GUJARAT TECHNOLOGICAL UNIVERSITY M. E. - SEMESTER - II • EXAMINATION - WINTER • 2014

Subject code: 1722001

Subject Name: Finite Element Method

Time: 02:30 pm - 05:00 pm

Instructions:

Total Marks: 70

07

Date: 02-12-2014

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- (a) Obtain stiffness matrix for the CST element whose nodal co-ordinates 07 0.1 are as under: Node-1 (3, -2), Node-2 (1, 5) and Node-3 (7,-9). The value of modulus of elasticity = 2×10^{11} N/m2, Poissonøs ratio = 0.3 and thickness of element = 8mm.
 - (b) Explain the terms: Constant strain triangle, Linear strain triangle and 07 Quadratic strain triangle.
- Q.2 (a) Explain the term - shape functions why polynomial terms are preferred 07 for shape functions in finite element method?
 - (b) Derive the load vector for two-noded bar element if it is loaded with 07 uniformly distributed load and uniformly varying load along its length.

OR

- (b) Write short note on pre and post processors.
- Using FEM, determine nodal displacements, elemental stresses and 14 Q.3 reaction forces for a bar subjected to axial force shown in Fig.1. The cross sectional area of AB and BC part is 900 mm² and 2500 mm², respectively. Modulus of elasticity of of AB and BC part is 0.8 x 10⁵ MPa and 2.1 x 10^5 MPa, respectively.

OR

- (a) Using FEM, determine nodal displacements and reaction forces for a 07 Q.3 bar subjected to torque shown in Fig.2. The polar moment of inertia of AB, BC and CD part is $1 \times 10^7 \text{ mm}^4$, $2 \times 10^7 \text{ mm}^4$ and $3 \times 10^7 \text{ mm}^4$, respectively. The shear modulus of both parts is $8.0 \times 10^7 \text{ kN/m}^2$.
 - (b) (i) Computers are mandatory for FEM implementation-Justify. 07 (ii) Describe the analytical capabilities and range of application of ANSYS.
- (a) Discuss the use of axi-symmetric element in finite element method. Give 07 Q.4 various strains to be considered for the same. Also give some real life structures which can be solved by axi-symmetric element.
 - (b) Derive strain displacement matrix for an axisymmetric element. The r-07and z-coordinates of the nodes of triangular element are (0, 1), (4, 0)and (2, 2). Take modulus of elasticity =210GPa, Poissonøs ratio = 0.22. OR
- (a) For the beam and loading as shown in Fig.3 determine slope at B and C, **O.4** 07 where modulus of elasticity = 210 GPa and moment of inertia = 3.5 x 10^{6} m^{4} .
 - (b) Write short note on Hermite Polynomial. 07
- Q.5 (a) Derive the shape functions for a three-noded bar element using 07

polynomial form in local coordinates.

(b) For a four nodded plate element having four nodes at (1,1), (6,2), (6,5) 07 and (1,4) calculate the Jacobean matrix using one point integration. (All dimensions are in meters.)

OR

- Q.5 (a) Derive the expressions for natural coordinates for a two-noded element 07 in terms of natural coordinate , when range is -1 to 1.
 - (b) Select a suitable displacement function for a beam element and show 07 that it satisfies the convergence criteria.



Figure 2

