GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL (STRUCTURAL ENGINEERING)
SUBJECT NAME: Advanced Structural Analysis
SUBJECT CODE:3712011
1st Year

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. Matrix method provides a comprehensive approach to the analysis of different structural systems and therefore offers a major advantage over many traditional methods. It is also suitable for digital computer. There are many structural problems involving complicated geometries, loadings and material properties for which mathematical solution involves ordinary or partial differential equations. Hence numerical methods such as the finite element method, finite difference method, boundary element method etc. may be used. Finite element method is such a versatile numerical method that can be used to solve any complex problem of structural mechanics. In light of above, the course on Advanced Structural Analysis provides the students a clear understanding of determining structural response of skeletal & continuum structure using matrix method and computer software.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	3	70	30	30	20	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
	Module – I: Stiffness Member Approach:		
1	Principles of Virtual work, Basic concepts of flexibility and stiffness.	01	---
2	Analysis of Continuous beam, Plane Truss, Plane Frame, Plane Grid including secondary effects such as Temperature changes, Prestrains and End-displacements.	14	35
3	Introduction to Non-linearity in structure and non-linear analysis.	02	05
	Module – II: Finite Element Method		
4	Principles of discretization, Element stiffness mass formulation based on direct, variational and weighted residual techniques.	03	09

5	Computations of element properties for bar elements, beam elements, truss elements, constant strain triangle and quadrilateral elements using generalized coordinates.	09	22
6	Computations of element properties for bar elements, beam elements, truss elements, constant strain triangle and quadrilateral elements using natural coordinates; Iso-parametric formulation.	10	22
7	Axisymmetric solids	03	07

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. A First Course in the Finite Element Method - D. L. Logan
10. Introduction to Finite Elements in Engineering - Chandrupatla, R.T. & Belegundu, A.D
11. Finite Element Analysis - S. S. Bhavikatti
12. Finite Element Method in Engineering - S.S.Rao
13. Finite Elements Methods - C.S.Krishnamurthy
14. Finite Element Method - Y. M. Desai, T. I. Eltho and A. H. Shah
15. Matrix Structural Analysis - McGuire, Gallagher, and Ziemian, John Wiley & Sons, Inc.
16. Finite Elements Procedures in Engineering analysis - Bathe, Wilson
17. Finite Element for Structural Analysis - Weaver & Johnston
18. The Finite Element Methods - Zienkiewicz
19. Finite Element Programming - Hinton & Owen

Course Outcome:

After learning the course the students should be able to:

1. Analyze skeleton structures using stiffness method,
2. Analyze skeleton structures having secondary effects using stiffness method,
3. Derive element properties and analyze structure using finite element method,
4. Solve realistic engineering problems through computational simulations using finite element code,

List of Experiments/ Tutorials:

Tutorial work shall consist of solution of at least five problems from each topic out of which atleast half of problems shall be checked by use of standard software.

Major Equipment/Software: ---

STAAD-Pro, SAP2000, ETABS, ABACUS, ANSYS

List of Open Source Software/learning website:

https://ndl.iitkgp.ac.in/

http://nptel.ac.in/

www.mastan2.com/

www.scilab.org/

http://www.code-aster.org/forum2/ (For open source FEA program Code_Aster)

http://www.calculix.de (For open source FEA program Calculix)

http://www.openfoam.org (For open source FEA program OpenFOAM)