	<i>Practical Antenna Handbook</i>	Joseph J. Carr & George W. Hippisley	5th Edition, 2012
11	<i>HVAC and Refrigeration Preventive Maintenance</i>	Eric Kleinert	McGraw-Hill Education, 1st Edition, 2015
12	<i>Practical Silo Construction: A Treatise Illustrating and Explaining the Most Simple and Easiest Practical Methods of Constructing Concrete Silos of All Types</i>	Albert Allison Houghton	Hardpress Publishing, 2012
13	<i>Tall and Supertall Buildings: Planning and Design</i>	Akbar R. Tamboli	McGraw-Hill Education, 2012
14	<i>Structural Steel Designer's Handbook</i>	Roger L. Brockenbrough & Frederick S. Merritt	McGraw-Hill Education, 6th Edition, 2020

15	<i>Structural Renovation of Buildings: Methods, Details, and Design Examples</i>	Alexander Newman	McGraw-Hill Education, 2nd Edition, 2021
16	<i>Foundation Engineering Handbook: Design and Construction with the 2009 International Building Code</i>	Robert W. Day	The McGraw-Hill Companies, Inc., 2nd Edition, 2010
17	<i>Construction Safety: Health, Practices, and OSHA</i>	M. Rashad Islam	McGraw-Hill, 1st Edition, 2022



SEMESTER 1**C26CST135 – MODERN CONSTRUCTION MATERIALS**

COURSE CODE	C26SCT135	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective - II

Course Objective:

1. To develop a strong understanding of the material science of various construction materials and its influence on the performance of the materials in the structure.

Course Outcomes:

After the completion of the course the student will be able to:

Course Outcomes		Bloom's Knowledge Level(KL)
CO 1	Apply the fundamentals of materials science to interpret the properties and behavior of engineering materials.	K3
CO 2	Apply knowledge of material properties to select suitable construction materials for engineering applications.	K3
CO 3	Analyse the principles of material behavior to assess failure under different loading conditions.	K4
CO 4	Decide the appropriateness of a material for a specific application	K4
CO 5	Analyze the structure, properties, specifications, and applications of bituminous materials, polymers, FRP, glass, and smart/intelligent materials	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				
CO 2			3				
CO 3	2		2		3		
CO 4	2			2	2	2	
CO 5			3		2		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	15
Apply	25
Analyse	20
Evaluate	

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODUL E	DESCRIPTION	CONTAC T HOURS
1	Bonds - Review of chemical bonds, states of matter, structure of materials, Movement of atoms, Development of microstructure; Surface Properties: Introduction to Surface Energy, Surface Tension, wetting, Adhesion, Adsorption, Surfactants, Capillary Rise, Colloids.	8
2	Review of mechanical behaviour - Deformation, Stress, Strain, Hooke's Law, Stress- Strain Diagram; Response to stress – Elastic Properties, Plasticity, Yielding, Slip along atomic planes, Strain Hardening, Annealing; Response to stress - Ductile Failure, Brittle Fracture, Fatigue Failure, Creep; Probabilistic Fracture -Tensile and Compressive Strengths, Statistics of Strength; Failure theories – Uni axial (Tensile) Behaviour of a Metal, Complex Inelastic Response, Multi axial Loading, Introduction to Rankine Theory, Tresca Criterion, von Mises Theory, Mohr coulomb Failure Theory	8
3	Introduction to Fracture Mechanics - Stress concentration, Pure modes of fracture - Mode I or opening crack, Linear Elastic Fracture Mechanics, Brittle Ductile Transition, Brittle Fracture, Elasto-Plastic Fracture; Fracture in Polymers, Fracture in Composites, Fracture in Concrete. Rheology - Time-Dependent Material Response, Rheological Models, Rheological Behaviour of Liquids, Thixotropy; Thermal properties - Heat Capacity, Thermal Expansion, Thermal Stresses, Thermal Conductivity	8
4	Metals - Structure, Properties and Applications of Iron and Steel, Aluminium; Timber - Structure of Wood, Properties of Wood, Seasoning of Timber, Engineering Properties, Thermal Properties, Applications of Timber, Wood-Based Composites; Concrete - Structure, Properties and Applications	8
5	Bituminous materials - Structure of Bitumen, Specification of Bitumen, Asphalt Concrete Paving	8

