Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 3171920 Date: 23/06/2023

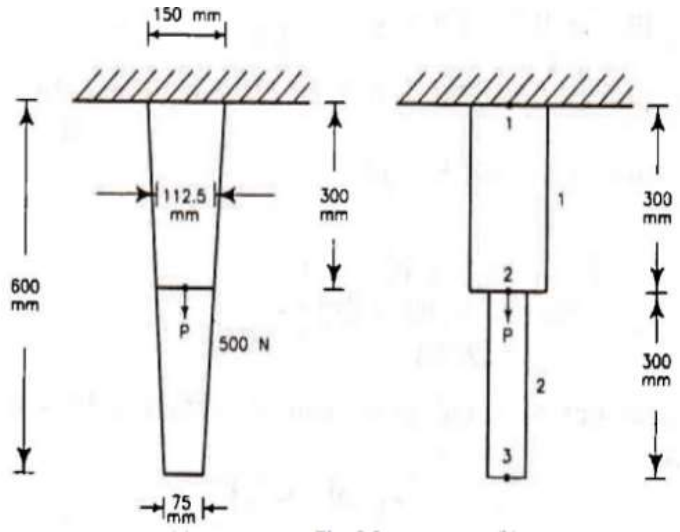
Subject Name: Finite Element Methods

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)**	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)	What do you understand by discretization? What are the factors to be considered for discrediting the domain?	**04**
	(c)	Explain engineering applications of the finite element method.	**07**
		OR	
	(c)	A thin plate as shown in Fig. has uniform thickness of 2 cm and its modulus of elasticity is 200 x 10^3 N/mm^2 and density 7800 kg/m^3. In addition to its self-weight the plate is subjected to a point load P of 500 N is applied at its midpoint. Solve the following: (i) Finite element model with two finite elements. (ii) Global stiffness matrix. (iii) Global load matrix. (iv) Displacement at nodal point. (v) Stresses in each element. (vi) Reaction at support.	**07**



Q.3	**(a)**	Explain symmetric banded matrices and skyline matrices.	**03**
	(b)	Explain local and global coordinate system for truss element?	**04**
	(c)	Explain general procedure of finite element method	**07**
		OR	
Q.3	**(a)**	Differentiate between CST and LST.	**03**

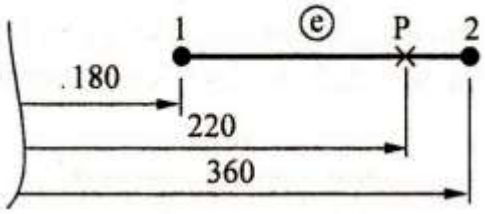
(b) A constant stain triangular element is defined by three nodes 1(1.5,2), 2(7,3.5) and 3(4,7). Evaluate the shape functions N1,N2, and N3 at the interior point P (3.85,4.8). **04**

(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. **07**

Q.4 **(a)** What are the ways through which 3D problems can be reduced to a 2D approach? **03**

(b) Define Iso-parametric element. **04**

(c) Consider an element having a linear shape function shown in fig. Evaluate the natural coordinate and shape functions for point P. If the displacement at Node 1 and Node 2 are 2 mm and -1 mm respectively, determine the value of displacement at point P. Also determine in global terms the point where the displacement would be zero. Also determine the shape function at zero displacement point. **07**

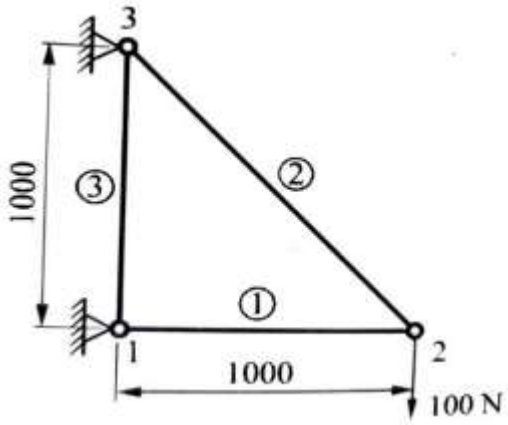


OR

Q.4 **(a)** Obtain the stress-nodal relationship for the one-dimensional elements. **03**

(b) State and describe various boundary conditions used in engineering problems. **04**

(c) Evaluate the deflection at node 2 for the truss element shown in figure. Take AE/L value as 1000 N/mm. **07**

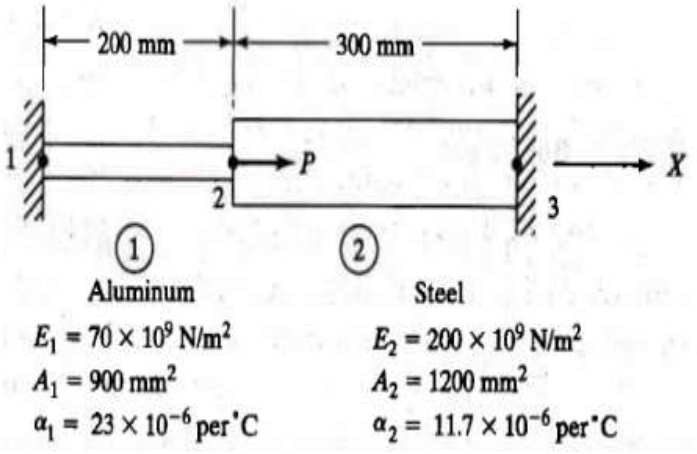


Q.5 **(a)** Explain Constant Strain Triangle. **03**

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

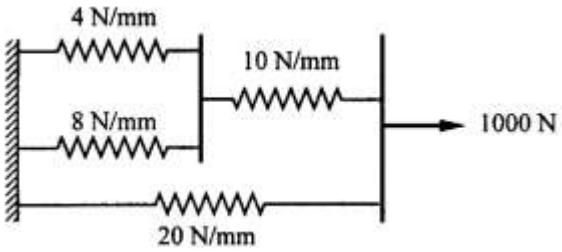
(c) An axial load P = 300 x 10^3 N is applied at 20°C to the rod as shown in Fig. The temperature is then raised to 60°C. **07**

(a) Assemble the K and F matrices. (b) Determine the nodal displacements and element stresses.



OR

Q.5	**(a)**	Enlist three examples of practical application of axisymmetric element.	**03**
	(b)	Discuss different types of analysis for FEM. Also mention advantage and limitation s of FEM.	**04**
	(c)	shows a cluster of four springs. One end of the assembly is fixed and a force of 1000 N is applied at the end. Using the finite element method, determine: (a) The deflection of each spring. (b) The reaction forces at support.	**07**



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