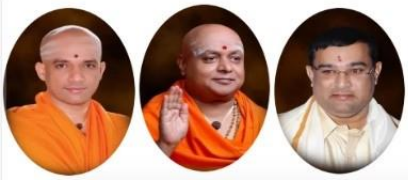

|| Jai Sri Gurudev ||
Sri Adichunchanagiri Shikshana Trust (R)

SJB Institute of Technology

An AUTONOMOUS INSTITUTION UNDER VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Approved by AICTE, 2(f) and 12(B) recognized by UGC, New Delhi
Accredited by NAAC, Accredited by NBA, Certified by ISO 9001 - 2015

PG

Autonomous Scheme & Syllabus

M.Tech STRUCTURAL ENGINEERING

I & II Semesters

2025 SHEME

SERVICE TO MANKIND IS SERVICE TO GOD

His Divine Soul Padmabhushana

Sri Sri Sri Dr. Balagangadharanath MahaSwamiji

Founder President, Sri Adichunchanagiri Shikshana Trust®

Belief in God is not ignorance or illusion. It is a belief that there is an unseen, ineffable Power that transcends all our powers of muscles, mind and lives.

His Holiness Parama Pujya

Sri Sri Sri Dr. Nirmalanandanatha MahaSwamiji

President, Sri Adichunchanagiri Shikshana Trust ®

True richness is the generosity of heart. Cultivate it and work to help the less fortunate ones in life.

Revered Sri Sri Dr. Prakashanatha Swamiji

Managing Director, BGS & SJB Group of Institutions & Hospitals

People and prosperity follow the path which the leaders take. So the elders and leaders should make sure that they give the right lead and take.

SJB Institute of Technology

VISION:

To become a recognized technical education center with a global perspective.

MISSION:

To provide learning opportunities that foster students' ethical values, intelligent development in science technology and social responsibility so that they become sensible and contributing members of society.

Department of Civil Engineering

VISION

To produce high quality Civil Engineering graduates to suit the ever-dynamic infrastructure industry.

MISSION

M1: To establish as a state of art learning center to meet the demands of future through conducive learning programs.

M2: To develop as a recognized consultancy and research centre to cater the needs of the industry and society.

M3: To contribute towards the country's infrastructure growth by encouraging creativity in aspiring civil engineers.

2025 Scheme – PG

Syllabus Book for (M. Tech Structural Engineering)

Syllabus for I & II Semester

The syllabus, scheme and guidelines are provided in detail.
The syllabus, scheme and guidelines are subjected to changes if any needed.
The updates will be done timely.
Regularly access the institution website for the updated information.

The Syllabus book is available on	www.sjbit.edu.in
For any queries, please write to	academicdean@sjbit.edu.in

UPDATES

Release / Revision	Date	Remarks
Release	28/06/2025	First release
Rev-1		

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AUTONOMOUS SCHEME - M.Tech Structural Engineering First Year CSE

SCHEME: 2025 **Date: 28/6/2025**

SL No	Course Type	Course type series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week L	T	P	O	Examinations CIE Marks	SEE Dur.	SEE Th. Mrks	SEE Lab. Mrks.	Tot. Marks
								Lecture	Tutorial	Practical	PBL/ABL/ SL/Othrs.					
SEM: I																
1	BSC	1	25CSET11	Numerical methods and Optimization Techniques	CV	CV	**3**	3	0	0	2	50	3	50	-	100
2	IPCC	1	25CSEI12	Advanced Design of RC Structures	CV	CV	**4**	3	0	2		50	3	50	-	100
3	PCC	1	25CSET13	Matrix methods of Structural Analysis	CV	CV	**3**	3	0	0	2	50	3	50	-	100
4	PCC	2	25CSET14	Mechanics of Deformable Bodies & Fracture Mechanics	CV	CV	**3**	3	0	0	2	50	3	50	-	100
5	PCC	3	25CSET15	Artificial Intelligence and Applications in Civil Engineering	CV	CV	**3**	3	0	0	2	50	3	50	-	100
6	PEC	1	25CSEP11x	Professional Elective 1	CV	CV	**3**	3	0	0		50	3	50	-	100
7	PCCL	1	25CSEL17	Computational Lab	CV	CV	**2**	1	0	2		50	3	-	50	100
						SEM-I Total	**21**	**19**	**0**	**4**	**8**	**350**		**300**	**50**	**700**
SEM: II																
1	PCC	4	25CSET21	Design of Plates and Shells	CV	CV	**3**	3	0	0	2	50	3	50	-	100
2	IPCC	2	25CSEI22	Finite Element Method of Analysis	CV	CV	**4**	3	0	2		50	3	50	-	100
3	PCC	5	25CSET23	Structural Dynamics & Earthquake Resistant Structures	CV	CV	**3**	3	0	0	2	50	3	50	-	100
4	PEC	2	25CSEP22x	Professional Elective 2	CV	CV	**3**	3	0	0	2	50	3	50	-	100
5	PEC	3	25CSEP23X	Professional Elective 3	CV	CV	**3**	0	0	0	2	50	3	50	-	100
6	PCCL	2	25CSEL26	Advanced Computation Laboratory	CV	CV	**2**	1	0	2		50	3	-	50	100
7	AEC	1	25CSEA21X	Skill and Ability enhancement courses(NPTEL)	CV	CV	**1**	1	0	0				-		
						SEM-II Total	**19**	**14**	**0**	**4**	**8**	**300**		**250**	**50**	**600**
						FIRST YEAR TOTAL	**40**									

BSC: Basic science course,PCC: Professional core. IPCC-Integrated Professional Core Courses, PCCL-Professional Core Course lab, PEC: Professional elective course,PRJ:Project,INT:Internship(G),SLC: Self learning course,L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities(Hours are for Interaction between faculty and students)

PEC 1		PEC 2		PEC 3	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
25CSEP111	Ground Improvement Techniques	25CSEP221	Advanced Pre-stressed Concrete	25CSEP231	Advanced Structural Analysis
25CSEP112	Design of Precast & Composite Structures	25CSEP222	Design of High-Rise Structures	25CSEP232	Design of Sub-structures
25CSEP113	DPR Preparation	25CSEP223	Design of Masonry Structures	25CSEP233	Repair and Rehabilitation of Structures
25CSEP114	Building Information Modelling	25CSEP224	Reliability Analysis of Structures	25CSEP234	Mechanics of Composites

Dr. Prasad CSMV
HOD

Dr. Babu N V
Academic Dean

Dr. K V Mahendra Prashanth
Principal

Dr. Puttarju
Academic Director

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AUTONOMOUS SCHEME - M.Tech Structural Engineering Second Year CSE

SCHEME: 2025 **Date 28/6/2025**

SL No	Course Type	Course type series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week L (Lecture)	T (Tutorial)	P (Practical)	O (PBL/ABL/ SL/othrs.)	Examinations CIE Marks	SEE Dur.	SEE Th. Mrks	SEE Lab. Mrks.	Tot. Marks
SEM: III																
1	PCC	6	25CSET31	Design of Bridges	CV	CV	**4**	3	2	0	2	50	3	50	-	100
2	PEC	3	25CSEP34X	Professional Elective 4	CV	CV	**3**	3	0	0	2	50	3	50	-	100
3	PEC	4	25CSEP35X	Professional Elective 5	CV	CV	**3**	3	0	0	2	50	3	50	-	100
4	PRJ	1	25CSEPR34	Project Work phase 1	CV	CV	**3**	0	0	0	@PBL	100	-	-	-	100
5	PRJ	2	25CSEPR35	Societal Project	CV	CV	**3**	0	0	0	@PBL	100	-	-	-	100
6	INT	1	25CSEG36	Internship			**6**	(06 weeks between II and III semesters.)				50	3	-	50	100
						SEM-III Total	**22**	**9**	**2**	**0**	**6**	**400**		**150**	**50**	**600**

PEC-4		PEC-5	
Course Code	**Course Title**	**Course Code**	**Course Title**
25CSEP341	Advanced Design of Steel Structures	25CSEP351	Special Concrete
25CSEP342	Design of Offshore Structures	25CSEP352	Geotechnical Earthquake Engineering
25CSEP343	Design of Industrial Structures	25CSEP353	Construction Planning and Contract
25CSEP344	Structural Health Monitoring	25CSEP354	Stability of Structures

SL No	Course Type	Course type series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week L (Lecture)	T (Tutorial)	P (Practical)	O (PBL/AB L/ SL/othrs.	Examinations CIE Marks	SEE Dur.	SEE Th. Mrks	SEE Lab. Mrk	Tot. Marks
SEM: IV																
1	PRJ	3	25CSEPR41	Project work phase 2			18	-	-	-	@PBL	100	03	-	100	200
2	SLC	1	25CSES1y	Self learning course - 1	NPTEL	NPTEL	**PP/NP**	0	0	0						
3	SLC	2	25CSES2y	Self learning course - 2	NPTEL	NPTEL	**PP/NP**	0	0	0						
						SEM-IV Total	**18**	**-**	**-**			**100**			**100**	**200**
						SECOND YEAR TOTAL	**40**									

BSC: Basic science course,PCC: Professional core. IPCC-Integrated Professional Core Courses, PCCL-Professional Core Course lab, PEC: Professional elective course,PRJ:Project,INT:Internship(G),SLC: Self learning course,L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities(Hours are for Interaction between faculty and students)

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Dr. K V Mahendra Prashanth
Principal

Dr. Puttarju
Academic Director

M. Tech Structural Engineering

25CSEA21X Skill and Ability Enhancement Courses (NPTEL)

Sl. No.	Code	Course Name
1	25CSEA211	Introduction to Accounting and Finance for Civil Engineers
2	25CSEA212	Project Planning & Control
3	25CSEA213	Leadership and Team Effectiveness
4	25CSEA214	Design Thinking - A Primer
5	25CSEA215	Smart Materials and Intelligent System Design
6	25CSEA216	Solar Energy Engineering and Technology
7	25CSEA217	Patent Law for Engineers and Scientists
8	25CSEA218	Training of Trainers

Table of Content

SCHEME: 2025 DATE:28.06.2025

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M.Tech Structural Engineering

Semester:	I	**Course Type:**	**BSC**		
Course Title: Numerical Methods and Optimization Techniques					
Course Code:	25CSET11			**Credits:**	3
Teaching Hours/Week (L:T:P:O)		**3:0:0:2**		**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I. Course Objectives:

Understand the fundamental definitions, classifications, and types of composite materials
Analyze the behavior of composite constituents at the microscopic level
Describe and assess the key mechanical behaviors of composite materials
Identify and explain different failure modes in composite materials

II. Teaching-Learning Process (General Instructions):

Chalk and talk using writing boards, PPT and videos.

III. Course Content

Module-1:	8 hrs

Introduction to optimization techniques: Nature and characteristics of operation research; Introduction to Linear programming, graphical solution, solution by simplex and revised simplex technique.

RBT Levels: L1, L2, L3

Module-2:	8 hrs

Non-Linear Programming- one dimensional minimization methods, elimination methods, Fibonacci method.

Constrained Nonlinear Optimization & Introduction to Advanced Techniques

Classical Methods for Constrained Optimization: Penalty Function Methods (Exterior and Interior), Lagrange Multipliers (for equality constraints).

Karush-Kuhn-Tucker (KKT) Conditions (for inequality constraints).

RBT Levels: L1, L2, L3

Module-3:	8 hrs

Dynamic programming- Introduction, Approaches, Application.

Geometric programming methods- Introduction, Approaches, conversion of NLP as a sequence of LP.

Introduction to Heuristic/Metaheuristic Algorithms (Conceptual): Genetic Algorithms (GAs): Basic principles (encoding, selection, crossover, mutation), Simulated Annealing. Particle Swarm Optimization (PSO).

RBT Levels: L1, L2, L3

Module-4:	8 hrs

Statistical inferences- Methods of least square and regression, multiple regression. Concept of probability, Random Variables, Binomial, Poisson and Normal distribution –applications, Chi- squared test and Analysis of Variance.