	Mixtures; Polymers and Plastics - Structure, Properties and Applications; FRP - Structure, Properties and Application; Glass – Types, properties and applications, Smart and intelligent materials (shape memory alloys, magnetostrictive materials, piezo electric materials) Smart and intelligent materials (shape memory alloys, magnetostrictive materials, piezo electric materials)	
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COURSE PLAN

No	Topic	No. of Lectures
1	Review of bonds; development of micro structure; surface properties	
1.1	Introduction to the subject – Need to understand the material structure – Relationship between micro structure to macro structure behavior	1
1.2	Bonds - Review of chemical bonds, states of matter, structure of materials	1
1.3	Movement of atoms, development of microstructure	2
1.4	Surface Properties: Introduction to Surface Energy, Surface Tension, Wetting, Adhesion	2
1.5	Surface Properties: Adsorption, Surfactants, Capillary Rise, Colloids	2
2	Mechanical behaviour of materials; Failure theories	
2.1	Review of mechanical behaviour - Deformation, Stress, Strain, Hooke's Law, Stress-Strain Diagram	1
2.2	Elastic Properties, Plasticity, Yielding, Slip Along Atomic Planes, Strain Hardening, Annealing	2
2.3	Ductile Failure, Brittle Fracture, Fatigue Failure, Creep.	1
2.4	Probabilistic Fracture -Tensile and Compressive Strengths, Statistics of Strength	1
2.5	Failure theories – Uni axial (Tensile) Behaviour of a Metal, Complex Inelastic Response, Multi axial Loading	1

2.6	Introduction to Rankine Theory, Tresca Criterion, von Mises Theory, Mohr-Coulomb Failure Theory	2
3	Fracture mechanics; Rheology	
3.1	Introduction to fracture Mechanics - Stress Concentration, Pure Modes of Fracture-Mode I or opening crack, Linear Elastic Fracture Mechanics, Brittle-Ductile Transition, Brittle Fracture, Elasto-Plastic Fracture	2
3.2	Fracture in Composites, Fracture in Concrete	2
3.3	Rheology - Time-Dependent Material Response, Rheological Models, Rheological Behaviour of Liquids, Thixotropy ;	2
3.4	Thermal properties - Heat Capacity, Thermal Expansion, Thermal Stresses, Thermal Conductivity	2
4	Structure, Properties and Application of Materials – Metals, Timber, Concrete	
4.1	Metals - Structure, Properties and Applications of iron, steel and aluminium	2
4.2	Timber - Structure of Wood, Properties of Wood, Seasoning of Timber,	1
4.3	Engineering Properties, Thermal Properties, Applications of Timber	1
4.4	Wood-Based Composites	1
4.5	Concrete - Structure, Properties and Applications	3
5	Structure, Properties and Application of Materials – Bitumen, Polymers and plastics, FRP, Glass, Smart and intelligent materials	
5.1	Bituminous materials - Structure of Bitumen, Specification of Bitumen, Asphalt Concrete Paving Mixtures	2
5.2	Polymers and Plastics - Structure, Properties and Applications	2
5.3	FRP - Structure, Properties and Applications	1
5.4	Glass – Types, Properties and Applications	1
5.5	Smart and intelligent materials (shape memory alloys, magnetostrictive materials, piezo electric materials)	2
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition
1	<i>The Science and Technology of Civil Engineering Materials</i>	J. F. Young, S. Mindess, R. J. Gray & A. Bentur	Prentice Hall, 1998
2	<i>Materials Science and Engineering: An Introduction</i>	W. D. Callister	John Wiley, 1994
3	<i>Construction Materials: Their Nature and Behaviour</i>	J. M. Illston & P. L. J. Domone	Spon Press, 2001
4	<i>Concrete, Microstructure, Properties and Materials</i>	P. Kumar Mehta & Paulo J. M. Monteiro	Indian Concrete Institute, Chennai
5	<i>Materials Science and Engineering: A First Course</i>	V. Raghavan	Prentice Hall, 2004
6	<i>Properties of Engineering Materials</i>	R. A. Higgins	Industrial Press, 1994
7	<i>Mechanics of Materials</i>	J. M. Gere	Nelson Thornes, 2001
8	<i>Fracture Mechanics: Fundamentals and Applications</i>	T. L. Anderson	CRC Press, 1991
9	<i>Engineering Materials 1</i>	M. F. Ashby & D. R. H. Jones	Elsevier, 2005
10	<i>Building Materials</i>	P. C. Varghese	Prentice-Hall India, 2005
11	<i>Properties of Concrete</i>	A. M. Neville	Pearson Education, Delhi, 2004

