Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013

Subject code: 1722001 **Date: 24-12-2013**

Subject Name: Finite Element Method

Time: 10.30 am – 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.**

Q.1 **(a)** Evaluate the stiffness matrix for the constant strain triangle element having three nodes at (1, 0), (4, 0) and (1, 4). The value of Modulus of Elasticity = 2×10^{11} N/m^2, Poisson's ratio = 0.3 and thickness of element = 8 mm. Assume plane stress conditions. The coordinates of the nodes are shown in units of metres. **07**

(b) Give advantages and disadvantages of Finite Element Method. **07**

Q.2 **(a)** Ejtdvtt!xjui!jmmvtusbujpo!Ejtdsfuj{bujpo!qspdftt/ **07**

(b) Derive the load vector for two-noded bar element if it is loaded with (i) uniformly distributed load along its length and (ii) uniformly varying load along its length. **07**

OR

(b) Describe pre-processing and post-processing capabilities of any software used for Finite element analysis. **07**

Q.3 Determine the nodal displacements at node B, stresses in each part and support reactions in the bar shown in Fig. 1, due to applied axial force of 80 kN and uniform temperature rise of 20^0C. The cross sectional area of AB and BC part is 1000 mm^2 and 2700 mm^2, respectively. Modulus of elasticity of AB and BC part is 0.7×10^5 MPa and 2×10^5 MPa, respectively. The coefficient of thermal expansion of AB and BC part is 22×10^{-6} /^{0}C and 12×10^{-6} /^{0}C, respectively. **14**

OR

Q.3 **(a)** Using FEM, determine nodal displacements and reaction forces for a bar subjected to torque shown in Fig. 2. The polar moment of inertia of AB and BC part is 2×10^7 mm^4 and 3×10^7 mm^4, respectively. The shear modulus of both parts is 8×10^7 kN/m^2. **07**

(b) (i) Enlist any five softwares used for Finite Element Analysis and (ii) enlist 2-D elements used by *ANSYS* or other software.! **07**

Q.4 **(a)** Identify axisymmetric problem. Discuss type of stresses and strains induced in axisymmetric element. **07**

(b) Derive strain displacement matrix for an axisymmetric element shown in Fig. 3. 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 = 210 GPa, Poisson's ratio = 0.22. The coordinates of the nodes are shown in units of metres. **07**

OR

Q.4 **(a)** For the beam and loading as shown in Fig. 4, determine slope at B and C. Take Modulus of Elasticity = 200 GPa and moment of inertia = 4.0×10^6 m^4. **07**

(b) Select a suitable displacement function for a beam element and show that it satisfies the convergence criteria. **07**

Q.5 **(a)** Derive the expressions for natural coordinates in a constant strain triangle element and show that they are nothing but area coordinates. **07**

(b) For a four noded plate element having four nodes at (1, 1), (6, 2), (6, 5) and (1, 4), calculate the Jacobian matrix using one point integration. The coordinates of the nodes are shown in units of metres. **07**

OR

Q.5 **(a)** Vtjoh! jtpqbsbnfusjd! gpsnvmbujpo-! efsjwf! tujggoftt! nbusjy! pg! uxp.opefe!jtpqbsbnfusjd!mjof!)cbs*!fmfnfou/! **07**

(b) Write short note on 'Hermite Polynomial'. **07**

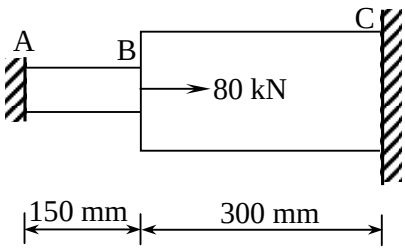

Fig.1

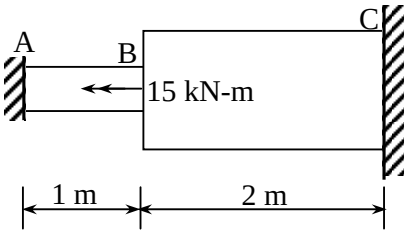

Fig. 2

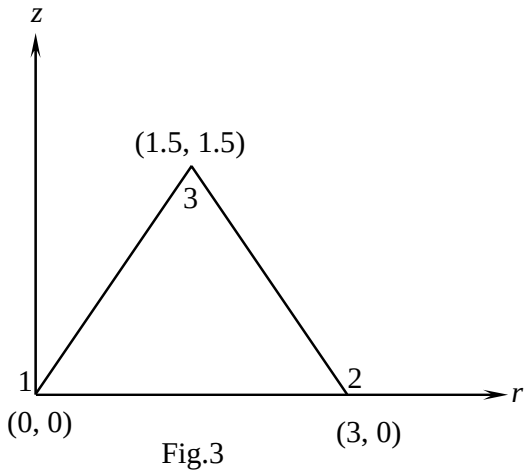

Fig.3

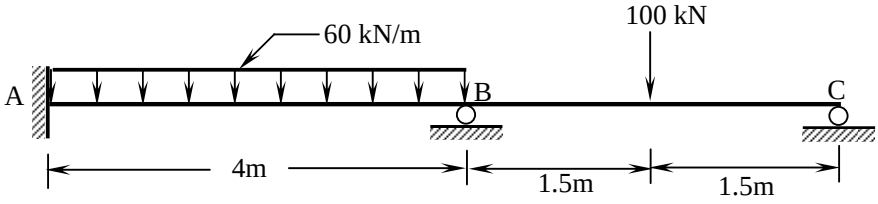

Fig. 4

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