RBT Levels: L1, L2, L3

Module-5:	8 hrs

Numerical Solutions: Solution of Ordinary differential equations: Euler's method, and RangaKutta 3rd and 4th order method, Taylor's series method, Solutions for Integral Equations: Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, and Weddle's Rule.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Differentiate and classify various composite materials
CO2	Calculate the effective elastic and thermal properties of unidirectional laminae
CO3	Apply Classical Laminate Theory to predict the strength characteristics of laminated composites
CO4	Evaluate the strength and durability of composite materials
CO5	Diagnose potential failure modes in composite structures

V. CO-PO-PSO MAPPING (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	1										2			
CO2	2	2	2										2			
CO3	2	2	2										2			
CO4	2	2	2										2			
CO5	2	2	2										2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a) Reference Books:

1	Numerical Methods for Engineers	Steven C. Chapra and Raymond P. Canale	1999	McGraw-Hill
2	Engineering Optimization: Theory and Practice	Singiresu S. Rao	2009	John Wiley & Sons
3	An Introduction to Composite Materials	D. Hull and T.W. Clyne	2011	Cambridge University Press
4	Mechanics of Composite Materials	Autar K. Kaw	2006	CRC Press
5	Micromechanics of Composites	Volodymyr Kushch	2015	CRC Press

VII(b): Web links and Video Lectures (e-Resources):

https://www.youtube.com/playlist?list=PLtG1yR2v36D8uD1t3qJ-f-mKq-t2f1C_X
https://www.youtube.com/playlist?list=PL46A0423086161BBF
https://www.youtube.com/@easycompositestv

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of technical seminars on recent research activities, Group Discussion

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

BOS Chairman (Sign & Seal)

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M.Tech Structural Engineering

Semester:	I	**Course Type:**	**IPCC**		
Course Title: Advanced Design of RC Structures					
Course Code:	25CSEI12			**Credits:**	4
Teaching Hours/Week (L:T:P:O)			**3:0:2:0**	**Total Hours:**	40hrs + 12 lab slots
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I. Course Objectives:

The objective of this course is to make students to learn principles of Structural Design, to design different types of structures and to detail the structures. To evaluate performance of the structures

II. Teaching-Learning Process (General Instructions):

Chalk and Talk using writing boards, PPT and videos.

III. Course Content

Module-1:	8 hrs
Design of R C slabs by yield line method, Design of flat slabs **RBT Levels: L1, L2, L3, L4**	
Module-2:	8 hrs
Design of grid or coffered floors by approximate methods, stiffness matrix method, or plate theories. Detailing. Design of continuous beams with redistribution of moments **RBT Levels: L1, L2, L3, L4**	
Module-3:	8 hrs
Design of R C Chimneys: Introduction, design factors, stresses due to self-weight, wind, and temperature. Combinations of stresses. Design problems. **RBT Levels: L1, L2, L3, L4**	
Module-4:	8 hrs
Design of R C silos: Components of a Silo, Design of Vertical Walls, Hopper Bottom, Roof, Ring Beams/Girders and Supporting Structures. **Design of R C bunkers**- Components of a Bunker, Design of Vertical Walls, Hopper Bottom and Supporting Structures. **RBT Levels: L1, L2, L3, L4**	
Module-5:	8 hrs
Introduction and General Requirements in design of water tanks, Fundamental Principles of Design of Liquid Retaining Structures, Design of Ground Supported Water Tanks, Design of Elevated Water Tanks and Staging. **RBT Levels: L1, L2, L3, L4**	

III(b). PRACTICAL PART

Sl. No.	**Experiments**
1	Excel programming to compute Concrete Mix Design, Excel programming to simple Flat Slab
2	Excel programming to compute continuous beam and coffered floor
3	Excel programming to compute Chimneys.
4	Excel programming to Compute Bunkers and Silos.

IV.COURSE OUTCOMES

CO1	Achieve Knowledge of design and development of problem-solving skills
CO2	Understand the principles of Structural Design.
CO3	Design and develop analytical skills.
CO4	Summarize the principles of Structural Design and detailing
CO5	Understand the structural performance.

V.CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	2				2					1	2			
CO2	2	2	2				2					1	2			
CO3	2	2	2									1	2			
CO4	2	2	2									1	2			
CO5	2	2	2									1	2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 2

VII. Learning Resources

VII (a). Reference Books:

1	Krishna Raju	Advanced R.C. Design	1986	CBS Publishers and Distributors
2	S. Pillai, Devdas Menon	Reinforced Concrete Design	1999	Tata McGraw-Hill, 3rd Edition
3	Varghese. P.C	Advanced Reinforced Concrete design	2007	Prentice, Hall of India
4	Gambhir M. L	Design of Reinforced Concrete Structures	2008	PHI Pvt. Ltd. New Delhi

VII(b): Web links and Video Lectures (e-Resources):

https://youtu.be/undsd92MM8w?si=kKmYkPb9TeAYtdaS
https://youtu.be/ba3mZhOpsTM?si=lwd8EK2NKPv-qvdJ
https://youtu.be/uyuPmBGX32g?si=w-mRZEOJNm5cz8c3

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of technical seminars on recent research activities
Group Discussion
Site visit

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

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M.Tech Structural Engineering

Semester:	**I**	**Course Type:**	**PCC**		
Course Title: Matrix Methods of Structural Analysis					
Course Code:	**25CSET13**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:2	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I Course Objectives:

- To understand basic concepts of Matrix Methods of Structural Analysis.
- To analyse the behaviour of plane trusses, continuous beams, and portal frames.

II Teaching-Learning Process (General Instructions):
Blackboard Teaching, Power Point Presentation, Group Discussion, Videos

III COURSE CONTENT

Module-1	**8 Hrs**

Basic concepts of structural analysis and methods of solving simultaneous equations: Introduction, Types of framed structures, Static and Kinematic Indeterminacy, Equilibrium equations, Compatibility conditions, Principle of superposition, Energy principles, Equivalent joint loads, Methods of solving linear simultaneous equations- Gauss elimination method, Cholesky method and Gauss-Seidel method.
RBT Levels: L1, L2, L3

Module-2	**8 Hrs**

Fundamentals of Flexibility and Stiffness Methods: Concepts of stiffness and flexibility, Local and Global coordinates, Development of element flexibility and element stiffness matrices for truss, beam and grid elements, Force-transformation matrix, Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames, Displacement-transformation matrix, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames.
RBT Levels: L1, L2, L3

Module-3	**8 Hrs**

Analysis using Flexibility Method: Analysis of continuous beams, plane trusses and rigid plane frames by Force Transformation Method.
RBT Levels: L2, L3, L4

Module-4	**8 Hrs**

Analysis using Stiffness Method: Analysis of continuous beams, plane trusses and rigid plane frames by Displacement Transformation Method.
RBT Levels: L2, L3, L4

Module-5	**8 Hrs**

Direct Stiffness Method: Stiffness matrix for truss element in local and global coordinates, Analysis of plane trusses, Stiffness matrix for beam element, Analysis of continuous beams and orthogonal frames.
RBT Levels: L2, L3, L4

IV.COURSE OUTCOMES

CO1	Formulate force displacement relation by flexibility and stiffness method
CO2	Analyze the plane trusses, continuous beams and portal frames transformation approach
CO3	Analyse the structures by direct stiffness method

V.CO-PO-PSO MAPPING (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2
CO1	3	3											1	
CO2	3	3											1	
CO3	3	3											1	

VI. Assessment Details (CIE & SEE)

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Reference Books:

1	Matrix Analysis of Framed Structures	Weaver, W., and Gere, J.M	Second Edition, 2004	CBS Publishers and distributors Pvt. Ltd.
2	Computational Structural Mechanics	Rajasekaran, S., and Sankarasubramanian, G.	First Edition, 2001	PHI, New Delhi
3	Introduction to Matrix Methods of Structural Analysis	Martin, H, C	First Edition, 1966	McGraw-Hill, New York
4	Matrix Computer Analysis of Structures	Rubinstein, M.F.	First Edition, 1966	Prentice-Hall, Englewood Cliffs, New Jersey,

VII(b): Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=Wa9ZSWlrpnk&list=PLbRMhDVUMngeZatm4MIOKG4sHxXuB_yri
https://www.youtube.com/watch?v=oMSoFeCZL5k&list=PL8pjaLEv3XhmeAp8aEWfp7t2bf2Nh2dYy

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Conduction of technical seminars on recent research activities
- Group Discussion

Sl. No.	BOS Member	Affiliation	Signature
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3			

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M.Tech Structural Engineering

Semester:	**I**	**Course Type:**	**PCC**		
Course Title: Mechanics of Deformable Bodies & Fracture Mechanics					
Course Code:	**25CSET14**			**Credits:**	**03**
Teaching Hours/Week (L: T:P:O)			**3:0:0:2**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives:

This course aims to provide

- students with a thorough understanding of the theory of elasticity and its applications in civil engineering.
- Students will learn to analyze stress and strain in various structural components, apply transformation techniques, and solve plane stress and strain problems.
- The curriculum also covers three-dimensional elasticity problems and introduces fracture mechanics, emphasizing the behavior of concrete.
- By the end, students will develop the skills to apply these concepts in practical engineering scenarios.

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, Field visits

III. COURSE CONTENT

Module-1:	8 Hrs

Theory of Elasticity: Introduction: Definition of stress and strain, and strain at a point; components of stress and strain at a point in Cartesian and polar coordinates. Constitutive relations, equilibrium equations, compatibility equations, and boundary conditions in 2-D and 3-D cases.

RBT Levels: L1 L2

Module-2:	8 Hrs

Transformation of Stress and Strain at a Point: Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatoric stress, spherical and deviatoric strains, maximum shear strain.

RBT Levels: L2 L3

Module-3:	8 Hrs

Plane Stress and Plane Strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axisymmetric problems, stress concentration due to the presence of a circular hole in plates.

RBT Levels: L3

Module-4:	8 Hrs

Elementary Problems of Elasticity in Three Dimensions: Stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, propagation of waves in solid media. Applications of finite difference equations in elasticity.

RBT Levels: L2 L3

Module-5:	8 Hrs

Fracture of Concrete: Introduction to fracture mechanics and limitations of theories of linear elastic fracture mechanics in concrete. Review of concrete behavior in tension and compression. Kaplan's experiments, concept of fracture energy, definition of a quasi-brittle material, concept of softening.

RBT Levels:L2 L3

IV. COURSE OUTCOMES

CO1	Understand the fundamental concepts of stress and strain in both 2D and 3D elasticity, along with the governing equations.
CO2	Analyze stress and strain transformations, principal stresses, and invariant properties at a point.
CO3	Apply Airy's stress function approach to solve 2D problems and analyze bending of beams.
CO4	Explore the behavior of materials under various loads and the propagation of waves in solid media.
CO5	Grasp the basics of fracture mechanics in concrete and understand concepts related to fracture energy and material softening.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	1											2			
CO2	2	2											2			
CO3	1	2	1										2			
CO4	2	1		1									2			
CO5	1		1	2									2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Theory of Elasticity	Timoshenko & Goodier	3rd Edition, 2010	McGraw Hill
2	Advanced Mechanics of Solids	Srinath L. S	10th print, 2014	Tata McGraw Hill Publishing Company
3	Theory of Elasticity	Sadhu Singh	4th Edition, 1978	Khanna Publishers

VII(b): Reference Books:

1	Plasticity for Structural Engineers	Chenn W. P. and Hendry D. J	15 Feb 2007	Springer Verlag
2	Fracture Mechanics: Fundamentals and Applications	T. L. Anderson	4th Edition, 2017	CRC Press

VII(c): Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=eICv1p8WjgI&list=PLbRMhDVUMngcbhsZgRWuYCi2kKQwQ0Av1
https://www.youtube.com/watch?v=lfEh3yWTBuM
https://www.youtube.com/watch?v=PTSFXu19OMghttps://www.youtube.com/watch?v=G5mcTw-PLEI

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- **Case Studies Analysis**: Analyze real-world case studies related to elasticity and fracture mechanics to understand practical applications.
- **Software Simulations**: Use software tools (like ANSYS or ABAQUS) to simulate stress and strain analysis in various structures.
- **Group Discussions**: Facilitate group discussions on recent advancements in elasticity and fracture mechanics to encourage collaborative learning.
- **Research Project**: Conduct a mini-research project on a specific topic within the elasticity domain, focusing on emerging theories or applications.
- **Workshops**: Participate in workshops on advanced material testing techniques for analyzing the mechanical properties of concrete and other materials.

