

# GUJARAT TECHNOLOGICAL UNIVERSITY

## CIVIL (STRUCTURAL ENGINEERING) MATRIX METHODS OF STRUCTURAL ANALYSIS SUBJECT CODE: 2712001 SEMESTER: I

**Type of course:** Core

**Prerequisite:** Mechanics of Solids, Structural Analysis and Matrix Algebra

**Rationale:** 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. 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. 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.

### 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#	2	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.	01	-
2	Flexibility Member Approach: Analysis of Continuous beam, Plane truss, Plane frame and Grid.	10	25
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, 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.	08	20
5	Introduction to Non-linearity in structure and non-linear analysis.	03	05

### 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

**Course Outcome:**

After learning the course the students should be able to:

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

**List of Experiments/Tutorials:**

1. Minimum 15 problems from above topics along with cross checking using any open-source / professional software.
2. Modelling and analysis of at least one real-life structure using open-source/ professional software.

**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 planner 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

**Major Equipments: --**

**List of Open Source Software/learning website:**

[www.mastan2.com/](http://www.mastan2.com/)

[www.scilab.org/](http://www.scilab.org/)

<http://nptel.ac.in/>

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