Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– II (Old course)• REMEDIAL EXAMINATION – SUMMER 2015

Subject Code: 1722001 **Date:12/05/2015**

Subject Name: Finite Element Method

Time: 02:30 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)**	Distinguish between a plane stress and plane strain problem with suitable examples. Also give their strain stress linking matrices.	**07**
	(b)	Using FEM, determine nodal displacements and reaction forces for bar subjected to torque shown in Fig. 1. The polar moment of inertia of AB, BC and CD part is 5 x 10^7 mm^4, 3 x 10^7 mm^4 and 4 x 10^7 mm^4, respectively. Take shear modulus = 8.0 x 10^7 kN/m^2.	**07**
Q.2	**(a)**	Explain the terms: Constant strain triangle, Linear strain triangle and Quadratic strain triangle.	**07**
	(b)	Discuss the use of Pascalôs triangle for selection of the displacement function. Also give the various examples for the same giving convergence criteria.	**07**
		OR	
	(b)	Using the theorem of minimum potential energy, derive expression for element stiffness matrix K.	**07**
Q.3		A constant strain triangle element has the three nodes as (0,0), (4,0) and (4,4). Calculate the Stiffness matrix for the element to be used in plane stress analysis. Assume E= 200kN/mm^2, thickness = 25 mm and Poissonôs ratio as 0.25.	**14**
		OR	
Q.3	**(a)**	Using natural co-ordinate system, list and draw, the shape functions and its variation, for four nodded plate element.	**07**
	(b)	Discuss the various uses of Jacobean matrix. For a four nodded plate element having four nodes at (0,0), (4,1), (4,3) and (0,2) calculate the Jacobean matrix using one point integration. (All dimensions are in meters.)	**07**
Q.4	**(a)**	Define axi-symmetric element. Give the various strains those are to be considered for the same. Also give some real life structures those can be solved by axi-symmetric element	**07**
	(b)	Calculate strain-displacement matrix for axisymmetric element. The *r*- and *z*-coordinates of the nodes of triangular element are (0, 0), (3, 0) and (1.5, 1.5). Take modulus of elasticity = 200GPa, Poissonôs ratio = 0.25. The dimension of coordinates is in meter.	**07**
		OR	
Q.4	**(a)**	Derive the expressions for natural coordinates for a two-noded element in terms of natural coordinate ξ, when range is -1 to 1.	**07**
	(b)	Derive the shape functions for a three-noded bar element using polynomial form in local coordinates.	**07**
Q.5	**(a)**	Derive stiffness matrix for beam element using general finite element approach.	**07**

(b) For the beam and loading as shown in Fig. 2, where E = 200 GPa and I= 5.5 x 10^6 m^4. Determine slope at B and C. **07**

OR

Q.5 **(a)** Write short note on óHermite Polynomialô. **07**

(b) A three-nodded axial member has three nodes at x=0, x=2 and x=4m. Derive the shape functions using Lagrange interpolation functions and hence derive the stiffness matrix for the same. **07**

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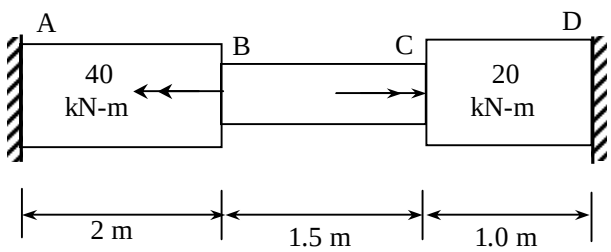

Figure 1

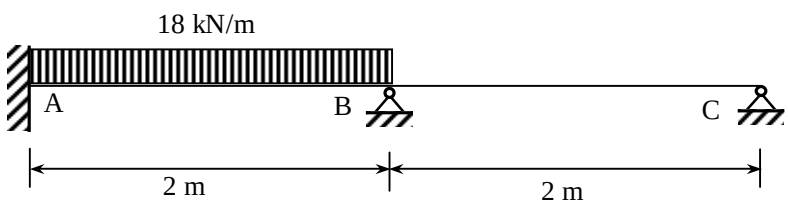

Figure 2