Sl. No.	BOS Member	Affiliation	Signature
1			
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M. Tech. Structural Engineering

Semester:	I	**Course Type:**	**PCC**		
Course Title: Artificial Intelligence and Applications in Civil Engineering					
Course Code:	**25CSET15**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:2	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

1) To introduce students to the fundamentals of Artificial Intelligence (AI)
2) To equip students with the knowledge of Machine Learning (ML) concepts, types of learning and their application in civil engineering projects.
3) To explore the structure and function of Artificial Neural Networks (ANNs), focusing on their architecture, training, and learning processes.
4) To introduce the concepts of fuzzy logic and its utility in dealing with uncertainty and imprecision in civil engineering systems.

II Teaching-Learning Process (General Instructions):

Blackboard Teaching, Power Point Presentation, Group Discussion, Videos

III COURSE CONTENT

Module-1: Introduction to AI	8 Hrs

Introduction to AI, definition of AI, Historical evolution of AI, AI types, brief introduction to the branches of AI, Machine learning, Natural Language processing, computer vision, robotics, expert systems, Artificial neural networks and deep learning, evolutionary computation, cognitive computing, and swarm intelligence. Applications in civil engineering in each branch of AI.

RBT Levels: L2

Module-2: Machine Learning	8 Hrs

Introduction to ML, Machine learning process model, Concept learning, general-to specific ordering, version spaces, inductive bias, general to specific ordering, introduction to different kinds of machine learning, supervised, unsupervised, semi supervised, reinforcement, transfer learning and federated learning. The related algorithms under each type of ML, Applications of different ML techniques in Civil Engineering. Well posed learning problem, designing a learning system, examples.

RBT Levels: L2

Module-3: Artificial neural networks (ANN)	8 Hrs

Introduction, biological motivation, appropriate problems in ANN learning, perceptron's, the representational power of perceptions, multilayer networks, back propagation. Introduction to recurrent neural networks, and deep learning. Illustrative real-world examples on applications of neural networks in highway/ infrastructure construction management and other civil engineering domains.

RBT Levels: L2

Module-4: Learning under uncertainty and ambiguity	8 Hrs

Fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Fuzzy inference system, Illustrative examples of engineering applications of fuzzy logic with specific reference to civil engineering.

RBT Levels: L2

Module-5: Introduction to Computer Vision	8 Hrs

Definition and scope, history and evolution, Image acquis ion, image representation (grey scale and color), basic operations like filtering, thresholding. Primitives of image processing, geometric primitives, 2d Transforms, 3D transforms, photometric image formation, lighting, reflectance and shading, the digital camera, sampling and aliasing. Applications of computer vision in Civil engineering.

RBT Levels: L2

IV. COURSE OUTCOMES

CO1	Gain insights into the role of AI in modern civil engineering practices and how it can enhance decision-making and efficiency.
CO2	Use the Acquired knowledge of basic Machine Learning algorithms and techniques and develop the ability to implement and evaluate ML models for solving complex civil engineering problems.
CO3	Comprehend the structure and functioning of Artificial Neural Networks, including various architectures and learning algorithms, and apply ANN techniques to model and solve real-world civil engineering problems.
CO4	Apply the principles of Fuzzy Logic and apply the same in handling uncertainty and imprecision in Civil engineering problems.
CO5	Implement computer vision and image processing techniques, and be able to implement computer vision methods for automated inspection, monitoring, and assessment of civil infrastructure.

V. CO-PO-PSO MAPPING (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2							3			
CO2	3	3	2		2								3			
CO3	3	3	2		2								3			
CO4	3	3											3			
CO5	3	3											3			
CO6	3	3	3		2								3			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a). Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Artificial Intelligence	Margaret A Boden	1996	Academic Press London
2	Artificial Intelligence- A modern approach	Stuart Russel, Peter Norvig	2nd edition, 2003	Pearson Education
3	Machine Learning	Indian Edition	2017	McGraw-Hill
4	Fuzzy Logic and Engineering Applications	Timoty. J. Ross	III edition	Wiley Publications
5	Computer Vision – Algorithms and Applications	Richard Selizski	2011	Spinger Publications
VII(b): Web links and Video Lectures (e-Resources):				
http://digimat.in/nptel/courses/video/106106213/L01.html http://digimat.in/nptel/courses/video/106106198/L01.html				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Conduction of technical seminars on recent research activities, Group Discussion				

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M.Tech Structural Engineering

Semester:	I	**Course Type:**	**PEC**		
Course Title: Ground Improvement Techniques					
Course Code:	25CSEP111			**Credits:**	3
Teaching Hours/Week (L:T:P:O)		**3:0:0:0**		**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I. Course Objectives:

To gain a deep understanding of advanced ground improvement methods, including preloading, sand drains, stone columns, MSE walls, and landfill design.
To develop skills in designing and analysing ground improvement solutions for complex geotechnical problems.
To engage in research-oriented learning, critically evaluating recent advancements and innovations in ground improvement techniques.

II. Teaching-Learning Process (General Instructions):

Chalk and Talk using writing boards, PPT and videos.

III. COURSE CONTENT

Module-1:	8 hrs

Introduction to Advanced Ground Improvement –Overview of traditional and modern ground improvement methods. Selection criteria for different techniques in various geotechnical contexts
Advanced Mechanical and Chemical Stabilization- High-energy impact and deep compaction methods. Dynamic compaction and its applications. Introduction to chemical stabilization: Principles and mechanisms. Lime stabilization: Applications, benefits, and challenges. Applications of biochemicals in soil stabilization. Use of fly ash, slag, and other industrial by-products in soil stabilization.
RBT Levels: L1, L2

Module-2:	8 hrs

Preloading and Drainage Techniques Purification – Preloading: Concepts, design principles, and applications. Sand drains: Design, installation, and case studies. Prefabricated vertical drains (PVDs): Design and application. Field monitoring and performance assessment of preloading with drains
Hydraulic Modification and Consolidation- Advanced dewatering techniques for high-water table environments. Vacuum consolidation: Theory, design, and applications. Electro-osmosis: Mechanisms, design considerations, and recent innovations
RBT Levels: L1, L2, L3

Module-3:	8 hrs

Geosynthetic Materials in Ground Improvement- Introduction to geosynthetics: Types and manufacturing processes. Material properties: Tensile strength, durability, creep, and chemical resistance. Applications in ground improvement: Reinforcement, filtration, drainage, and containment. Permittivity (cross – plane plane permeability) and Transmittivity (in – plane permeability) Concepts, testing, and applications in drainage design. Design considerations for

geosynthetics in soil reinforcement, erosion control, and environmental protection. Case studies of geosynthetic applications in complex geotechnical projects

Stone Columns and Ground Reinforcement Techniques – Stone columns: Overview, Design, installation, and applications in soft soils. Introduction to geosynthetic encased stone columns (GESC). Advances in coupling GESC with electro-kinetic method. Effect of GESC on consolidation

RBT Levels: L1, L2, L3

Module-4:	8 hrs

Design of Mechanically Stabilized Earth (MSE) Walls- Design of geotextile walls Design principles of MSE walls: Reinforcement types and configurations. Applications of geosynthetics (Geogrids, geotextiles, geonets, and geocells) in MSE Walls Analysis of MSE wall against external and internal stability. Design problems of MSE walls as per IRC – 102. Considering modular blocks, vertical panels

RBT Levels: L1, L2, L3

Module-5:	8 hrs

Impact of ground improvement on soil and groundwater quality: Renewable Geoenvironmental natural resources. Water and soil quality indicators. Sustainability practice examples (rehabilitation of airport land, sustainable mining conservation, agriculture sustainability study, petroleum oil well development)

Case-based learning: Analysis of landmark ground improvement projects

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Understanding Ground Improvement Methods
CO2	Analyze ground improvement systems such as MSE walls and landfills
CO3	Apply skill in ground improvement methods like preloading, sand drains, and stone columns
CO4	Identify and solve complex geotechnical problems using appropriate ground improvement techniques, ensuring stability and sustainability
CO5	Awareness of the environmental impacts and safety considerations associated with ground improvement techniques

V. CO-PO-PSO MAPPING (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	1										2			
CO2	2	2	2										2			
CO3	2	2	2										2			
CO4	2	2	2										2			
CO5	2	2											2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII.a Reference Books:

1	Ground Improvement Techniques	P. Purushothama Raj	1999	Laxmi Publications
2	Principles and Practice of Ground Improvement	Jie Han	2018	Wiley India
3	Designing with Geosynthetics	Robert M Koerner	2012	Xlibris
4	Fundamentals of Geosynthetic Engineering	Sanjay Kumar Shukla	2006	CRC Press
5	Ground Improvement Techniques	Nihar Ranjan Patra	2012	Vikas publishing

VII(b): Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=RQ70G1uQwe8 https://www.youtube.com/watch?v=Lj3DCNRe8GM https://www.youtube.com/watch?v=jYCdh9_XYJk
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Conduction of technical seminars on recent research activities, Group Discussion

Sl. No.	**BOS Member**	**Affiliation**	**Signature**
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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	**I**	**Course Type:**	**PEC**		
Course Title: Design of Precast & Composite Structures					
Course Code:	**25CSEP112**			**Credits:**	3
Teaching Hours/Week (L: T:P:O)			**3:0:0:0**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	03

I. Course Objectives:

1. Understand the concepts and techniques of precast construction.
2. Select or design precast elements suitable for project specific requirements.
3. Design precast systems to ensure integrity and safety of the structure and to avoid progressive collapse.
4. Design composite floors and beam elements.

II. Teaching-Learning Process (General Instructions):

Chalk and Talk using writing boards, PPT and videos.

III. COURSE CONTENT

Module-1:	8 Hrs

Introduction: Concepts, components, Structural Systems and Design of precast concrete floors Need and types of precast construction, Modular coordination, Precast elements- Floor, Beams, Columns and walls. Structural Systems and connections.
Design of precast Concrete Floors: Theoretical and Design Examples of Hollow core slabs, Precast Concrete Planks, floor with composite toppings with and without props.
RBT Levels: L1,L2

Module-2:	8 Hrs

Design of precast reinforced and prestressed Concrete beams: Theoretical and Design Examples of ITB – Full section precast, Semi Precast, propped and unpropped conditions. Design of RC Nibs
RBT Levels: L3, L4

Module-3:	8 Hrs

Design of precast concrete columns and walls: Design of braced and unbraced columns with corbels subjected to pattern and full loading. Design of Corbels Design of RC walls subjected to Vertical, Horizontal loads and moments, Design of vertical ties and horizontal joints.
RBT Levels: L3, L4

Module-4:	8 Hrs

Design of Precast Connections and Structural Integrity Beam bearing, Beam half Joint, Steel Inserts, Socket Connection, Structural integrity, Avoidance of progressive collapse, Design of Structural Ties.
RBT Levels: L3, L4

Module-5:	8 Hrs

Design of Steel Concrete Composite Floors and Beams Composite Floors: Profiled Sheeting with concrete topping, Design method, Bending and Shear Resistance of Composite Slabs, Serviceability Criteria, Design Example

Composite Beams: Elastic Behaviour, Ultimate Load behaviour of Composite beams, Stresses and deflection in service and vibration, Design Example of Simply Supported beams.

