Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 1724301 **Date: 09/12/2015**

Subject Name: Finite Element Method In Geotechnical Engineering

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)**	Explain the process of Discretization in the Finite Element method	**04**
	(b)	Derive the shape function for a 3 noded bar element having node at 0, 0.3L & L. Take EA is constant. Also find out load vector, if it is subjected to surface traction force of 25 kN/m on its full length.	**10**
Q.2	**(a)**	Give use of Pascal triangle in selection of displacement function and write displacement function for six noded triangular plane stress element.	**07**
	(b)	Compute axial displacement of a tapered rod of 20 mm diameter at free end and 40 mm diameter at fixed end and having length of 1.5 m. The rod is subjected to 50 kN at free end. Take 2 noded two elements.	**07**
		OR	
	(b)	For a spring assemblage shown in ***fig.-1***, calculate displacement at nodes and reactions at supports. Take K=100 kN/m.	**07**
Q.3	**(a)**	Explain C^0 and C^1 continuity with illustrations	**04**
	(b)	Determine displacement in the two span continuous beam as shown in ***fig.2*** using finite element method. Consider two noded beam element whose shape function N is { $1-3S^2+2S^3$, $L(S-2S^2+S^3)$, $3S^2-2S^3$, $L(S^3-S^2)$}, where S=X/L.	**10**
		OR	
Q.3		For the plane truss shown in ***fig.-3***, determine the nodal displacements and stresses in each element. All elements have E = 70 GPa, L=500 mm and A = 200 mm^2.	**14**
		OR	
Q.4	**(a)**	Explain plane stress and plane strain problems and differentiate [D] matrix (constitutive matrix) of both the types of problems.	**06**
	(b)	A CST element having nodal coordinates of (3,0), (12,8) and (0,4) has nodal displacement vector $[u]^T = [0, 0, 3, 4.5, 3, 0]^T$ in mm. A concentrated load of 100 kN is applied at the centroid in the direction of unit vector 9i+40j. Compute nodal forces. Take E=200 GPa & poison's ratio μ = 0.25 and thickness of element is 4 mm.	**08**
		OR	
Q.4		Derive the coefficient K_{22} of the stiffness matrix of a 4 noded isoparametric quadrilateral element whose nodal coordinates are (0,0), (120,50), (90,90) & (0,90) in mm. Take thickness of element is 10 mm. Take 2x2 point Gauss quadrature.	**14**

Q.5 (a) Discuss Isoparametric, Superparametric & Subparametric element. **06**

(b) Derive Jacobian matrix, J and stress, σ at ε=0 and η=0 for a four noded isoparametric quadrilateral element having nodal coordinates of node 1,2 3 & 4 are (0,0), (50,0), (50,23) and (0,25) respectively and nodal displacements are q^T ={ 0, 0, 0.05, 0.075, 0.15, 0.08, 0, 0}^{T} in mm. Take E = 200 x 10^5 N/mm^2. **08**

OR

Q.5 A furnace wall is made of 200 thick fire bricks (K=1.23x 10^{-3} KW/m ^{0}C), insulated bricks having 100 mm thickness (K=0.5x 10^{-3} KW/m ^{0}C) and 150 mm thick red bricks (K=0.85x 10^{-3} KW/m ^{0}C). If inner temperature near fire bricks is 1500 ^{0}C and at outer face of red brick is 50 ^{0}C, determine and draw internal temperature distribution. Neglect losses. **14**

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FIGURES

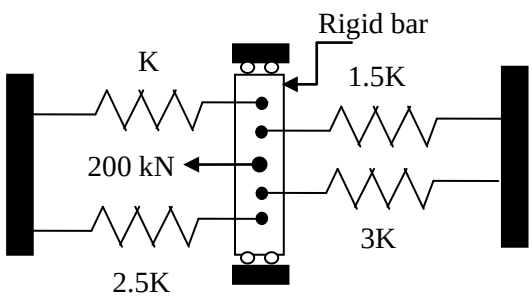

Fig. 1

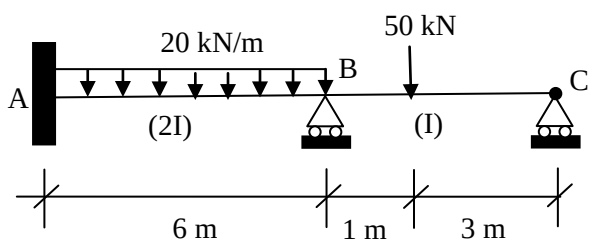

Fig. 2

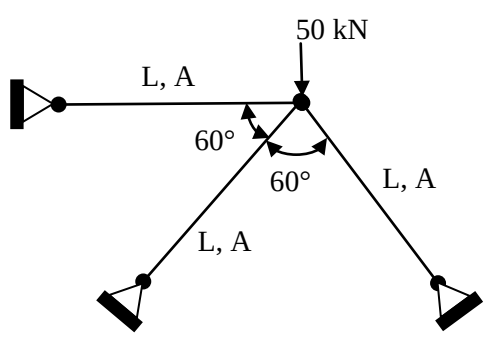

Fig. 3