NPTEL Course for reference:

- NPTEL course on “Modern Construction Materials”, Prof. Ravindra Gettu, IIT Madras
https://onlinecourses.nptel.ac.in/noc20_ce05/preview

SEMESTER 1**C26SCT145 – CONSTRUCTION CONTRACTS METHODS AND EQUIPMENT**

COURSE CODE	C25SCT145	CAE Marks	40
Teaching Hours/ Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. and 30 Mins
Prerequisites (If Any)	None	Course Type	Program Elective – II

Course Objectives:

1. To understand the definition, types, elements and characteristics of contract as per Indian contract act and laws related to dispute management, insurance and bonds as part of the project management.
2. To familiarize construction methods and also the latest equipments used for the successful completion of modern construction projects.

Course Outcomes: After the completion of the course, the student will be able to

Course Outcomes		Bloom's Knowledge Level (KL)
CO 1	Describe the basic elements, types and conditions of contract.	K2
CO 2	Analyse the various steps involved in the contract documentation, claims and methods for dispute management.	K4
CO 3	Analyse the laws related to insurance, bonds, specifications and termination of contract.	K4
CO 4	Apply the modern construction methods, and their applications in the construction industry.	K3
CO 5	Apply the various types of equipment used in the construction projects And their capabilitie	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				
CO 2			3	2			

CO 3			3				
CO 4			2	2			
CO 5			3				

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	15
Apply	25
Analyse	20

Mark distribution

Continuous Assessment and Evaluation (CAE):			40 Marks	
End Semester Exam (ESE)			60 Marks	
Total Marks:			100 Marks	
ESE Duration			2 Hrs 30 Mins	
CAE			ESE	
Review article based on peer reviewed original publications	Course based task/ Seminar/ Quiz	Continuous Evaluation Test 1 (CET 1)	Part A	Part B
			5 questions with 1 question from each module (5 Marks each) Students shall answer all questions.	7 Questions with 1 question from each module and additional 2 questions from any module. Students shall answer any 5 questions out of 7
15	15	10	5×5=25	5×7=35
Total	40		60	

SYLLABUS

MODULE	DESCRIPTION	CONTACT HOURS
1	Contracts Requirement of Contract, Elements of Contracts based on Indian Contract Act (1872), Types of Contracts based on Stakeholder responsibilities, Project Delivery Models – (Turnkey, EPC and PPP Models), Standard forms of contract - (FIDIC, NHAH and CPWD), General conditions of the contract for construction.	9
2	Contract Administration Project Documentation, Submission and approval of documents, Permits and approvals, Construction claims and disputes, Potential major claim areas, The Bid Proposal Process and the Potential for Disputes, Modes of resolving disputes, Understanding of Arbitration and Conciliation Act 1996 with latest amendments.	7
3	Contract Management Discharge of contract, Breach of contract, Tendering issues, Risks in construction contract, Regulatory aspects and ethics, Intellectual property act, Law of Torts, General Construction specifications, Commercial Construction Specifications, Bonds, Types of Bonds, Insurance, Workers compensation Insurance, Commercial general liability insurance, Builders risk insurance.	7
4	Construction Methods Horizontal Systems – Hand - set slab forms, Table forms, Vertical Systems – Wall forms, Column forms, Combined Horizontal and Vertical Systems – Tunnel Form Systems, Trench Safety. Cost effective construction methods - Prestressed concrete construction - 3D printing. Precast Flat Panel System-3D Volumetric Construction-Flat Slabs-Hybrid Concrete Construction-Precast Foundations-Insulating Concrete Formwork-Soil stabilisation methods	9
5	Construction Equipment Dozers and graders, Scrapers, hydraulic excavators, Draglines and Clamshells. Concreting equipment - Crushers	8