RBT Levels: L3, L4

IV. COURSE OUTCOMES

CO1	Explain the need for precast elements in building construction.
CO2	Design precast reinforced and prestressed concrete beams for different conditions.
CO3	Design precast concrete columns and walls.
CO4	Analyse and design composite floors and beams

V. CO-PO-PSO MAPPING (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	3	1										2			
CO2	2	3	3										2			
CO3	2	3	3										2			
CO4	2	3	3										2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Reference Books:

1	Precast Concrete – Design and applications	Hass A.M.	1983	Applied Science
2	Plant cast, Precast and Prestressed concrete	David Sheppard	1989	McGraw Hill
3	Composite Structure of Steel and Concrete (Volume 1)	R.P. Johnson	1994	Blackwell Scientific Publication (Second Edition)
4	NBC – 2005 (Part I to Part VII)	-	IS 15916- 2011, IS 11447, IS6061 – I and III IS: 11384-1985	BIS Publications

VII(b): Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_ar04/preview.
https://www.youtube.com/watch?v=fRqxXkxApSY.
www.steel-insdag.org (INSDAG Teaching Resource Chapter 21 to 27)

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Seminar, Assignments, Quiz.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	**I**	**Course Type:**	**PEC**		
Course Title: DPR Preparation					
Course Code:	**25CSEP113**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives:

- Prepare project report for new and upgradation type road works by conducting necessary feasibility/detailed studies.
- Conduct the soil and material investigations to understand their behavior and performance.
- Perform various traffic related studies helping to finalize the project preparations and methods of forecasting traffic data.
- Analyse the social impact of road projects and also determine the economic feasibility analysis for justification of investments.
- Prepare DPR on road projects with relevant drawings and get knowledge of tendering process for the construction.

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations.

III. COURSE CONTENT

Module-1	8 Hrs

Introduction: Project overview, objectives, location stakeholder engagement plan, Project scope, time-lines, Investigations for preparation of project reports for new and up-gradation of roads. Objects and scope of pre – feasibility, feasibility and detailed studies for project preparation. Typical HR structure for preparations and implementation of projects, Key Acts related to Road / infrastructure Projects. Salient features of ongoing road/ infrastructure projects in India, Stakeholder analysis and engagement, Project scope and boundaries.

RBT Levels: L1, L2, L3

Module-2	8 Hrs

Surveys and investigations: Site investigation, topographical survey and mapping, finalization of horizontal alignment and vertical profile of roads, Application of GIS. geotechnical investigation, Material surveys for availability and choice of basic and alternate materials for construction and for soil stabilization. Cross drainage structures and drainage surveys, Interpretation of survey results. Traffic forecasting: classified traffic volume, growth rate, projected traffic for assessing roadway requirements, origin- destination characteristics and studies, road safety furniture, Mx ROAD.

RBT Levels: L1, L2, L3, L4

Module-3	8 Hrs

Design and Engineering: Design details and specification, design standards and guidelines, Geometric design of roads: Cross sectional elements, horizontal and vertical alignment, Intersections-requirements, capacity of roads, roadway facilities: Pedestrian facilities, bus bays, truck lay byes, traffic, medical and vehicle aid posts, street lighting, Pavement design and materials, Drainage and stormwater management.

RBT Levels: L1, L2, L3, L4

Module-4	8 Hrs

Environmental and Social Impact Assessment: Objectives, procedure of environmental impact assessment, socio economic survey, mitigation measures, Landscaping and tree plantation, implementation of environment management plan, Key environmental legislations, clearances required for road project- environmental, forest, CRZ, wildlife, air, noise quality standards. Social Management Plan, community engagement and participation, Conflict resolution mechanism.

RBT Levels: L1, L2, L3, L4

Module-5	8 Hrs

Preparation of DPR: Design details, estimates, BOQ, drawings and detailed project, report, use of software.

Cost Estimation and Financial Analysis: Cost estimation methods and techniques, Financial analysis and viability, Project funding options and financing plan, Risk assessment and mitigation strategies, Public Private Partnership (PPP), environmental economics, Toll collection, economic viability PPP projects, risk analysis, case studies.

Rate Analysis: Prerequisites, factors affecting rate analysis, overhead expenses, procedure for rate analysis, schedule of rates, Task work: labour requirement for different works, material requirement for different works, Rate analysis of different Items of work.

Tendering process - Preparation of tender documents for different types of road/infrastructure projects, Tender evaluation. Salient clauses of tender document, tender evaluation – technical and Financial.

RBT Levels: L1, L2, L3, L4

IV. COURSE OUTCOMES

CO1	Prepare project report for new and up-gradation type road works by conducting necessary Feasibility/detailed studies.
CO2	Conduct the soil and material investigations to understand their behaviour and performance.
CO3	Analyse the surveys and investigations and select geometry of road Understand the contract document, evaluation and contract management for road projects.
CO4	Analyse the social impact of road projects and determine the economic feasibility analysis for justification of Investments.
CO5	Prepare DPR on road projects with relevant drawings and get the knowledge of tendering process for the Construction.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**S1**	**S2**		
CO1	1	2	2		2	3	3					2		3		
CO2	2	2	2	3	3	2	2	3						3		
CO3	3	3	3		3	3		3						3		
CO4	2	3	2			3	2	2			2	2		3		
CO5	2	3	3		3	2		3	3	3	2	3		3		

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the publisher**
1	Principles and Practices of Highway Engineering	L. R. Kadyali, N. B. Lal,	Second Edition, 2005	Khanna Publishers

VII(c): Web links and Video Lectures (e-Resources):

- https://youtu.be/Fz0xhy_TMFI?si=Cu3-9LQaN3jvZIme
- https://youtu.be/0WYqoC173wY?si=an47SWz1L5c-ea2X
- https://youtu.be/Ka_dVajxf1M?si=qGBpv-IeuyX2nmIO
- https://youtu.be/RM_5YXm0CLA?si=YB_vVzlBmTwlgs1p
- https://youtu.be/9STJQF8atoc?si=1sSWR2cIJIyGHWB5
- https://youtu.be/GNunzK2r0Eo?si=pQKwFi3oLyoQaEwy
- https://youtu.be/tti8x9t3yBc?si=PJ28Y1jDLSf6hwNw
- https://youtu.be/0zwkSFyuTe0?si=YM2fz6BHlcpjXDfQ
- https://youtu.be/UsrErKxIN7s?si=nU3kUOoKOlh4HUIX
- https://youtu.be/XMjZ4jHOIF0?si=DqIixRn0jATfGsMY
- https://youtu.be/OZUl3TcG3Hs?si=C5eVF1FRY-Qb6kEQ

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Prepare the BOQ of minor and major projects and compare the cost.
- Prepare excels sheets for growth factor estimation as per IRC :105-2015.
- Carry out the traffic studies specific to a project and infer from the data collected.
- Prepare mind-maps after studying various DPRs for Road projects to understand the various stages of DPR preparation.

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

BOS Chairman (Sign & Seal)

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	I	**Course Type:**	**PEC**		
Course Title: Building Information Modelling					
Course Code:	**25CSEP114**			**Credits:**	03
Teaching Hours/Week (L: T:P:O)			**3:0:0:0**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	03

I. Course Objectives:

- To provide a comprehensive understanding of Building Information Modelling (BIM), including its significance in the architecture, engineering, and construction (AEC) industry, and familiarize students with international and national BIM standards, protocols, and execution plans.
- To introduce various BIM software tools and their applications in different phases of a project lifecycle and educate students on the processes and challenges of implementing BIM in real-world projects.
- To explore the use of BIM in the design, construction, operation, maintenance, and renovation phases of a project, highlighting the importance of collaboration and coordination among different disciplines using BIM.
- To delve into advanced BIM topics such as sustainable design, infrastructure projects, emerging technologies, and future trends.
- To cover the management strategies, educational needs, and best practices in BIM, enabling students to effectively manage BIM projects and develop educational programs.

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations.

III. Course Content

Module-1	8 Hrs

Introduction to BIM : Understanding BIM Definition and Importance of BIM, Historical Development of BIM, Key Concepts and Terminology BIM Standards and Protocols International BIM Standards, National BIM Standards, BIM Execution Plans (BEP) and Protocols BIM Software and Tools Overview of Popular BIM Software (e.g., Revit, Lumion), Comparison of Different BIM Tools, Introduction to BIM Interoperability BIM Implementation Process Steps in Implementing BIM in Projects, Challenges and Barriers in BIM Adoption, Case Studies of Successful BIM Implementation

Self-Learning: Learning Popular BIM Software (e.g., Revit, Lumion)

RBT Levels: L3 L4

Module-2	8 Hrs

BIM in Project Lifecycle: BIM in Design Phase Role of BIM in Architectural Design, Collaboration between Architects and Engineers, Design Visualization and Analysis using BIM BIM in Construction Phase BIM for Construction Planning and Management, 4D BIM (Time Dimension) and 5D BIM (Cost Dimension), Construction Simulation and Sequencing BIM in Operation and Maintenance BIM for Facility Management, Integrating BIM with Building Management Systems (BMS), Lifecycle Asset Management using BIM BIM for Renovation and Retrofit Projects BIM for Existing Buildings and Infrastructure, Challenges in Using BIM for Renovation, Case Studies of BIM in Renovation Projects

Self-Learning: Learning Popular BIM Software (e.g., Revit, Lumion)

RBT Levels: L3 L4

Module-3	8 Hrs

BIM Collaboration and Coordination: BIM Collaboration Techniques Collaborative Design and Engineering, Communication and Data Sharing in BIM Projects, Role of Common Data Environment (CDE) BIM Coordination and Clash Detection Coordination between Different Disciplines, Clash Detection and Resolution Techniques, Tools for BIM Coordination (e.g., Navisworks) BIM and Integrated Project Delivery (IPD) Principles of IPD, Benefits of IPD with BIM, Case Studies of BIM in IPD Projects Legal and Contractual Aspects of BIM , Risk Management in BIM Projects .
Self-Learning: Learning Popular BIM Software (e.g., Revit, Lumion)
RBT Levels: L3 L4

Module-4	8 Hrs

Advanced BIM Concepts : BIM for Sustainable Design ,BIM for Energy Analysis and Simulation, Green Building Certifications and BIM, Sustainable Materials and BIM ,BIM for Infrastructure Projects BIM Management Roles and Responsibilities, Developing a BIM Execution Plan, BIM for Project Managers Application of BIM in Civil Engineering Projects, BIM for Transportation Infrastructure, Case Studies of BIM in Infrastructure Projects BIM and Emerging Technologies ,BIM and Internet of Things (IoT), Augmented Reality (AR) and Virtual Reality (VR) in BIM, Artificial Intelligence (AI) and Machine Learning in BIM
Self-Learning: Learning Popular BIM Software (e.g., Revit, Lumion)
RBT Levels: L3 L4

Module-5	8 Hrs

BIM Management: BIM Management Strategies, BIM Research and Development Current Research in BIM, Future Research Directions in BIM, Opportunities for Innovation in BIM Case Studies and Best Practices Analysis of Successful BIM Projects, Lessons Learned from BIM Implementation, Best Practices in BIM Management and Execution.
Self-Learning: Learning Popular BIM Software (e.g., Revit, Lumion)
RBT Levels: L3 L4

IV. Course Outcomes

CO1	Demonstrate a thorough understanding of BIM concepts, history, and terminology, and apply international and national BIM standards and protocols effectively in projects.
CO2	Utilize various BIM software tools for different project phases, ensuring interoperability among them, and develop and execute a BIM implementation plan, addressing challenges and barriers.
CO3	Apply BIM techniques in the design, construction, operation, maintenance, and renovation phases of a project, and facilitate effective collaboration and coordination among project stakeholders using BIM tools and techniques.
CO4	Analyze and implement advanced BIM concepts such as sustainable design, infrastructure projects, and emerging technologies.
CO5	Manage BIM projects effectively, develop educational programs, and apply best practices in BIM management and execution.

