Enrolment No./Seat No________________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2025

Subject Code:3171920 **Date:14-05-2025**

Subject Name:Finite Element Methods

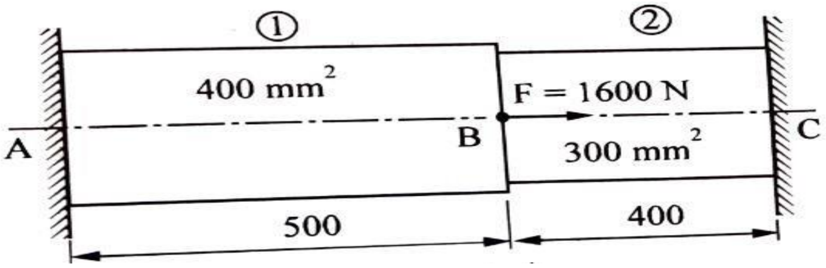
Time:02:30 PM TO 05:00 PM **Total Marks:70**

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.**

Q.1	**(a)**	Enlist different types of 1D element with their applications.	**03**
	(b)	Explain the Rayleigh-Ritz method for finding an approximate solution to the engineering problems.	**04**
	(c)	Classify the different boundary condition & explain it in detail.	**07**
Q.2	**(a)**	Why FEA gives an approximate solution.	**03**
	(b)	Do you understand by discretization? What are the factors to be considered for discrediting the domain?	**04**
	(c)	For the compound section as shown in figure fixed at both ends, estimate reactions at both ends and stresses when a force of 1600 N is applied at the change of cross section. Use penalty approach.	**07**

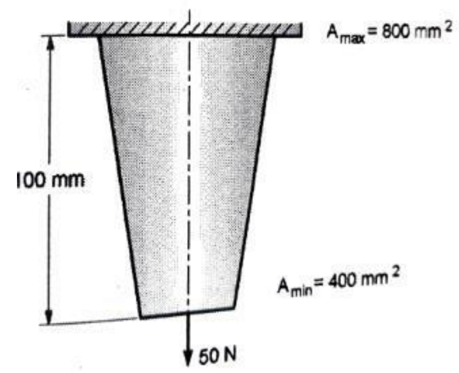
Component	AB	BC
MATERIAL	COPPER	ALUMINIUM
CROSS SECTIONAL AREA	400 mm2	300 mm2
Length	500 mm	400 mm
Young's Modulus (Gpa)	125	80



OR

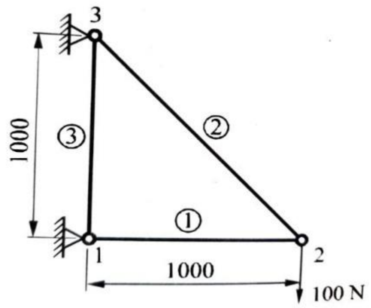
	(c)	Derive element stiffness matrix for 1 D bar element & Derive Element Stiffness Matrix for a Spring Element.	**07**
Q.3	**(a)**	Explain symmetric banded matrices and skyline matrices.	**03**
	(b)	Explain local and global coordinate system for truss element?	**04**

(c) A tapered plate made of steel (E=2 * 105 Mpa) is loaded as shown in figure. Model the bar using two linear spar elements and determine the nodal displacements



OR

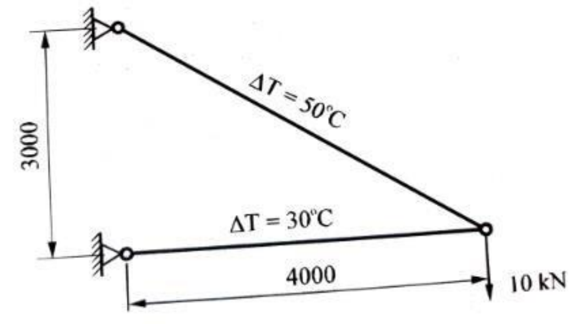
Q.3	**(a)**	Differentiate between plane stress and plane strain.	**03**
	(b)	Explain the properties of stiffness matrices.	**04**
	(c)	Evaluate the deflection at node 2 for the truss element shown in figure. Take AE/L value as 1000 N/mm.	**07**



Q.4	**(a)**	Differentiate between CST and LST.	**03**
	(b)	A constant stain triangular element is defined by three nodes 1(1.5,2), 2(7,3.5) and 3(4,7).Evaluate the shape functions N1,N2, and N3 at the interior point P (3.85,4.8).	**04**
	(c)	Illustrate the Plane Frames element with neat sketch indicating degree of freedoms. How it is differed from beam element. Write element stiffness matrix K ,transformation matrix L and load vector F.	

OR

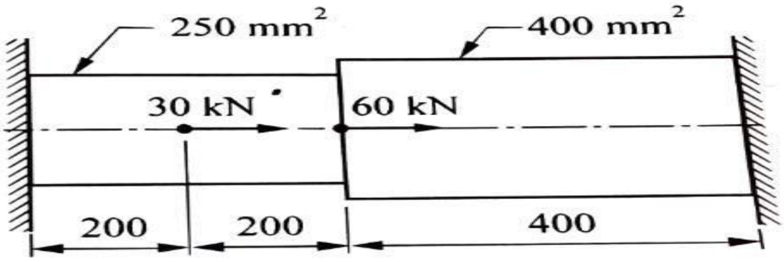
Q.4	**(a)**	Enlist three examples of practical application of axisymmetric element.	**03**
	(b)	What are the conditions necessary to be followed for considering a problem as axisymmetric?	**04**
	(c)	Determine the global stiffness matrix and global load vector in the truss shown in figure. The cross-sectional area of each member is 200 mm^2 and modulus of elasticity is 200 GPa. Assume α = 12 * 10-6 per °C.	**07**



Q.5 **(a)** Explain Constant Strain Triangle. **03**

(b) How are the thermal effects considered in the analysis of 1 d linear elements? **04**

(c) Consider the bar as shown in figure. Determine the global stiffness matrix and global load vector, if the temperature rises by 60°C.Assume modulus of elasticity for the complete bar as 200 GPa and coefficient of thermal expansion as 12 * 10-6 per °C. **07**



OR

Q.5 **(a)** What are the ways through which 3D problems can be reduced to a 2D approach? **03**

(b) Define Isoparametric element. **04**

(c) For the indicated beam in figure determine the global stiffness matrix. Take product of young's modulus and moment of inertia as 400*103 N-m2. **07**