Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– II(Old course) • EXAMINATION (Remedial) – WINTER- 2015

Subject Code: 1721501 **Date: 09/12/2015**

Subject Name: Finite Element Method

Time:2:30 pm to 5:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Give the general steps included in a finite element method formulation. Explain principle of discretization.	**07**
	(b)	Derive the load vector for a two noded bar element having length óLô, loaded with uniformly distributed along the length.	**07**
Q.2	**(a)**	For the two-bar truss shown in fig.1, determine the displacement of node 1 and the axial force in each element. E = 210 GPa and A = 6×10^{-4} m^2.	**07**
	(b)	Derive the shape function for 3-noded bar element of length óLô, having intermediate node at centre of the bar.	**07**
		OR	
	(b)	Derive the expression for shape function for a 2-noded bar element using natural coordinate ε varying from ï 1 to 1.	**07**
Q.3	**(a)**	What is displacement function? Explain about choice of displacement function for 1D & 2D element.	**07**
	(b)	Compute axial displacement of a steel tapered rod of 1.0 m length, 20 mm diameter at free end and 40 mm diameter at fixed end. The rod is subjected to axial tensile force of 100 kN. Discretize the rod in to 2-noded 2-element. E=200 GPa.	**07**
		OR	
Q.3	**(a)**	Derive the coefficient k_{11} of the element stiffness matrix of a beam element.	**07**
	(b)	Determine the slopes at node 2 & 3 for the beam shown in fig. 2. E = 200 GPa and I = 4.0×10^6 m^4.	**07**
Q.4	**(a)**	Evaluate the stiffness matrix for the 10 mm thick element shown in fig. 3. The coordinates are given in units of millimeters. Assume plane stress conditions. E = 210 GPa, ε = 0.25.	**07**
	(b)	Determine the element stresses $\mathring{u}_x$, $\mathring{u}_y$, $\acute{U}_{xy}$ for the element given in Q.4(a), the nodal displacements are given as u_1 = 2.0 mm, v_1 = 1.0 mm, u_2 = 0.5 mm, v_2 = 0.0 mm, u_3 = 3.0 mm, v_3= 1.0 mm	**07**
		OR	
Q.4	**(a)**	Determine shape functions for the Constant Strain Triangle (CST).	**07**
	(b)	For the one-dimensional bar fixed at both ends and subjected to a uniform temperature rise T = 50°C, determine the reactions at the fixed ends and the axial stress in the bar. Use 2-noded 2-element for the analysis. E = 2×10^5 N/mm^2, A = 25 mm^2, L = 2 m, Ŭ= 2×10^{-5} /°C.	**07**
Q.5	**(a)**	Define axisymmetric element. Discuss type of stresses & strains induced in axisymmetric element.	**07**

(b) Derive strain displacement matrix for axisymmetric element shown in fig.4. The coordinates (in millimeters) are shown in the figure. E = 200 GPa, ε = 0.25. **07**

OR

Q.5 **(a)** Derive the consistent mass matrix for dynamic analysis of one dimensional bar element having modulus of elasticity E, mass m, density ɟ and cross sectional area A. **07**

(b) Which are the steps of finite element analysis for the computer implementation? Explain each step in brief. **07**

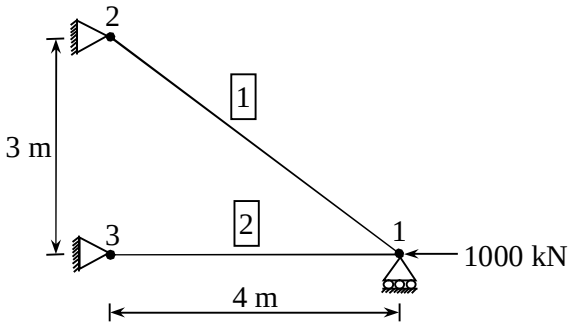

Fig. 1 Q-2(a)

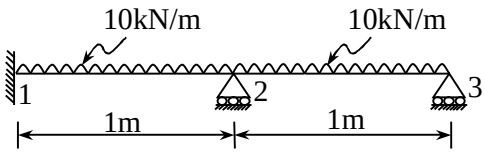

Fig. 2 Q-3(b) OR

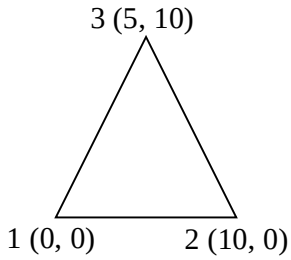

Fig. 3 Q-4(a),(b)

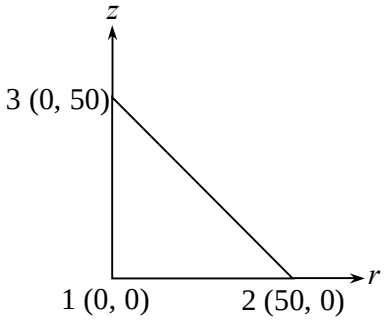

Fig. 4 Q-5(b)

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