V. CO-PO-PSO Mapping (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	2	2	3	2		2				2	2			
CO2	2	3	3	3	3							2	2			
CO3	2	3	3	2	3			2	3	2		2	2			
CO4	2	2	2	2	3	2	3					3	2			
CO5	2	2	2	2	2			2	2	2	2	2	2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	BIM Handbook: A Guide to Building Information Modeling	Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston	3rd Edition (2018)	Wiley Publications
2	Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations	Willem Kymmell	2008	McGraw-Hill
3	Building Information Modeling: Technology Foundations and Industry Practice	Edited by André Borrmann, Markus König, Christian Koch, Jakob Beetz	2018	Springer
VII(b): Reference Books:				
1	Implementing Successful Building Information Modelling	Erika Epstein	2012	Artech House
2	The Impact of Building Information Modelling: Transforming Construction	Ray Crotty	2011	Routledge

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=lOosKtbE9KM
- https://www.youtube.com/watch?v=RKNXW83N9Cs
- https://www.youtube.com/watch?v=4r1pEr63mAI

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Create 3D models using Revit or ArchiCAD for a small residential or commercial building.
- Split students into teams to draft a BEP for a simulated construction project, assigning roles (e.g., BIM Manager, Architect, MEP Engineer).
- Use Navisworks to identify clashes between structural, electrical, and plumbing models.
- Integrate project schedule with 3D models to simulate construction sequencing.
- Visit an active construction site where BIM is being implemented; compare model with physical site using AR or mobile BIM viewers.
- Time-bound challenge where teams develop BIM solutions for specific project issues like sustainability, renovation, or retrofitting.

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

BOS Chairman (Sign & Seal)

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Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	I	**Course Type:**	**PCCL**		
Course Title: Computational Lab					
Course Code:	**25CSEL17**			**Credits:**	02
Teaching Hours/Week (L:T:P:O)			**1:0:2:0**	**Total Hours:**	12 lab slots
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	Practical			**Exam Hours:**	03

I Course Objectives:

- To develop proficiency in creating 3D building models using Revit, enabling students to set up levels, grids, and design walls, doors, and windows with accurate elevation and 3D views.
- To enable students to create and annotate detailed floor plans to use Revit, including dimensions, room tags, and text notes, while generating professional sheets for effective documentation.
- To develop proficiency in constructing structural models in Revit Structure, including beams, columns, and foundations, ensuring alignment with architectural designs.

II Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations, practical sessions.

Sl. No.	Experiments
1	Basic3D Building Information Modeling Setup building levels and grids, draw walls, insert doors, and place windows.
2	Create the building's roof and floors, place columns and footings at grids. Generate elevation views and 3D views.
3	Create custom families such as furniture, windows, or doors in Revit.
4	Develop detailed floor plans with a notation such as dimensions, room tags, and text notes.
5	Generate sheets with proper layout and title blocks.
6	Generate schedules (e.g., door schedule, window schedule, room schedule) from the Revit model.
7	Place foundations and footings at the base of columns.
8	Detailing of Columns, Beams, and Foundations in Revit Structure

III COURSE OUTCOMES

CO1	Create detailed 3D architectural models using Revit, effectively visualizing building structures with precision and parametric tools.
CO2	Generate comprehensive construction documentation including floor plans, sections, elevations, and schedules, ensuring accurate project coordination and data extraction.
CO3	Construct and analyse structural framing models in Revit Structure, integrating beams, columns, and foundations while maintaining alignment with architectural plans.

IV CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2						2	1					1			
CO2	3	2											1			
CO3	3	2											1			

V Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 3

Semester End Examination (SEE): Refer Annexure Section 3

VI Learning Resources

VI.(a) Reference Books:

1	Autodesk Revit 2024 Architecture Basics	Elise Moss	2023	SDC Publications
2	Revit Architecture: Learn Designing with Ease (For Beginners)	Madhumita Kshirsagar	2021	Kindle Edition

VI(b): Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=Mux0p1dNBvw&list=PLu_C7oK7LrjqH7IxdBS2tMr20AHxPzcuf
https://www.youtube.com/watch?v=6_ZGaQeofVQ
https://www.youtube.com/watch?v=7lbciQRnb6s

VII: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical sessions

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

BOS Chairman (Sign & Seal)

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M. Tech. In Structural Engineering

Semester:	II	**Course Type:**	PCC		
Course Title: Design of Plates and Shells					
Course Code:	**25CSET21**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:2	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

1) To introduce the fundamental theories and analytical methods for the design and analysis of plates and shell structures.
2) To enable students to apply classical and modern techniques, including IS codes and software tools, for the structural design of practical shell elements like domes, tanks, and folded plates.

II. Teaching-Learning Process (General Instructions):

III. Course Content

III. Theory Part

Module-1: Plate Theory Basics	8 Hrs

Introduction to plate theory, small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions (No derivation), Numerical examples.
RBT Levels: L2, L3

Module-2: Energy Methods for Plates	8 Hrs

Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings.
RBT Levels: L2, L3

Module-3: Membrane Theory of Shells	8 Hrs

Classification and applications of shell structures, Membrane theory of shells of revolution: stress resultants in cylindrical, conical, and spherical shells, Assumptions and limitations of membrane theory, Design principles for cylindrical and spherical tanks, Introduction to IS: 2210 and IS: 3370 (Part 4)
RBT Levels: L2, L3

Module-4: Bending of Shells & Folded Plates	8 Hrs

Bending theory of cylindrical shells: Donnell's and Flügge's equations, Long shell under symmetric load and boundary conditions, Introduction to folded plate structures: types and applications, Whitney's method and Simpson's method for folded plates, Load transfer mechanisms and joint detailing
RBT Levels: L3

Module-5: Design of Domes & Shells	8 Hrs

Design of domes, hyperbolic paraboloid (hypar) shells, IS Code provisions and detailing for shell structures, Introduction to finite element method (FEM) in shell analysis (basic overview), Software applications in plate and shell design (e.g., STAAD, SAP2000), Case studies of real-world structures using plates and shells.

RBT Levels: L3, L4

IV.COURSE OUTCOMES

CO1	To introduce the fundamental concepts of thin plate and shell theories used in structural engineering.
CO2	To familiarize students with classical solutions for plate bending problems using Navier's and Levy's methods.
CO3	To apply energy methods in the analysis of rectangular and circular plates under various loading and support conditions.
CO4	To explain the behavior and analysis of shell structures using membrane and bending theories.
CO5	To develop the ability to design shell structures such as domes, folded plates, and hypar shells using IS codes and design guidelines.
CO6	To provide exposure to modern numerical and software tools for the structural analysis and design of plates and shells.

V.CO-PO-PSO Mapping (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3		3										3			
CO2	3	3	3										3			
CO3	3	3	3										3			
CO4	3	3	3										3			
CO5	3	3	3										3			
CO6	3	3	3										3			

VI.Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VI. Learning Resources

VII(a) : Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Theory of Plates and Shells	Timoshenko, S. & Woinowsky-Krieger, S.	2nd Edition, 1959	McGraw Hill Education
2	Design and Construction of Concrete Shell Roofs	Ramaswamy, G. S.	1st Edition, 1986	CBS Publishers and Distributors
3	Stresses in Plates and Shells	Ugural, A. C.	2nd edition, 1999	McGraw-Hill
4	Reinforced concrete shells and folded plates	P. C. Varghese	1st Edition, 2014	PHI
5	Finite Element Analysis: Theory and Programming	Krishnamoorthy, C. S.	2nd Edition, 1994	Tata McGraw Hill Publishing

VII(b): Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/105/103/105103209/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Discussions, Quiz/Assignments

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			
BOS Chairman (Sign & Seal)			

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M.Tech Structural Engineering

Semester:	**II**	**Course Type:**	**IPCC**		
Course Title: Finite Element Method of Analysis					
Course Code:	**25CSEI22**			**Credits:**	**4**
Teaching Hours/Week (L: T:P:O)			**3:0:2:0**	**Total Hours:**	**40 + 12 Lab slots**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives:

- To provide the fundamental concepts of the theory of the finite element method
- To develop proficiency in the application of the finite element method (modelling, analysis, and interpretation of results) to realistic engineering problems through the use of software.

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, Field visits

III. Course Content

Module-1	8 Hrs

Kinematics and static variables for various types of structural problems – approximate method of structural analysis – Rayleigh-Ritz method – Difference between Finite Difference Method and Finite Element Method – variational method and minimization of energy approach for element formulation – principles of finite element method – advantages & disadvantages – finite element procedure – finite elements both first and second order elements used for one-, two- and three-dimensional problems.

Textbook: Krishnamoorthy C. S

RBT Levels: L1 L2

Module-2	8 Hrs

Nodal displacement parameters – convergence criteria – compatibility requirements – geometric invariance – shape function – polynomial form of displacement function – generalized and natural coordinates – Lagrangian interpolation function.

Textbook: Krishnamoorthy C. S

RBT Levels: L1 L2 L3

Module-3	8 Hrs

Isoperimetric elements, Internal nodes and higher order elements, Serendipity and Lagrangian family of Finite Elements, Sub-parametric and Super- parametric elements, Condensation of internal nodes, Jacobian transformation Matrix, Development of strain-displacement matrix and stiffness matrix, consistent load vector.

Textbook: Krishnamoorthy C. S

RBT Levels: L1 L2 L3

Module-4	8 Hrs
Application of Finite Element Method for the analysis of one- & two-dimensional problems: Analysis of plane trusses and beams, Application to plane stress/strain, Axisymmetric problems using CST and Quadrilateral Elements. **Textbook**: Reddy. J **RBT Levels: L1 L2 L3**	
Module-5	8 Hrs
Numerical integration- Gauss quadrature. Line or one-Dimensional Integrals: One point, Two point and Three-point formula. Procedure and Numerical examples. Area or two-dimensional Integrals: procedure and Numerical examples. Volume or three-dimensional Integrals: procedure and Numerical examples. **Textbook**: Reddy. J **RBT Levels: L1 L2 L3**	

IV. PRACTICAL COMPONENT

1	Analysis and Design of Simple Multi-storeyed structure using any commercially available FEA packages
2	Analysis and Design of Simple Multi-storeyed structure with earthquake load using any commercially available FEA packages
3	Analysis and Design of Simple shell structure using any commercially available FEA packages
4	Analysis and Design of Simple plate structure using any commercially available FEA packages
5	Analysis and Design of Simple overhead RCC water tanks using any commercially available FEA packages
6	Analysis and Design of simple bridge decks under IRC loading using any commercially available FEA packages
7	Analysis of Unrestrained steel beams as per IS 800-2007 norms using Excel spread sheets / MATLAB programming soft-computing techniques.

V. COURSE OUTCOMES

CO1	Explain the basic theory behind the finite element method.
CO2	Formulate force-displacements relations for 2-D elements
CO3	Use the finite element method to analyze real structures.
CO4	Implement numerical integration technics for 1D,2D and 3D integrals.

VI. CO-PO-PSO Mapping (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3											1	1			
CO2	3	2	2									1	1			
CO3	3	2	2	2	2							1	1			
CO4	3	2	2	2								1	1			

VII. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 2

Semester End Examination (SEE): Refer Annexure section 2

VIII. Learning Resources

VII(a): Textbooks:				
Sl. No.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the publisher**
1	Finite Element Analysis: Theory and programming	Krishnamoorthy C. S	2017	Tata McGraw Hill Publishing Co. Ltd
2	Fundamental finite element analysis and applications	M. Asghar Bhatti	2005	John Wiley & Sons
VII(b): Reference Books:				
1	The Finite Element Method for Solid and Structural Mechanics	Zeinkeiwich, O.C. and Tayler	2013	Butterworth-Heinemann
2	An Introduction to Finite Element Methods	Reddy, J	2013	McGraw Hill Co.

VII(c): Web links and Video Lectures (e-Resources):

- https://youtu.be/KR74TQesUoQ?si=jwtjtelLx1kARotC
- https://youtu.be/RM-c-8xDwZk?si=2sshBrSUwqrqj1Vl
- https://youtu.be/IzUfWuh8B8Q?si=wALjY8uii-pbr1g2
- https://youtu.be/WwgrAH-IMOk?si=Unr-xfK7Z7LYg5gB

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Field Visits
- Quiz/Assignments/Open book test to develop skills
- Encourage collaborative learning in the class
- Demonstration of Geological models and animations
- Hands on experiments with Rock and Minerals.

