Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – IInd - Examination – June/July- 2011

Subject code: 1720901

Subject Name: Finite Element Method

Date:22/06/2011 **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)** Explain in detail the discretization process with respect to following points. **07**

(i) Type of elements (iv) Numbering of elements
(ii) Size of elements (v) Node numbering system
(iii) Location of nodes

(b) A system of springs is as shown in Fig.1. Determine the overall stiffness matrix and determine the deflection of each of the springs. **07**

Q.2 **(a)** Explain the basic concepts of plane stress and plane strain problems in detail. **07**

(b) Consider the bar as shown in Fig.2. Determine the nodal displacements, elemental stresses and reactions, if the temperature rises by 60° C. Assume the modulus of elasticity for the complete bar as 200Gpa and coefficient of thermal expansion as 12×10^{-6} per ^{O}C. **07**

OR

(b) For the loading system as shown in Fig. 3, determine the displacements, stresses and support reactions using the concept of penalty approach. Assume E = 80Mpa. **07**

Q.3 **(a)** Using the potential energy approach method derive the following relation: **07**

$$KQ = F$$

Where K = Global stiffness Matrix
Q = Global Displacement vector
and F = Global Load vector

(b) A four bar truss is shown in fig. 4. Assuming that for each element, the cross-sectional area is $400mm^2$ and modulus of elasticity is 200 Gpa, determine the deflections and stresses in each elements. **07**

OR

Q.3 **(a)** Explain the concept of Boundary Conditions in detail **07**

(b) Fig. 5 shows a truss consisting of two elements, determine the displacements and the stresses in the bars. Assume E = 70Gpa and A = $200mm^2$ for both the members. **07**

Q.4 **(a)** Determine the shape functions N_1, N_2 and N_3 at the point P for the triangular element as shown in fig. 6. **07**

(b) Explain the function of displacement model? Signify of selection of Displacement model. **07**

OR

Q.4 **(a)** For the triangular element shown in Fig. 7, obtain the strain displacement relation matrix B and determine the strains ε_x, ε_y, ε_{xy}. The displacements at the nodes are: **07**

$q_1 = 0.01$, $q_2 = -0.04$, $q_3 = 0.03$, $q_4 = 0.02$, $q_5 = -0.02$ and $q_6 = 0.05$

(b) Explain isoparametric element formulations. **07**

Q.5 **(a)** For a fixed beam shown in Fig. 8, obtain the displacements at point B. Using these displacements, find the forces acting on each element. Assume EI = unity **10**

(b) How would you formulate a frame element that would enable us to model a buckling problem? **04**

OR

Q.5 **(a)** Determine the displacement and the rotation under the force and moment located at the center of the beam as shown in Fig. 9. Assume E = 210Gpa and $I = 2 \times 10^{-4} m^4$. **10**

(b) Derive the shape function for linear distribution. **04**

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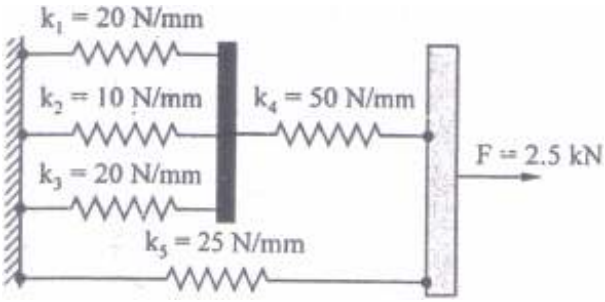

