

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING COMPUTATIONAL MECHANICS SUBJECT CODE: 2160609 B.E. 6th SEMESTER

Type of course: Applied Mechanics

Prerequisite: Mechanics of Solids, Structural Analysis-I& II

Rationale: This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Stiffness Method: Types of skeletal structures, Internal forces and deformations. Introduction and applications of stiffness member approach to analyze beams, Trusses, plane frames and grids.	14	40
2	Stiffness Method (Special topics) Various secondary effects like deformation of support, prestrain & temperature. Symmetry/Anti-symmetry, Oblique, supports Elastic supports, Axial-flexural interaction. Analysis of Composite structures having combination of different type of members.	10	20
3	Nonlinear problems in solid mechanics Material and geometric nonlinearities, Solution techniques for nonlinear equations: Newton-Raphson method.	06	10
4	Finite Element method Theory of Stresses: State of stress and strain at a point in two and three dimensions, stress and strain invariants, Hook's law, Plane stress and plain strain problems. Equations of equilibrium, boundary conditions, compatibility conditions. Introduction and Application of FEM to One dimensional (bar & beam) problems & two dimensional problems using Constant strain triangles.	12	30
5	Computer Software Application Application to skeletal structure and 2D problems using professional	During Laboratory/ Tutorial Hours	

software like STAAD/SAP etc. Pre-processing, Post-processing, Modelling aspects, Type of analysis (linear, non-linear), Result interpretation.	20
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Gere & Weaver; Matrix Analysis of framed structures, CBS Publications
2. Bhavikatti; Finite Element Analysis, New Age International Publishers
3. Desai & Abel; Finite Element Method, Tata Mcgraw hill
4. Meghre & Deshmukh; Matrix Analysis of Structures, Charotar Publication
5. A First Course in the Finite Element Method – D. L. Logan
6. Elements of Matrix and Stability Analysis of Structures by Manicka Selvam

Course Outcome:

After learning the course the students should be able to:

1. Apply equilibrium and compatibility equations to determine response of statically determinate and indeterminate structures.
2. Determined is placements and internal forces of statically indeterminate structures by matrix methods.
3. Understanding software applications in analysis of complex and skeleton structures

Term-Work:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial and verify using professional software.

Practical examinations shall consist of oral based on term-work and solving (modeling, analysis & result interpretation) one problem using professional software.

1. Analyze multi-storied plane frame structure considering all possible types of load cases using professional software.
2. Prepare computer program using any programming language (like C/C++/Fortran/MATLAB etc.) for matrix method for various types of skeleton problem/Finite element problem.
3. Prepare spread sheet for analyzing structures using matrix method with help of MS-Excel.

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/

ACTIVE LEARNING ASSIGNMENTS: 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.