Sl. No.	**BOS Member**	**Affiliation**	**Signature**
1			
2			
3			

BOS Chairman (Sign & Seal)

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	**II**	**Course Type:**	**PCC**		
Course Title: Structural Dynamics and Earthquake Resistant Structures					
Course Code:	**25CSET23**			**Credits:**	**03**
Teaching Hours/Week (L: T:P:O)			**3:0:0:2**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives:

- The objective of this syllabus is to provide students with a comprehensive understanding of dynamic analysis in civil engineering, including single and multi-degree-of-freedom systems, seismic forces, and earthquake-resistant design.
- It aims to equip students with practical skills in modelling, numerical methods, and structural design, using modern engineering tools and adhering to national standards, such as IS 1893, for real-world applications. Evaluate the dynamic characteristics of the structures

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, Field visits

III. Course Content

Module-1	8 Hrs

Introduction: Introduction to dynamic problems of Civil Engineering, Concept of degrees of freedom, D'Alemberts principle, Principle of virtual displacement and energy, Single degree of freedom systems, Examples of Single degree of freedom systems in Engineering, Free vibration of damped and undamped systems.

Textbook: M. Mukhopadhaya

RBT Levels: L1 L2

Module-2	8 Hrs

Single degree of freedom systems (SDOF): Single degree of freedom systems subjected to sinusoidal loading, Resonance and its resonance diagram – support motion, Vibration isolation, transmissibility, Methods of damping measurements, Response of Single degree of freedom systems to arbitrary excitation, Duhamel integral solution, Response to suddenly applied load and triangular pulse loading, Principles of vibration measuring instruments

Textbook: M. Mukhopadhaya

RBT Levels: L1 L2 L3

Module-3	8 Hrs

Multiple Degree of Freedom System (MDOF): Mathematical Models of Multi-Degree-Of Freedom Systems, Shear Building Concept, Free Vibration of Undamped Multi-Degree-Of-Freedom Systems -Natural Frequencies and Mode Shapes – Orthogonality Property of Modes. Response To Free Vibration of Shear Buildings Without Damping Using Normal Mode Approach.

Textbook: M. Mukhopadhaya

RBT Levels: L1 L2 L3

Module-4	8 Hrs

CODE PROVISIONS FOR SEISMIC ANALYSIS OF RC BUILDING AS PER IS: 1893 (PART 1): 2016: Introduction. General Principles. Load Combinations and Increase Permissible Stresses- Load Combinations, Design Horizontal Earthquake Load, Design Vertical Earthquake Load, Combination of Two or Three Component Motion, Increase in Permissible Stress. Design Spectrum.

Textbook: Anil K. Chopra

RBT Levels: L1 L2 L3

Module-5	8 Hrs

EARTHQUAKE RESISTANT ANALYSIS AND DESIGN OF STRUCTURES: Seismic Weight, Design Lateral Force, Design Seismic Base Shear, Fundamental Natural Period, Distribution of Design Force. Determination of Lateral Force, Base Shear and Its Distribution of RC Buildings (Maximum Of 4 Story), Step by Step Procedure of Equivalent Static Lateral Force Method and Response Spectrum Methods (Without Infill and Maximum 3 Stories)

Textbook: Anil K. Chopra

RBT Levels: L1 L2 L3

IV. COURSE OUTCOMES

CO1	Achieve Knowledge of design and development of problem-solving skills
CO2	Understand the principles of Structural Dynamics
CO3	Summarize the Solution techniques for dynamics of multi-degree freedom systems
CO4	Evaluate seismic forces in multi-storied buildings using IS 1893 standards, understand the impact of masonry infill walls on structural performance.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1	1			1				1		2			
CO2	3	3	2	2			2				1		2			
CO3	3	3	2	2			2				1		2			
CO4	3	3	2	2			2				1		2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Vibrations, structural dynamics	M. Mukhopadhaya	2008	Oxford IBH
2	Earthquake Resistant Design of Building Structures	Vinod Hosur	2012	WILEY (India)

VII(b): Reference Books:

1	Theory and Application to Earthquake Engineering	Anil K. Chopra	2nd	Pearson Education
2	Structural Dynamics	Mario Paz	5th ed. 2004	CBS publishers

VII(c): Web links and Video Lectures (e-Resources):

- http://www.digimat.in/nptel/courses/video/105101006/L36.html
- http://digimat.in/nptel/courses/video/105107204/L10.html
- http://www.digimat.in/nptel/courses/video/105104189/L08.html
- http://digimat.in/nptel/courses/video/105101006/L26.html

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Field Visits
- Quiz/Assignments/Open book test to develop skills
- Encourage collaborative learning in the class
- Demonstration of Geological models and animations
- Hands on experiments with Rock and Minerals.

Sl. No.	BOS Member	Affiliation	Signature
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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Advanced Pre-stressed Concrete					
Course Code:	**25CSEP221**			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			**3:0:0:2**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	03

I. Course Objectives:

- To understand the principles and concepts of prestressed concrete structures
- To analyze and design prestressed concrete members for various loads and conditions
- To apply design codes and standards for prestressed concrete structures
- To develop problem-solving skills in prestressed concrete design

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations.

III. Course Content

Module-1: Analysis of Members under axial load and flexure	8 Hrs

Analysis of Members Under Axial Load – Introduction, Analysis at transfer, Analysis at services loads, Analysis of ultimate strength, Analysis of behavior,
Analysis of Member Under Flexure -Introduction, Analysis at Service Loads, based on stress concept, based on force concept, based on load balancing concept, Cracking moment, Kern point, Pressure line, Variation of stress in steel, Condition at ultimate limit state, Analysis of Rectangular Sections, Analysis of Flanged Sections, Analysis of Partially Prestressed Sections, Analysis of Un-bonded Post-tensioned Beams, Analysis of Behavior. Numerical problems

Module-2: Design of Member under axial tension and flexure	8 Hrs

Design of Members -Calculation of demand
Design of members for Axial Tension -Design of prestressing force, Analysis of ultimate strength, Analysis of ultimate strength
Design of Member for Flexure-Calculation of moment demand., Preliminary design of Sections for Flexure (Part I) Final design, Final design for type 1 members, Special case, Final design of type 2 members, Choice of sections, Determination of limiting zone, post-tensioning in stages, Magnel's graphical method, Detailing Requirements for Flexure, Detailing Requirements for Shear, Detailing Requirements for Torsion Numerical problems

Module-3: Shear and Torsion	8 Hrs

Analysis and Design for Shear and Torsion
Analysis for Shear - Introduction, Stress in an uncracked beam, Types of cracks, Components of shear resistance, Modes of failure, Effect of prestressing force,
Design for Shear - Limit state of collapse for shear, Maximum permissible shear stress, Design of transverse reinforcement, Detailing requirement for shear, General comments, Design steps, Design of stirrups for flange, Analysis for Torsion -Introduction, Stresses in an uncracked beam, Crack pattern under pure torsion, Components of resistance for pure torsion, Modes of failure, Effect of prestressing force,
Design for Torsion - Limit state of collapse for torsion, Design of longitudinal reinforcement, Design of transverse reinforcement, Detailing requirements, General comments, Design steps, Numerical problems.

Module-4: Deflection and Crack width	8 Hrs

Calculations of Deflection and Crack Width

Calculation of Deflection due to gravity loads, Deflection due to prestressing force, Total deflection, Limits of deflection, Determination moment of inertia, Limits of span-to-effective depth ratio,

Calculation of Crack Width -Method of calculation, Limits of crack width Transmission of Prestress Introduction, Pre-tensioned members, Transmission length, Development length, End zone reinforcement, Post-tensioned members, End zone reinforcement, Bearing plate, Numerical problems.

Module-5: Cantilever and Continuous Beams	8 Hrs

Cantilever Beams -Introduction, Analysis, Determination of limiting zone, Cable profile, **Continuous Beams** – Introduction, Analysis, Incorporation of moment due to reactions, Pressure line due to prestressing force, Concordant cable profile, Cable profiles, partially continuous beams, Analysis at ultimate limit state, Moment redistribution, Numerical problems.

IV. COURSE OUTCOMES

CO1	Analyse the prestressed structural member under flexure and axial load.
CO2	Design prestressed structural member under flexure and axial load.
CO3	Calculate deflection and crack width in prestressed structural elements
CO4	Analyse prestressed cantilever and continuous beams.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	2	2		2		1		1		1	1			
CO2	3	1	-	-				2		1		1	1			
CO3	2	-	2	1				2				1	3			
CO4	1	2	1	2		1		2				1	2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Prestressed Concrete	N Krishnaraju	2008	Tata McGraw- Hill Education
2	Prestressed Concrete structures	Lin T. Y and H. Burns	2009	Wiley Publication

VII(b): Reference Books:

1	Prestressed Concrete	N. Rajagopalan	2005	Narosa Publishing House
2	Design of Prestressed Concrete	A. Nilson	1997	John Willey & Sons

VII(c): Web links and Video Lectures (e-Resources):

https://youtu.be/-PHTbrvC2sk

https://youtu.be/xztDNgsY13Q

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

https://youtu.be/egoXjG5n8Ik

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

BOS Chairman (Sign & Seal)

|| Jai Sri Gurudev ||
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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M. Tech. Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Course Title: Design of High-Rise Structures					
Course Code:	**23CSEP222**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3-0-0-2	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To understand the various structural systems for high rise structures.
- To evaluate the behavior of structure under dynamic loading.
- To analyse and design of advanced structures.
- To apply the advanced method of analysis of such structures and modelling these structures in various software with pros and cons.

II. Teaching-Learning Process:

Chalk and talk, videos, Power Point presentation, animations.

III. Course Content

Module-1: Analysis and Design of RC and Steel Chimney — 8 Hrs

Design Factors, Stresses due to Temperature, Components & Safety Ladders, Analysis and Design of RC and Steel Chimney, Foundation design for Varied Soil Strata.

RBT Levels: L2, L3

Module-2: Design of transmission/ TV tower, Mast and trestles — 8 Hrs

Types of Loads & Tower Configuration, bracing system, Analysis and Design for Vertical & Transverse Loads.

RBT Levels: L2, L3

Module-3: Tall Buildings — 8 Hrs

General Consideration for Design of Tall Structures

Requirements of Tall Buildings, Factors affecting Tall Structures, Structural Concept.

Design Criteria & Loadings for Tall Buildings

Design Philosophy, National & International Codal Provisions for Loading, Strength & Stability, Stiffness & Drift Limitations, Effects of Creep, Shrinkage, Temperature, Fire etc., Human Comfort Criteria. Gravity Load, Live Load Reduction, Construction Load, Wind Load-Static & Dynamic Methods, Earthquake Load-Concept & Procedure of Equivalent Lateral Load, Response Spectrum & Modal Analysis, Load Combinations.

RBT Levels: L2

Module-4: Structural Forms & Systems:	8 Hrs

Structural Forms & Systems:

Concrete Structures

Rigid Frame, Braced Frame, Infilled Frame, Flat Plate-Slab, Shear Wall, Coupled Shear Wall, Flat Slab with Shear Wall, Shear Wall Frame Interaction, Framed Tube Structural System, Core Supported Structures, Outrigger, Belt Truss, Buttress Core System for Tall Building. Various Floor Systems.

Steel Structures

Rigid Frame, Semi-Rigid Frame, Braced Frame, Eccentric Braced Frame System, Buckling Restrained Brace Frame, Steel Plate Shear Wall, Interacting System of Braced and Rigid Frame, Staggered Truss System, Core Outrigger & Belt Truss System, Framed Tube System, Bundled Tube. Various Floor Systems.

