Total No. of Questions : 12] SEAT No. :

P1943 [Total No. of Pages : 4

[5254]-44
B.E. (Mechanical)
FINITE ELEMENT METHOD
(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer any three questions from each section.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of electronic pocket calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Explain the difference between the Ritz method and the Finite Element Method. **[8]**

b) Describe the physical meaning of boundary conditions for a given DE. **[8]**

OR

Q2) a) Discuss the importance of idealization and mathematical modeling in finite element analysis. **[8]**

b) Explain the terms 'Plane stress' and 'Plane strain' problems. Give constitutive laws for these cases. **[8]**

Q3) a) Derive an expression for the element stiffness matrix of the two noded truss element. Also show the element stress calculations. **[8]**

b) For the plane truss as shown in figure 1, P=1000kN, L=lm, E=210 GPa, A= 6.0×10^{-4} m^2 for element 1 and 2, A=$6\sqrt{2} \times 10^{-4}$ m^2 for element 3. Determine displacement and reaction solutions. **[10]**

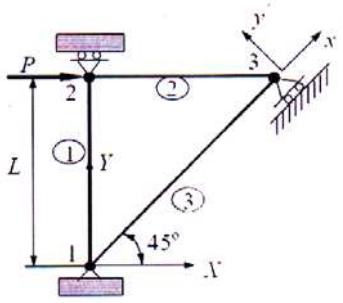

Figure 1

P.T.O.

OR

Q4) a) Solve for the displacements and the reaction force at node 1 as shown in figure 2, if k_1 = 4 N/mm, k_2 = 6 N/mm, k_3 = 3 N/mm, F_2 = –30 N, F_3 = 0, F_4 = 50 N using minimum potential energy approach. **[9]**

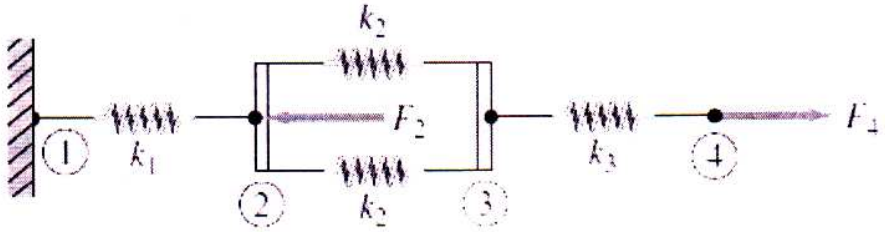

Figure 2

b) For the three - bar truss shown in Fig. 3, determine the nodal displacements and the stress in each member. Find the support reactions also. Take modulus of elasticity as 200 GPa. **[9]**

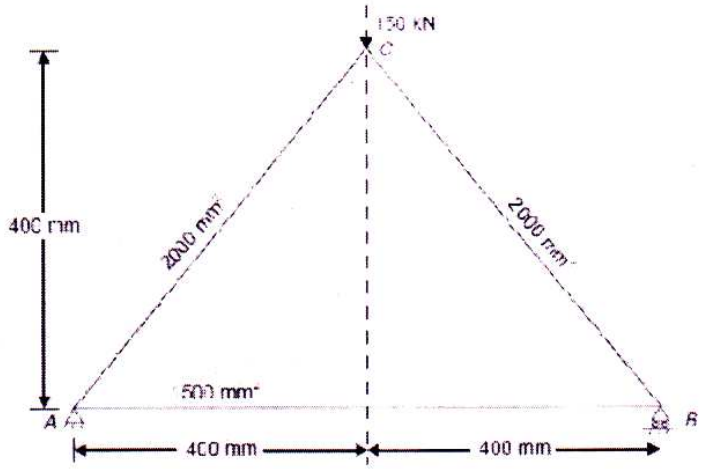

Figure 3

Q5) a) