

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-II Examination July 2010****Subject code: 721501****Subject Name: Finite Element Method****Date: 05 /07 /2010****Time: 11.00am – 1.30pm****Total Marks: 60****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define the term Finite Element and list at least three common types of Finite Element with its shape function. **06**
- (b) Derive the expression for constant load vector which varies linearly from P_1 at node 1 to P_2 at node 2 on a beam element of length L_e using isoparametric concept. **06**

- Q.2** (a) Derive element stiffness matrix of plane truss element. **06**
- (b) For a spring assemblage shown in fig. 1, calculate (1) displacement at node 2 & 3 (2) reaction at node 1 & 4 (3) forces in each spring. **06**

OR

- (b) Find displacement at concentrated load of 50 kN applied at centre of propped cantilever beam of 6 m span. Take $EI=20000 \text{ kN.m}^2$. For a 2 noded beam element, shape function is $\{1-3S^2+2S^3, L(S-2S^2+S^3), 3S^2-2S^3, L(S^3-S^2)\}$, where $S=X/L$. **06**

- Q.3** (a) Derive shape function for a three noded bar element having two nodes at the end and third node at one third of its length. **06**
- (b) A tapered bar of 500 mm depth and width of 20 mm at free end and 40 mm at fixed end is subjected to axial force of 50 kN at free end. Find nodal displacements and element stresses considering minimum two elements. Take thickness of the element is 5 mm & $E=2 \times 10^5 \text{ N/mm}^2$. **06**

OR

- Q.3** (a) Give various convergence criteria to be adopted in the solution of FEM problems. **06**
- (b) For a plane truss shown in fig. 2, determine the nodal displacements and stresses in each element. Take $A= 4.0 \times 10^{-4} \text{ m}^2$ and $E=70 \text{ GPa}$ for all elements. **06**

- Q.4** (a) Define the plane stress and plane strain problems with illustrations. Also mention different parameters differ in both types of problem. **06**
- (b) Derive the strain displacement matrix for three noded 2D element using linear displacement function. **06**

OR

- Q.4** For the triangular element having coordinates of node 1, 2 & 3 in cm are (0,0), (10,0) and (5,10) respectively. The displacement vector $\{u\}^T$ is $\{2.0, 1.0, 0.5, 0.0, 3.0, 1.0\}$ in mm. Determine element stresses, principal stresses & von mises stresses in the element. Take $E=2 \times 10^5 \text{ N/mm}^2$ and poisson's ratio $\nu=0.25$ and thickness of element is 6 mm. **12**

- Q.5 (a)** Explain axisymmetric problems and derive stress-strain relationship matrix for axisymmetric element. **06**
- (b)** Determine the load vector of a triangular element mentioned in Q.4 is subjected to nonuniform pressure of 10 N/mm^2 at node 1 and 20 N/mm^2 at node 2 in the direction of perpendicular to edge 1-2. **06**
- OR**
- Q.5 (a)** Explain Isoparametric element and give shape functions of 4 noded quadrilateral element. **06**
- (b)** Determine the consistent mass matrix for one dimensional bar element having modulus of elasticity E , mass m , density ρ and cross sectional area A . **06**

Figures

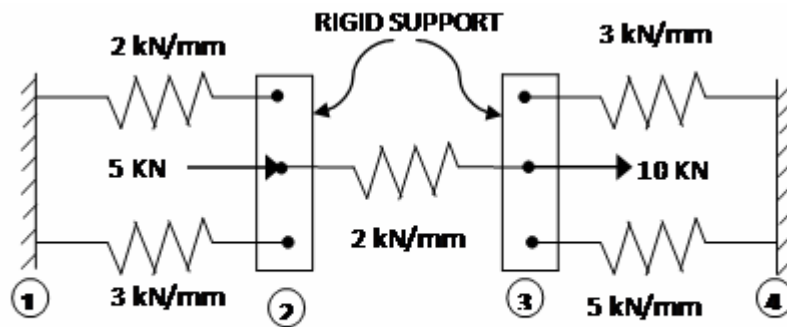


FIG. 1

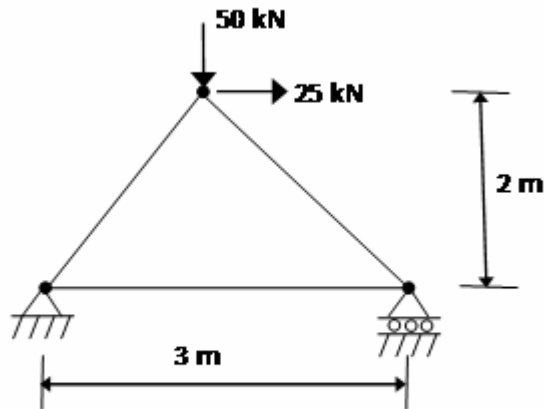


FIG. 2