Composite Structure

Various Composite Members, Composite Subsystems like Ordinary & Special Moment Frames, Composite Braced Frame, Composite Eccentric Braced Frame, Composite Tube Systems, Vertically Mix Systems. Various Floor Systems

RBT Levels: L2

Module-5: Modelling of Tall Structures for Analysis & Design	8 Hrs

Different Approach of Analysis, Assumptions & Behaviour, Modelling for Approximate Analysis-Modelling of Slabs, Continuum Analysis, Modelling for Exact Analysis of Plane Frame, Plane Shear Wall, 3-D Frame & Wall Structures, P-Delta Effects, Wall Opening Effect.

Braced Frame -Types, Behaviour, Method of Analysis & Drift Estimation.

Rigid Frame - Behaviour, Approximate Analysis of member Forces by Gravity and Lateral Loads, Drift Estimation. Computer Analysis of Rigid Frame.

Shear Wall & Coupled Shear Wall – Behaviors, Method of Analysis.

RBT Levels: L2

IV COURSE OUTCOMES

CO1	Analyse and Design of RC and Steel Chimney
CO2	Design transmission/ TV tower, Mast and trestles
CO3	Explain the design criterion, design philosophy and loadings in tall structures
CO4	Outline the behaviour of Structural Forms & Systems
CO5	Discuss the Modelling of Tall Structures for Analysis & Design

V.CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3											3			
CO2	3	3											3			
CO3	3	3											3			
CO4	3	3											3			
CO5	3	3											3			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII.(a): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Structural Design of Multi-storeyed Buildings	Varyani U. H.	2, 2014	South Asian Publishers
2	Design of Multi Storeyed Buildings	-	2007	CPWD Publications
3	Advanced Reinforced Concrete Design	Varghese P. C.	2, 2005	Prentice Hall of India, New Delhi
4	Tall Building Structures	Smith Byran S. and Coull Alex	1, 1997	Wiley India
5	Structural Analysis and Design of Tall Buildings	Taranath B. S.	1, 2011	McGraw Hill

VII(b): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=un_Fjz_dfXI&list=PLFEqFwyPC3WwDLI6jtt2xXVPw2ygj0Jxz
- https://www.youtube.com/watch?v=_ypvXxOesm4
- INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Conduction of technical seminars on recent research activities
- Group Discussion

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M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Course Title: DESIGN OF MASONRY STRUCTURES					
Course Code:	23CSEP223			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			**3:0:0:2**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I Course Objectives:

- To learn performance of masonry structures
- To design the masonry structures for earthquake resistance.
- To evaluate the strength and stability of the masonry structures

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations.

III. COURSE CONTENT

Module-1:	8 hrs

Introduction, Masonry units, materials and types: History of masonry, Masonry units – Brick- Types of bricks, Tests conducted on bricks. Other masonry units - stone, clay block, concrete block, laterite block, stabilized mud block masonry units Masonry materials – Classification and properties of mortars, selection of mortars. Cracks - Cracks in masonry structures, Type of crack, causes and prevention of crack.

RBT Levels: L1 L2 L3

Module-2:	8 hrs

Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar Characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, Failure theories of masonry under Compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength

Masonry Bond Strength and Masonry in Shear and Flexure: Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength.

RBT Levels: L1 L2 L3

Module-3:	8 hrs

Design of load bearing masonry wall Permissible stresses**,** Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress, and shear stresses. Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness,

slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.

Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.

RBT Levels: L1 L2 L3

Module-4:	8 hrs

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings. Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls.

RBT Levels: L1 L2 L3

Module-5:	8 hrs

Earthquake resistant masonry buildings: Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions. In- filled frames: Types – modes of failures.

Reinforced brick masonry Methods of reinforcing masonry, Analysis of reinforced Masonry under axial, flexural and shear loading.

RBT Levels: L1 L2 L3

IV.COURSE OUTCOMES

CO1	Achieve Knowledge on properties of masonry units.
CO2	Evaluate Strength of Masonry in Compression, shear and flexure.
CO3	Design of load bearing masonry wall.
CO4	Design of wall subjected to axial, transverse and lateral loads.
CO5	Evaluate the strength and stability of the reinforced masonry structures.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	2										2			
CO2	2	2	2										2			
CO3	2	2	2										2			
CO4	2	2	2										2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII.(a) Reference Books:

1	Structural Masonry	Hendry, A.W.	1990	Macmillan Education Ltd
2	Structural masonry	K.S. Jagadish	1992	I.K. International
3	Brick and Reinforced Brick Structures	Dayaratnam P	1987	McGraw Hill, New York

4	Building and Construction Materials	M. L. Gambhir	1995	Mc Graw Hill education Pvt.Ltd
5	Handbook On Masonry Design and Construction	-	1996	BIS

VII(b): Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=s4CN6aVKhPo&list=PLEE5D02698EAAF2C0.
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Conduction of technical seminars on recent research activities Group Discussion Site visit

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Reliability Analysis of Structures					
Course Code:	**25CSEP224**			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			**3:0:0:2**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	03

I. Course Objectives:

- Analyze and design structures with a focus on reliability and safety.
- Statistical techniques to assess variability in structural elements.
- determine appropriate safety formats for failure surfaces, and utilize regression and correlation methods to analyse relationships between variables
- Prepare students to make informed decisions in structural engineering that prioritize safety, efficiency and integrity

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations.

III. COURSE CONTENT

Module-1: Concept of Variability	8 Hrs

Applications of statistical principles to deal with randomness in basic variables.
Statistical parameters and their significance.
Description of various probability distributions: Binomial, Poisson, Normal, Log-Normal, Beta, and Gamma distributions.
Testing the goodness of fit of distributions to actual data using the Chi-Square method and the Kolmogorov-Smirnov (K.S.) method.
RBT Levels: L1, L2, L3

Module-2: Statistical Regression and Correlation	8 Hrs

Least squares and Chi-Square methods, Operations on one random variable, expectation, and multiple random variables, Reliability distributions and basic formulations.
RBT Levels: L1, L2, L3

Module-3: Statistical Quality Control in Civil Engineering	8 Hrs

Sampling for quality control: Characteristic strength and characteristic load, Probability modeling of strength, geometrical dimensions, material properties, and loading, Statistical inference problems: Comparison of various acceptance and rejection testing.
RBT Levels: L1, L2, L3

Module-4: Safety Assessment of Structures	8 Hrs

Reliability analysis using I, II, and III order reliability formats, Mean value method and its applications in structural designs.
RBT Levels: L1, L2, L3

Module-5: Reliability of Structural Elements	8 Hrs

Simulation techniques: Monte Carlo method and its applications, Reliability index and reliability formulation in various limit states, Reliability-based design: Application to the design of reinforced concrete (RC), prestressed concrete (PSC), and steel structural elements under the Load and Resistance Factor Design (LRFD) concept.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Apply the theoretical principles of randomness of variables in structural engineering through density functions and probability distribution
CO2	Analyse components of structure to assess safety using concepts related to structural reliability by various methods.
CO3	Evaluate the safety reliability index at system level.
CO4	Perform reliability-based design for beam element at given level of safety.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	2	2		2		1		1		1	1			
CO2	2	1	2	1		2		1		1		1	1			
CO3	2	2	2	1				1				1	3			
CO4	1	2	1	2		1		1		2		1	2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Probability Concepts in Engineering Planning & Design	Ang, A.H.S., and Tang, W.H.	1984	John Wiley & Sons
2	Reliability Analysis and Design of Structures	Ranganathan, R.	2008	Tata McGraw-Hill Publishing Co. Ltd

VII(b): Reference Books:

1	Statistics: Theory, Methods & Applications	Sancheti, D.C., and Kapoor, V.K	1996	Narosa Publishing House
2	Reliability-Based Analysis & Design for Civil Engineers	Devaraj, V., and Ravindra, R	2017	IK International Publishing House Pvt. Ltd.

VII(c): Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/105/103/105103140/

https://archive.nptel.ac.in/courses/105/105/105105209/

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Course Title: Advanced Structural Analysis					
Course Code:	25CSEP231			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			**3:0:0:2**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I. Course Objectives:

Analysis of curved beams, Beams on elastic foundation, shear centre and unsymmetrical bending and buckling of non-prismatic columns and beam columns.

II. Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations.

III. Course Content

Module-1:	8 hrs

Curved Beams: Curved beams, Introduction, assumptions, derivation of Winkler Bach equation, Radius to the neutral surface of simple geometric figures, Limitation, Stress distribution in open curved members such as Hooks and chain links, Stress distribution in closed rings and chain links. Deformations of open and closed rings.

RBT Levels: L1 L2 L3

Module-2:	8 hrs

Beams on Elastic Foundations: Governing differential equation for elastic line, Interpretation of constants, Infinite beam with point load, moment & UDL with problems. Semi- infinite beams with point load and moment UDL with problems over fixed and hinged support conditions.

RBT Levels: L1 L2 L3

Module-3:	8 hrs

Shear Centre: Concept of shear centre in torsion induced bending of beams, expression to the Shear Centre for Symmetrical and Unsymmetrical Sections, Derivation of shear centre for angles, channel, semicircular and built-up sections with numerical problems.

RBT Levels: L1 L2 L3

Module-4:	8 hrs

Unsymmetrical Bending: Theory behind unsymmetrical bending, Assumptions, obtaining the stresses in beams, simply supported and cantilever unsymmetrical beams subjected to inclined loading, Deflections of unsymmetrical simply supported and cantilever beams with numerical problems.

RBT Levels: L1 L2 L3

Module-5:	8 hrs

Buckling of Non Prismatic Columns and Beam-Column: Principle behind Euler's theory of buckling, Governing differential equation applied to buckling of columns and evaluation of constants for various boundary conditions, Obtaining the characteristic equation for the buckling load of non-prismatic compound columns, Analysis of Beam- column, conceptual theory of magnification stresses and deformations subjected to axial and different types of lateral loads with numerical problems..

RBT Levels: L1 L2 L3

IV.COURSE OUTCOMES

CO1	Apply Winkler Bach and Strain Energy principles to obtain stresses and deformation in curved members.
CO2	Derive the expressions to Foundation pressure, Deflection, Slope, BM and SF of infinite and semi-infinite Beams resting on Elastic Foundation.
CO3	Obtain the equations for the shear centre for symmetrical and unsymmetrical from fundamentals.
CO4	Extrapolate the bending theory to calculate the stresses and deformations in unsymmetrical bending
CO5	Develop the characteristic equation for the buckling load of compound column and stresses and deformations in beam-column.

V.CO-PO-PSO MAPPING (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	2										2			
CO2	2	2	2										2			
CO3	2	2	2										2			
CO4	2	2	2										2			
CO5	2	2	2										2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII.(a) Reference Books:

1	Advanced mechanics of solids and structures	Krishna Raju N & Gururaj D R	1998	NAROSA Publishers Company Delhi.
2	Advanced Mechanics of Solids", Tenth Print,.	Srinath L. S	1992	Tata McGraw Hill publishing company. New Delhi
3	Optimum Structural Design	Uri Kirsch	1994	McGraw Hill, New York
4	Advanced theory of structures & Matrix Method	Vazirani V N and Ratwani M M	1995	Khanna publishers
5	Indeterminate Structural Analysis	Sterling Kinney	1996	Oxford & IBH publishers

VII(b): Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=s4CN6aVKhPo&list=PLEE5D02698EAAF2C0
https://archive.nptel.ac.in/courses/105/106/105106050/
https://archive.nptel.ac.in/courses/105/106/105106050/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of technical seminars on recent research activities
Group Discussion
Site visit

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M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Course Title: Design of Sub-Structures					
Course Code:	**25CSEP232**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			**3:0:0:2**	**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I. Course Objectives:

- To learn principles subsoil exploration,
- To design the sub structures.
- To evaluate the soil shear strength parameters.

II. Teaching-Learning Process (General Instructions):

Chalk and Talk using writing boards, PPT and videos.

III. Course Content

Module-1:	8 hrs

Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts.

RBT Levels: L2, L3

Module-2:	8 hrs

Concept of soil shear strength parameters, Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C-Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads.

RBT Levels: L2, L3

Module-3:	8 hrs

Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil structure interaction, different methods of modeling the soil. Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft – super structure interaction effects & general concepts of structural design, Basement slabs

RBT Levels: L2, L3

Module-4:	8 hrs

Deep Foundations: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.