	– feeders – screening equipment – batching and mixing equipment – hauling, pouring and pumping equipment – transporters. Equipment for compaction- Pneumatic Tired Rollers, Impact Compactors, Compaction Wheels, Intelligent compaction. Trucks and Hauling Equipments - Capacities of Trucks and Hauling Equipment – Calculation of truck productivity.	
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COURSE PLAN

No	Topic	No. of Lectures
1	MODULE 1-Contracts(9)	
1.1	Requirements of Contract	1
1.2	Elements of Contract based on ICA	1
1.3	Types of contracts based on stakeholder responsibilities	1
1.4	Project delivery models - Turnkey model, EPC model, PPP model	3
1.5	Standard forms of contract – FIDIC, NHAI, CPWD	2
1.6	General conditions of the contract for construction	1
2	MODULE 2-Contract Administration (7)	
2.1	Project Documentation, Submission and approval of documents	2
2.2	Permits and approvals, Construction claims and disputes	1
2.3	Potential major claim areas	1
2.4	The Bid Proposal Process and the Potential for Disputes, Modes of resolving disputes	2
2.5	Understanding of Arbitration and Conciliation Act 1996 with latest Amendments	1
3	MODULE 3-Contract Management (7)	
3.1	Discharge of contract, Breach of contract, Tendering issues	1
3.2	Risks in construction contract, Regulatory aspects and ethics, Intellectual property act, Law of Torts	1

3.3	General Construction Specifications, Commercial Construction Specifications	1
3.4	Bonds, Types of Bonds	1
3.5	Insurance, Workers compensation Insurance, Commercial general liability insurance, Builders risk insurance	3
4	MODULE 4-Construction Methods (9)	
4.1	Horizontal systems-Hand-Set slab form, Table forms, Vertical Systems-Column form-Wall forms	2
4.2	Combined Horizontal and vertical Systems-Tunnel form systems, Trench safety	2
4.3	Cost effective Construction Methods-Prestressed Concrete Construction-3 D Printing	2
4.4	Precast Flat Panel System-3D Volumetric, Flat Slab, Hybrid Concrete Construction	1
4.5	Precast Foundations, Insulating Concrete Formwork	1
4.6	Soil Stabilization Methods	1
5	MODULE 5- Construction Equipment (8)	
5.1	Dozers and graders, Scrapers, hydraulic excavators, Draglines and Clamshells	2
5.2	Concreting equipment - Crushers – feeders – screening equipment – batching and mixing equipment – hauling, pouring and pumping, equipment – transporters	2
5.3	Equipment for compaction- Pneumatic Tired Rollers, Impact Compactors, Compaction Wheels, Intelligent compaction	2
5.4	Trucks and Hauling Equipment - Capacities of Trucks and Hauling Equipment – Calculation of truck productivity	2
Total		40

Reference Books

Sl. No.	Title of the Book	Name of Author(s)	Publisher & Edition / Year
1	<i>Project Management in Construction</i>	Sidney M. Levy	McGraw-Hill Education, 7th Edition, 2018
2	<i>Urban Construction Project Management</i>	Richard Lambeck & John Eschemuller	The McGraw-Hill Companies, Inc., 2009
3	<i>Law for Professional Engineers: Canadian and Global Insights</i>	Donald L. Marston, J.D., P.Eng.	5th Edition
4	<i>Commercial Building Construction: Materials and Methods</i>	David A. Madsen	1st Edition
5	<i>Handbook for Building Construction: Administration, Materials, Systems, and Safety</i>	Clifford J. Schexnayder & Christine M. Fiori	McGraw Hill, 1st Edition, 2021
6	<i>Construction Planning, Equipment, and Methods</i>	Robert L. Peurifoy, Clifford J. Schexnayder, Robert L. Schmitt & Aviad Shapira	McGraw-Hill Education, 9th Edition, 2018
7	<i>Construction Equipment and Its Planning and Application</i>	Dr. Mahesh Varma	Metropolitan Book Company, New Delhi
8	<i>Structural Engineering Handbook</i>	Mustafa Mahamid, Edwin H. Gaylord & Charles N. Gaylord	5th Edition
9	<i>Manufacturing Engineering Handbook</i>	Hwaiyu Geng	2nd Edition
10	<i>Foundation Engineering: Geotechnical Principles and Practical Applications</i>	Richard L. Handy	1st Edition
11	<i>Indian Contract Act, 1872</i>		