

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2024

Subject Code:3172008

Date:30-11-2024

Subject Name: Finite Element Analysis

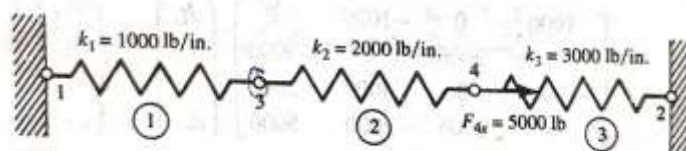
Time:10:30 AM TO 01:00 PM

Total Marks:70

Instructions:

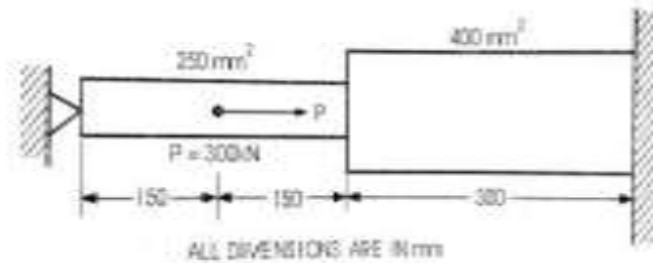
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) Define finite element analysis (FEA) and explain its significance in engineering applications	03
	(b) Compare and contrast finite element analysis with other numerical methods commonly used in engineering analysis.	04
	(c) Give the derivation of the Stiffness Matrix for a Bar Element in Local Coordinates.	07
Q.2	(a) Describe the role of boundary conditions in finite element analysis. How do boundary conditions influence the accuracy of FEA results?	03
	(b) Define the terms "element" and "node" in the context of finite element analysis. How are these fundamental components utilized in constructing a finite element model?	04
	(c) Discuss the importance of a shape function. Derive the shape function for a spring element highlighting its significance.	07
	OR	
	(c) Obtain the total potential energy of the spring assemblage for given fig. and find its minimum value. The procedure of assembling element equation can then be seen to be obtain from the minimization of the total potential energy.	07



Q.3	(a) Explain the significance of axial force and displacement in a bar element. How are these quantities related through Hooke's Law?	03
	(b) Describe the process of applying boundary conditions to a finite element model containing bar elements. Discuss the implications of fixed and free boundary conditions on the solution.	04

- (c) A stepped is subjected to axial loads as shown in following fig. Determine the nodal displacement. 07



OR

- Q.3 (a) Explain why truss elements are often referred to as one-dimensional elements. 03
- (b) Describe a scenario where truss elements would be suitable for structural analysis. And discuss one limitation of truss elements in modeling complex structures 04
- (c) Discuss the formulation of stiffness matrix for a linear truss element. Include the governing equations and the method used to derive the stiffness matrix 07

- Q.4 (a) Explain the concept of distributed loads and point loads in the context of beam elements. How are these types of loads applied to beam elements in finite element analysis? 03
- (b) Discuss the role of dynamics in analyzing structures using FEA. 04
- (c) Establish the shape functions and derive the strain displacement matrix for an axisymmetric triangular element. 07

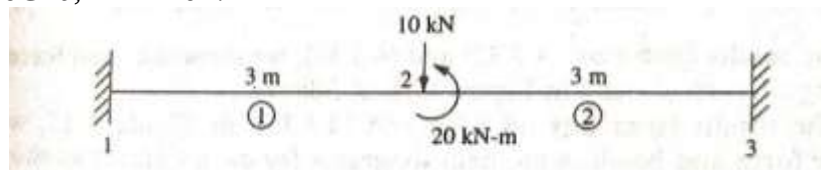
OR

- Q.4 (a) Differentiate between dynamics and statics in FEA. 03
- (b) Differentiate between spring, bar and beam elements from general and application point of view. 04
- (c) Give Potential Energy Approach to Derive Beam Element Equations. 07

- Q.5 (a) Discuss the significance of element distortion and element aspect ratio in CST element analysis. How can distorted elements affect the accuracy of results? 03
- (b) Explain in brief : CST & LST 04
- (c) Discuss the Isoparametric formulation for a bar element 07

OR

- Q.5 (a) Prove: "Higher number of elements leads to getting a solution closer to the exact one" 03
- (b) Determine the global element stiffness matrix for given problem: $E = 210\text{GPa}$, $I = 4 \times 10^{-4}$. 04



- (c) Compare and Contrast: Plane stress and Plane strain conditions with suitable example. 07
