

GUJARAT TECHNOLOGICAL UNIVERSITY
CIVIL & INFRASTRUCTURE ENGINEERING
Computer Aided Structural Analysis and Design
SUBJECT CODE: 2174007
7th SEMESTER

Type of course: Department Elective

Prerequisite: Mechanics of Solids, Fundamental Structural Analysis, Advance Structural Analysis

Rationale: To make the students

- Understand the stiffness member approach for structural analysis
- Familiar with fundamentals of structural analysis & design software
- Capable of developing computer programmes for design of structural elements

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2	0	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Principles of Virtual work, Basic concepts of flexibility and stiffness. Types of skeletal structures, Internal forces and deformations. Introduction and applications of flexibility method and stiffness method to analyze beams, Trusses and plane frames.	4	10%
2	Matrix concepts and Matrix analysis of structures: Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations; eigenvalues and eigenvectors. Coordinate systems; displacement and force transformation matrices, Contra-gradient principle; element and structure stiffness matrices. Element and structure flexibility matrices; equivalent joint loads; Stiffness and flexibility approaches.	4	10%
3	Stiffness Member Approach: Analysis of Continuous beam, Plane truss, Plane frame and Composite structures including secondary effects such as Temperature variations, Pre-strains and Restrained displacement; Programming direct stiffness method.	20	50%

4	Special Problems: Member discontinuities, Non-prismatic members, curved members, beams on elastic supports, semi-rigid connections, effect of shear deformations by stiffness method, Sub-structure analysis and symmetry concepts.	2	5%
5	Programming: Analysis of structures using C++ Application : Excel spread sheets for the design of (1) Reinforced Concrete members like slabs, beams, columns, isolated, footings etc. (2) Steel members like Beam/Girders, Compression & Tension members, Connections etc.	6	15%
6	Software Usage: Modelling (Skeletal members, Joints, Material specification, Loadings), analysis (Forces, Deflection, Stability, Displacement, stresses) and design of frame structure using tools/software.	4	10%
		40	100

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 - Meghre & 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. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
11. Devdas Menon, "Structural Analysis", Narosa Publishing House, 2008.
12. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
13. Programming in C++ - E. Balaguruswamy
14. Teach yourself C++ - Herbert Schildt
15. Object Oriented programming in Turbo C++ - Robert Lafore
16. Introduction to Computer Aided Drafting - Voisinet
17. Mastering AutoCAD - George Omura
18. Computer programming and engineering analysis - Syal & Gupta

Course Outcome:

After learning the course the students should be able to:

- Analyze framed structures using member approach method.
- Develop computer programs for structure design & structural elements.
- Use software tool for analysis and design
- Prepare the structural layout and detail plan of building

List of Experiments/Tutorials:

- Analysis of beams with stiffness member approach
- Analysis of trusses with stiffness member approach
- Analysis of frames with stiffness member approach

Open Ended Problems:

- A group of students has to model and analyze one frame structure using open-source/ professional software and design of members on the basis of analysis output and cross check it with software design.
- Development of computer program for design of structure elements such as beam, Column, slab, footing etc.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N	E Level	C
10	15	20	20	25	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate
C: Create and above

List of Open Source Software/learning website:

www.mastan2.com/ www.scilab.org/

<http://nptel.ac.in/> <http://ocw.mit.edu/courses/civil-and-environmental-engineering/>

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.