

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII EXAMINATION – SUMMER 2025

Subject Code:3172008

Date:16-05-2025

Subject Name:Finite Element Analysis

Time:02:30 PM TO 05:00 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) Write the various application of Finite Element Analysis.	03
(b) Define the h , p , r and hp refinement.	04
(c) Discuss the steps of Finite Element Method.	07
Q.2 (a) List out limitations of Finite Element Analysis.	03
(b) Draw the two 2D and 3D types of finite element.	04
(c) Derive the element stiffness matrix for 1D problem..	07
OR	
(c) For the spring assemblage with arbitrarily numbered nodes shown in following Figure 1, obtain (a) the global stiffness matrix, (b) the displacements of nodes 3 and 4 and (c) the reaction forces at nodes 1 and 2. A force of 5000 lb is applied at node 4 in the x direction. The spring constants are given in the figure. Nodes 1 and 2 are fixed.	07

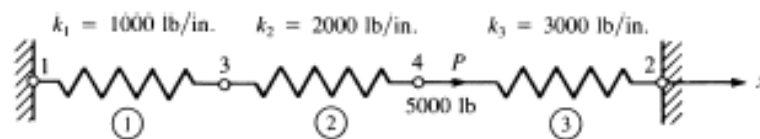


Figure 1

Q.3 (a) Clarify the meshing convergence.	03
(b) Discuss the penalty approach in short.	04
(c) Analyse the following truss as shown in Figure 2. The cross-sectional area of each member is $6 \times 10^{-4} \text{ m}^2$ and the modulus of elasticity is 210 GPa. Determine the displacements and stresses in each of the members.	07

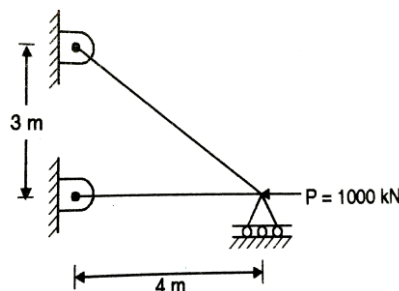


Figure 2

OR

- Q.3** (a) What is the significance of node numbering? **03**
(b) Derive the element stiffness matrix of truss element. **04**
(c) A tapered bar 1200 mm long, having cross-sectional area 450 mm² at one end and 150 mm² at other end is fixed at the larger end. It is subjected to an axial load of 35 kN. Calculate the displacements, on a model bar having three finite elements 400 mm long. Assume modulus of elasticity, $E = 2 \times 10^5$ N/mm². **07**

- Q.4** (a) Define Plane Stress and Plane Strain problem for the FEA. **03**
(b) Derive the additional load vector and the stress under temperature effect for the truss element. **04**
(c) Derive the element stiffness matrix of a CST element for plane stress condition. **07**

OR

- Q.4** (a) Write the shape functions for a beam element. **03**
(b) Write the four shape function equations for a beam element. **04**
(c) Using the direct stiffness method, solve the problem of the propped cantilever beam subjected to end load P in Figure 3. The beam is assumed to have constant EI and length 2L. It is supported by a roller at mid length and is built in at the right end. Propped cantilever beam shown in below Figure 3 **07**

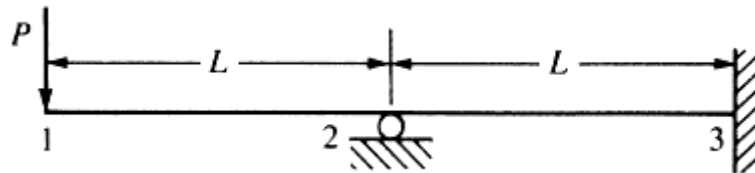


Figure 3

- Q.5** (a) Write the Lumped and Consistent Mass matrix. **03**
(b) Discuss the role of dynamic analysis in FEA. **04**
(c) List out various software used in FEA and discuss about its pre-processor, processor and post-processor. **07**

OR

- Q.5** (a) Write the point force, body force and surface traction force using natural coordinate system. **03**
(b) List out applications of the axisymmetric elements. **04**
(c) Derivation of the Linear-Strain Triangular Element Stiffness Matrix **07**
