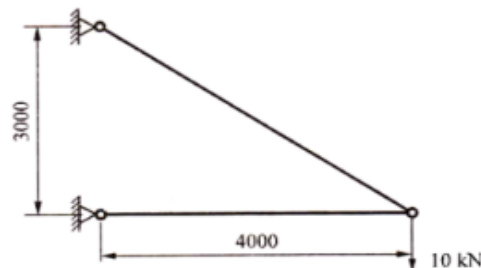


GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2023****Subject Code:3172008****Date:08-12-2023****Subject Name: Finite Element Analysis****Time: 10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

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.

- Q.1** (a) Explain the different types of Elements used in Finite Element Analysis **03**
 (b) What do you mean by 'Discretization'? State precautions required during discretization. **04**
 (c) Explain general steps of the Finite Element Method in detail. **07**
- Q.2** (a) Derive element stiffness matrix for 1D bar element. **03**
 (b) Explain in brief: CST & LST. **04**
 (c) Explain the different types of nonlinearities with appropriate examples. **07**
- OR**
- (c) What is shape function? Derive linear shape functions for 1- dimensional bar element in terms of natural coordinate. Also plot variation of shape functions within this element. **07**
- Q.3** (a) What are the properties of the Stiffness matrix? **03**
 (b) Explain penalty approach used to solve FEA problem **04**
 (c) Discuss the importance of dynamics in Finite Element Analysis. Also explain the different types of nonlinearities. A two-member truss is as shown in Fig. The cross-sectional area of each member is 200 mm^2 and the modulus of elasticity is 200 GPa. Determine the deflections, reactions in each of the members. **07**

**OR**

- Q.3** (a) How does axis symmetric differ from planer symmetry? **03**
 (b) Compare Finite Element Solution to the Exact Solution for a Beam. **04**
 (c) Discuss the different types of elements used in FEA with its application. **07**
- Q.4** (a) Differentiate between plane stress and plane strain **03**
 (b) What are the merits and demerits of FEA as compared to other conventional methods? **04**
 (c) Derive stiffness matrix for an axial bar element using direct stiffness matrix. State the properties of global stiffness matrix. **07**
- OR**
- Q.4** (a) Discuss "Higher number of elements leads to getting a solution closer to the exact one" **03**

- (c) Consider an axial bar element with a length of 2 meters and a cross-sectional area of 0.01 square meters. The material has a Young's modulus of 200 GPa. The bar is subjected to a tensile force of 50 kN at its ends. Calculate the displacement at each node and the axial stress in the bar.. 07

- Q.5** (a) Explain evaluation of Eigen values and eigenvectors in dynamic consideration. 03
- (b) Differentiate between spring, bar and beam elements from general and application point of view. 04
- (c) Consider the Bar as shown in figure 1. Take modulus of elasticity of the bar material. $E=200 \times 10^9 \text{ N/m}^2$. Determine the nodal displacement, elements stresses and support reaction using elimination approach. 07

OR

- Q.5** (a) What are the ways which 3D problems can be reduced to a 2D approach? 03
- (b) Explain the significance of the following terms related to a Finite Element Problem (i). Approximation function (ii). Boundary conditions 04
- (c) Write down the expression of shape function N and displacement u for one dimensional bar element. 07

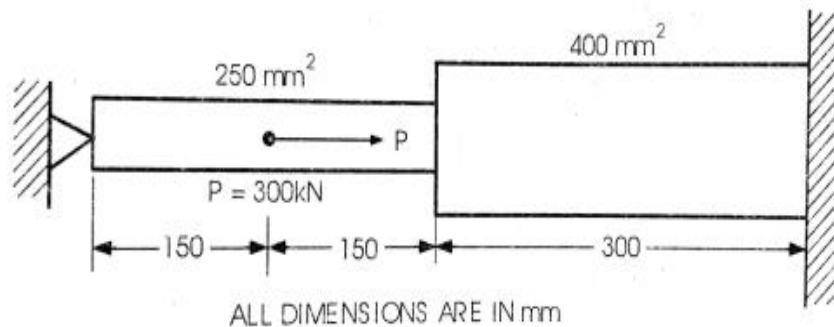


Figure 1 Q.5 (C)