Figure 1

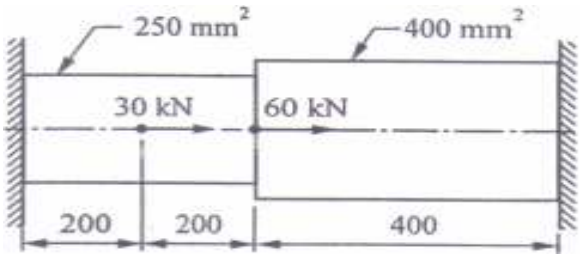

Figure 2

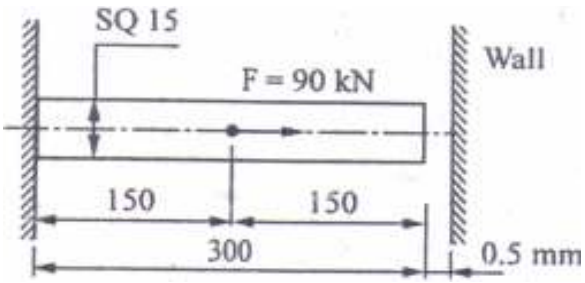

Figure 3

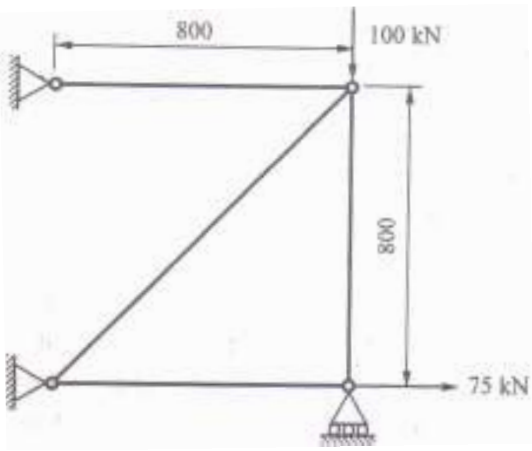

Figure 4

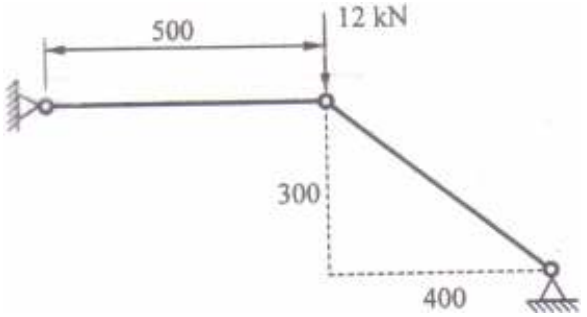

Figure 5

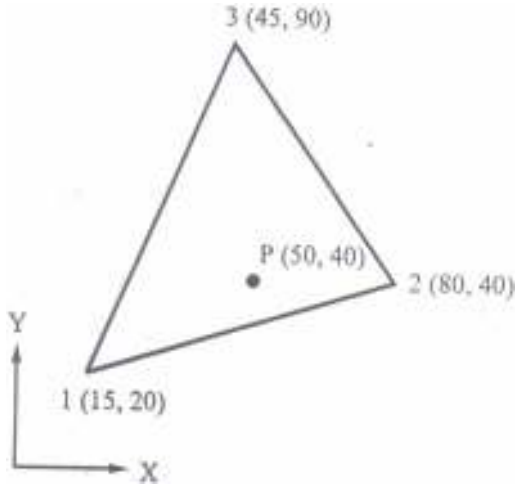

Figure 6

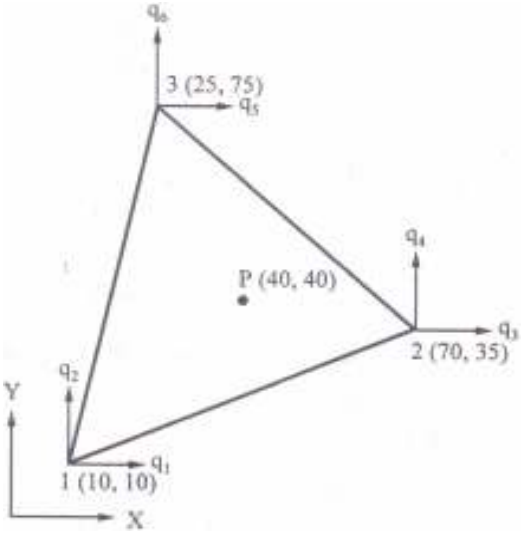

Figure 7

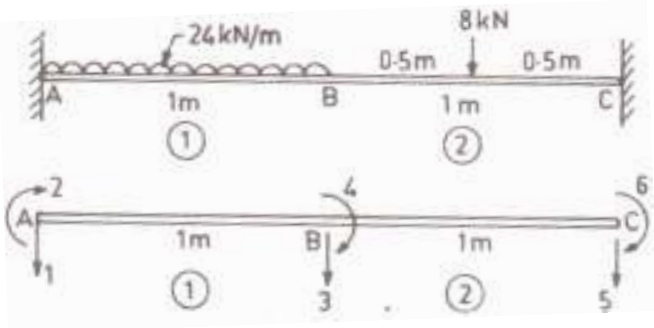

Figure 8

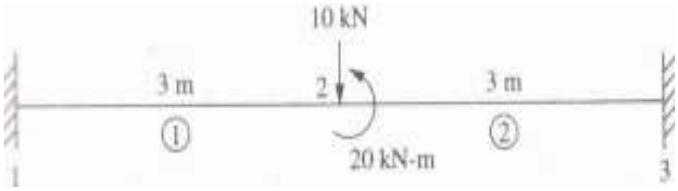

Figure 9