Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2014

Subject code: 1724301 Date: 02-12-2014

Subject Name: Finite Element Method in Geotechnical Engineering

Time: 02:30 pm - 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.**

Q.1	**(a)**	Explain the process of discretization in the finite element analysis.	**07**
	(b)	Derive the expression of shape functions for a 3-noded bar element element.	**07**
Q.2	**(a)**	Derive and draw the shape functions for the Constant Strain Triangle.	**07**
	(b)	Derive element stiffness matrix for a plane truss element in global coordinates.	**07**
		OR	
	(b)	Determine nodal displacements for fixed beam of length 2m subjected to uniformly distributed load 10 kN/m. Consider 2-noded two element. The beam is assumed to have constant EI.	**07**
Q.3	**(a)**	Give convergence criteria and show that whether the displacement function of beam element satisfy it or not.	**05**
	(b)	Determine nodal displacements and element stresses for plane truss shown in *fig.-1*. The axial rigidity of both the members is EA.	**09**
		OR	
Q.3	**(a)**	Give use of Pascleôs triangle and tetrahedron in deciding the displacement function of the element.	**05**
	(b)	The metalic fin shown in *fig.-2* is insulated on the perimeter. A positive heat flux of q=2500 W/m^2 acts on the right end and the left end has a constant temperature of 90^o C. The thermal conductivity of the element, k_{xx} = 5W/(m ^oC) and cross-sectional area A = $0.1m^2$. Determine the temperatures at 0.15 m and 0.3m.	**09**
Q.4	**(a)**	Justify the name of the CST element.	**05**
	(b)	The 3 noded triangular element is shown in *fig.-3*. Determine element stiffness matrix and element stresses for the element. Take plane stress conditions, E = 2×10^5 MPa, ε = 0.25, and thickness t = 10 mm. Assume the element nodal displacements $u_1 = 0$, $v_1 = 2$ mm, $u_2 = 1$mm, $v_2 = 0$, $u_3 = 0$, and $v_3 = 2$ mm. The coordinates shown in the figure are in mm.	**09**
		OR	
Q.4	**(a)**	Explain with illustration, plane stress and plane strain problems. Give elasticity matrix of both types of problem.	**05**
	(b)	Obtain strain displacement matrix for the CST element with nodal coordinates are as follows: Node-1 (0, ī 5), Node-2 (5, 0) and Node-3 (0, 5).	**09**
Q.5	**(a)**	Give name of various softwares used in finite element analysis. Also give various features generally available in the pre processor and post processor of such software.	**07**
	(b)	Determine natural frequencies of 2 noded bar element fixed at one end and free at other end having length *l*, modulus of elasticity E, mass density ɟ, and cross-sectional area A. Take two element and lumped mass matrix.	**07**
		OR	
Q.5	**(a)**	Explain Isoparametric element. Derive shape function for 4 noded quadrilateral element considering isoparametric element.	**07**

(b) Determine Jacobian matrix at the centre of the quadrilateral element have nodal coordinates of node 1, 2, 3 & 4 are (7,1), (6,9), (-2,5) and (0,0) respectively. **07**

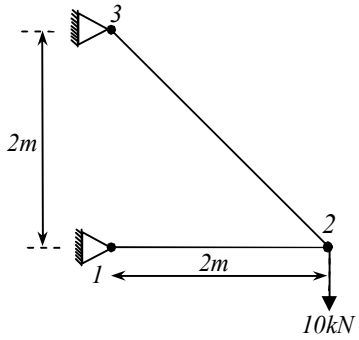

Fig. 1 Q-3(b)

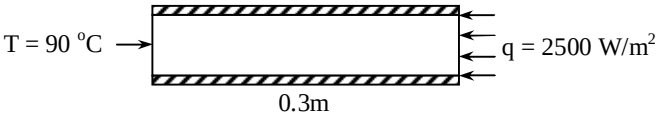

Fig. 2 Q-3(b) OR

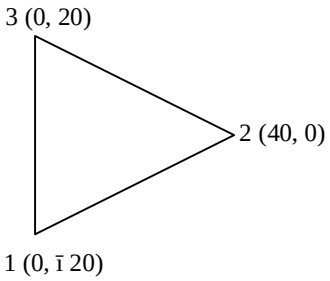

Fig. 3 Q-4(a)

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