

Sankalchand Patel University
Faculty of Engineering and Technology
First Year Master of Technology in Civil Engineering
(Computer Aided Structural Analysis and Design)
In Effect from Academic Year 2023-24

Branch Name:	Civil Engineering (Computer Aided Structural Analysis & Design)
Semester/Year:	Semester I / First Year
Subject Title:	Advanced Structural Analysis
Subject Code:	2ET2100101T
Pre-requisite:	Mechanics of Solids, Structural Analysis and Matrix Algebra

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	4	0	0	4	24	60	16	40	00	00	00	00	100

Course Objective:

1. In the present era of computerization, it has become necessary to recognize the theory of structures into a more systemic form that is valid for all types of structures and can be more easily programmed for a digital computer.
2. For such a systematic approach using computer, use of matrices is natural because they permit large groups of numbers to be manipulated in a simple and effective manner.
3. In light of above, the course on Matrix Methods of Structural Analysis provides the students a clear understanding of the structural response and help for preparing their own programs for analysis of skeletal structures or to learn how that is done.

Subject Contents			
Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction: Types of Structures, Static and Kinematic Indeterminacy, Review of Matrix Algebra	04	5
2	Stiffness System Approach: Analysis of Continuous beams, Plane truss, Plane frames and Grids.	10	20
3	Stiffness Member Approach: Analysis of Continuous beam, Plane truss, Plane frame, Grid, Space truss,Space frame and Composite structures including secondary effects such as Temperature variations, Support settlement / rotations. symmetry concepts.	16	25
4	Introduction to FEM: Principles of discretization, Element stiffness mass formulation based on direct, variational and weighted residual techniques, Finite element displacement approach: Shape functions convergence criteria Computation of element properties, plane stress, plane strain Problems, Computations of element properties: bar elements, beam elements, truss elements, constant strain triangle, linear strain triangle and quadrilateral elements using generalized coordinates	10	20
5	Axisymmetric solids, Computations of element properties: bar elements, beam elements, truss elements, constant strain triangle and quadrilateral elements using natural coordinates; Is-parametric formulation, Dynamic analysis: Free vibration analysis of truss bars with two D.O.F. considering lumped mass and consistent mass formulations. Flexural vibration of beam elements	08	15
6	Miscellaneous Topics: Non-prismatic members, beams on elastic supports, Non-linearity in structure and non-linear analysis. Programming direct stiffness method.	08	15

Term-Work:

1. Minimum 15 problems from above topics along with cross checking using any open-source / professional software.

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2. Modelling & analysis of at least one real-life structure using open-source /professional software

Course Outcome:

After learning the course, the students should be able to:

1. Analyze framed structures using flexibility and stiffness method, Skill Development
2. Develop computer programs for analysis of framed structure, Skill Development
3. Use effectively commercial software for analysis and design of structures Skill Development
4. Analyze structure having member discontinuities, curved members, non-prismatic members, elastic supports, semi-rigid connections etc Skill Development

Open Ended Problems:

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem few examples of the same are given below:

1. Development of computer programme for the analysis of planar and space skeletal structure.
2. Development of front end and back end for the computer programme developed as mentioned above.
3. Modelling and analysis of real-life structure using open-source/professional software

Reference Books

1. Matrix Analysis of Framed Structure - Weaver W. and Gere J. M., CBS Publishers, Delhi.
2. Structural Analysis –Ghali&Nevelle, Spon Press, London.
3. Matrix Analysis of Structures – Aslam Kassimali, Cengage Learning, USA.
4. Elementary matrix analysis of structures - H. Kardestuncer, Mc-Graw Hill, USA
5. Matrix Analysis of Structures - Meghree & Deshmukh, Charotar Publication, Anand.
6. Computer Methods of Structural Analysis - Beaufait, Rowan, Hadley and Heckett
7. Linear Analysis of Frame works - Graves Smith
8. Computer Analysis of Structural Systems - Fleming J.F
9. Matrix Structural Analysis - McGuire, Gallagher, and Ziemian, John Wiley & Sons, Inc. 2000.
10. Finite Elements Procedures in Engineering analysis - Bathe, Wilson
11. Finite Element for Structural Analysis - Weaver & Johnston
12. The Finite Element Methods –Zienkiewicz
13. Introduction to Finite Elements in Engineering - Chandrupatla, R.T. & Belegundu, A.D
14. Finite Element Programming - Hinton & Owen
15. Finite Elements Methods - C.S.Krishnamurthy

E-Resources (If any):

www.scilab.org/
<http://nptel.ac.in/>
<http://ocw.mit.edu/>
www.mastan2.com/

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Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Analyze framed structures using flexibility and stiffness method,	L-3 and L-4
CLO2	Develop computer programs for analysis of framed structure,	L-3 L-4 and L-5
CLO3	Use effectively commercial software for analysis and design of structures	L-5
CL04	Analyze structure having member discontinuities, curved members, non-prismatic members, elastic supports, semi-rigid connections etc	L-4 and L-5

L1- Remember, L2- Understand, L3- Apply, L4- Analyze, L5- Evaluate, L6- Create

Mapping of CLOs with POs & PSOs

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
Course Learning Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CLO1	M	M		M	M	M			M				M		
CLO2	M	M	M	M	M	M		M	M				M		M
CLO3	M	M	M	M	H	M		M	M			H	M	H	M
CL04	M	M		M	H	M		M				M	M	M	

H: High, M: Medium, L: Low