RBT Levels: L2, L3, L4

Module-5:	8 hrs

Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking. Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations, Ring foundations –general concepts

RBT Levels: L2, L3, L4, L5

IV. COURSE OUTCOMES	
CO1	Achieve Knowledge of design and development of problem-solving skills.
CO2	Understand and apply the principles of subsoil exploration
CO3	Design and develop analytical skills.
CO4	Identify and evaluate the soil shear strength parameters.
CO5	Apply the concepts of Settlement analysis.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3	3					2					2			
CO2	3	2				2	2	2					2			
CO3	3	3	3										2			
CO4	3	3											2			
CO5	3	3											2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a). Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Analysis & Design of Substructures	Swami Saran	1998	Oxford & IBH Pub. Co. Pvt. Ltd.
2	Design of Foundation Systems	Nainan P Kurian	1992	Narosa Publishing House.
3	Foundation Engineering	R.B. Peck, W.E. Hanson & T.H. Thornburn	1984	Wiley Eastern Ltd
4	Foundation Analysis and Design	J.E. Bowles	1996	McGraw-Hill Int.

VII(b): Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=lsYFtwwlHIw&list=PLbRMhDVUMngeiZjKPTPEFl1CByXmYX3Kv

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of technical seminars on recent research activities
Group Discussion

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

BOS Chairman (Sign & Seal)

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

M. Tech. Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Course Title: Repair and Rehabilitation of Structures					
Course Code:	**23CSEP233**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3-0-0-2	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

The objective of this course is imparting skills of

- Project Management and Economic Analysis
- Life Cycle Cost Analysis (LCCA) for repair vs. replacement decisions
- Risk assessment and reliability-based maintenance planning
- Sustainability metrics and carbon footprint considerations

II. Teaching-Learning Process (General Instructions):

Chalk and Talk using writing boards, PPT and videos.

III.COURSE CONTENT

Module-1: Fundamentals of Structural Deterioration and Assessment	8 Hrs

Introduction to structural deterioration, causes and mechanisms, Environmental factors affecting structures- carbonation, chloride attack, freeze-thaw cycles, Structural assessment techniques and condition surveys, Non-destructive testing methods - ultrasonic, rebound hammer, core testing.
RBT Levels: L2

Module-2: Concrete Repair Materials and Technologies	8 Hrs

Classification of concrete repair materials (cementitious, polymer-based, epoxy systems), Surface preparation methods and importance of substrate preparation, Repair techniques for cracks, spalls, and structural defects, Quality control and curing requirements for repair materials
RBT Levels: L2

Module-3: Structural Strengthening and Retrofitting Techniques	8 Hrs

Principles of structural strengthening and load transfer mechanisms, Fiber Reinforced Polymer (FRP) strengthening systems, Steel plating and external post-tensioning techniques, Seismic retrofitting strategies and base isolation systems.
RBT Levels: L2

Module-4: Steel and Masonry Structure Rehabilitation	8 Hrs

Steel corrosion mechanisms and assessment methods, Steel repair techniques (welding, bolting, section replacement), Masonry deterioration patterns and diagnostic methods, Masonry repair techniques (repointing, structural strengthening, heritage considerations).
RBT Levels: L2

Module-5: Advanced Rehabilitation Technologies	8 Hrs

Advanced Rehabilitation Technologies: Self-healing concrete and bio-concrete applications, Shape Memory Alloy (SMA) applications in structural repair, Nanotechnology in construction materials, Smart monitoring systems and IoT integration.
Project Management and Economic Analysis: Life Cycle Cost Analysis (LCCA) for repair vs. replacement decisions, Risk assessment and reliability-based maintenance planning, Sustainability metrics and carbon footprint considerations, Construction scheduling and phasing for occupied structures.
RBT Levels: L2

IV.Course Outcomes

CO1	Evaluate structural deterioration mechanisms and analyze condition assessment data using non-destructive testing methods to determine the extent of damage and remaining service life of concrete, steel, and masonry structures.
CO2	Synthesize repair material properties with structural requirements and design compatible rehabilitation solutions by selecting appropriate surface preparation methods and application techniques while justifying adherence to relevant codes and standards.
CO3	Create structural strengthening designs using FRP composites, external post-tensioning, and steel plating systems by integrating load transfer principles and evaluating enhanced structural performance against design criteria.
CO4	Develop comprehensive seismic retrofitting strategies by comparing various techniques including base isolation and damping systems, and formulate implementation plans that optimize earthquake resistance and structural resilience.
CO5	Assess economic feasibility and sustainability of rehabilitation projects by applying life cycle cost analysis methodologies, critiquing environmental impacts, and recommending optimal solutions for repair versus replacement decision-making scenarios.

V.CO-PO-PSO Mapping (H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2							2			
CO2	3	3	2			2							2			
CO3	3	3	3			3							2			
CO4	3	3	3			3							2			
CO5	2	2											2			

VI.Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII.Learning Resources

VII(a): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Repair and Rehabilitation of Structures	N. Madhavi	1st Edition, 2016	Elsevier
2	Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques	Peter H. Emmons and Brandon W. Emmons	2nd Edition, 2019	RS Means Company
3	Repair and Rehabilitation of Concrete Structures	Poonam I. Modi and Chirag N. Patel	2nd Edition, 2016	PHI Learning

4	Structural Rehabilitation of Old Buildings	Aníbal Costa, João Miranda Guedes, Humberto Varum	1st Edition, 2014	Springer
5	Repair and Rehabilitation of Structures	Dr. R.N. Krishna and Prof. A.R. Santhakumar	3rd Edition, 2022	New Age International

VII(b): Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/105106202
https://onlinecourses.nptel.ac.in/noc22_ce20/preview

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of technical seminars on recent research activities , Group Discussion

Sl. No.	BOS Member	Affiliation	Signature
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M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PEC**		
Course Title: Mechanics of Composites					
Course Code:	25CSEP234			**Credits:**	3
Teaching Hours/Week (L:T:P:O)		**3:0:0:2**		**Total Hours:**	40
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3hrs

I. Course Objectives:

- Understand the fundamental definitions, classifications, and types of composite materials
- Analyze the behaviour of composite constituents at the microscopic level
- Describe and assess the key mechanical behaviour of composite materials
- Identify and explain different failure modes in composite materials

II. Teaching-Learning Process (General Instructions):

Chalk and Talk using writing boards, PPT and videos.

III. COURSE CONTENT

Module-1:	8 hrs

Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

RBT Levels: L1, L2

Module-2:	8 hrs

Mechanical Properties -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear. fibre/polyester, etc.

RBT Levels: L1, L2, L3

Module-3:	8 hrs

Micromechanics of Composites:

Constitutive equations for unidirectional lamina, Stress-strain relations for a single lamina, Volume and weight fractions of constituents, Elastic properties of a unidirectional lamina (Young's moduli, Poisson's ratios, shear moduli).

Thermal expansion coefficients.RBT Levels: L1, L2, L3

Module-4:	8 hrs

Macromechanics of Laminates: Classical laminate theory (CLT), Stress and strain analysis of laminated composites, Stiffness matrices for symmetric and general laminates, Failure criteria for composite laminates, and Effect of stacking sequence on laminate properties.

RBT Levels: L1, L2, L3

Module-5:	8 hrs

Mechanical Behavior of Composites: Tensile, compressive, and shear strength of composites, Interlaminar shear strength, Fatigue behavior of composite materials, Impact resistance of composites.

Failure Analysis: Different failure modes in composite materials, Fracture mechanics of composites, and Damage tolerance of composite structures.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Differentiate and classify various composite materials
CO2	Calculate the effective elastic and thermal properties of unidirectional laminae
CO3	Apply Classical Laminate Theory to predict the strength characteristics of laminated composites
CO4	Evaluate the strength and durability of composite materials
CO5	Diagnose potential failure modes in composite structures

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2	1										2			
CO2	2	2	2										2			
CO3	2	2	2										2			
CO4	2	2	2										2			
CO5	2	2	2										2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a). Reference Books:

1	Mechanics of Composite Materials	Robert M. Jones	1999	CRC Press
2	Principles of Composite Material Mechanics	Ronald F. Gibson	2016	CRC Press
3	An Introduction to Composite Materials	D. Hull and T.W. Clyne	2011	Cambridge University Press
4	Mechanics of Composite Materials	Autar K. Kaw	2006	CRC Press
5	Micromechanics of Composites	Volodymyr Kushch	2015	CRC Press

VII(b): Web links and Video Lectures (e-Resources):

https://www.youtube.com/playlist?list=PLtG1yR2v36D8uD1t3qJ-f-mKq-t2f1C_X
https://www.youtube.com/playlist?list=PL46A0423086161BBF
https://www.youtube.com/@easycompositestv

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of technical seminars on recent research activities, Group Discussion

Sl. No.	BOS Member	Affiliation	Signature
1			
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3			

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M.Tech Structural Engineering

Semester:	II	**Course Type:**	**PCCL**		
Course Title: Advanced Computation Laboratory					
Course Code:	**25CSEL26**			**Credits:**	02
Teaching Hours/Week (L:T:P:O)			**1:0:2:0**	**Total Hours:**	12 lab slots
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	100
SEE Type:	Practical			**Exam Hours:**	03

I Course Objectives:

- To develop proficiency in creating 3D building models using Revit, enabling students to set up levels, grids, and design walls, doors, and windows with accurate elevation and 3D views.
- To enable students to create and annotate detailed floor plans to use Revit, including dimensions, room tags, and text notes, while generating professional sheets for effective documentation.
- To develop proficiency in constructing structural models in Revit Structure, including beams, columns, and foundations, ensuring alignment with architectural designs.

II Teaching-Learning Process (General Instructions):

Chalk and talk, videos, Power Point presentation, animations, practical sessions.

III. Practical Part

Sl. No.	Experiments
1	Analysis and Design of RCC beam and column elements using MATLAB/Python
2	Analysis and Design of RCC slabs for different end conditions using MATLAB/Python
3	Structural Analysis of 2D beams with different loading and support conditions by using MATLAB/Python
4	Analysis of unidirectional fiber reinforced composite materials by using MATLAB/Python to compute parameters of rule of mixture and engineering constants.
5	Analysis of STEEL beam and column elements using MATLAB/Python
6	Static and Dynamic analysis and design of Multi-storey Building structures using any FE software
7	Analysis of RC Chimneys/silos/bunkers FE software.
8	Analysis and design of large span roof structure (dome structure) using any FE software.
9	Design of structural drawings for a multi-storied building using FE software
10	Analysis of unidirectional fibre reinforced composite materials by using MATLAB/Python to compute compliance matrix, stiffness matrix and other related parameters

IV. COURSE OUTCOMES

CO1	Analyse and Design RC components with different end conditions and load conditions
CO2	Analyse and design multi storey buildings, chimney, silos and bunkers
CO3	Analysis of unidirectional fiber reinforced composite materials.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2						2	1					1			
CO2	3	2											1			
CO3	3	2											1			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE): Refer Annexure Section 3

Semester End Examination (SEE): Refer Annexure Section 3

VII. Learning Resources

VII.(a) Reference Books:

1	Matlab Programming	Y. Kirani Singh, B. B. Chaudhuri	2007	PHI Learning Pvt. Ltd
2	Advanced Structural Analysis with MATLAB	Srinivasan Chandrasekaran	2019	CRC Press
3	Python for Civil and Structural Engineers	Vittorio Lora	2023	Vittorio Lora

VII(b): Web links and Video Lectures (e-Resources):

https://www.mathworks.com/videos/finite-element-analysis-in-matlab-part-1-structural-analysis-using-finite-element-method-in-matlab-1600851689410.html
https://www.youtube.com/watch?v=Y8BOsDvzfXQ
https://www.youtube.com/watch?v=opw5M-IIJPA
https://www.youtube.com/watch?v=bme0V7fgj28

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical sessions

Sl. No.	BOS Member	Affiliation	Signature
1			
2			
3			

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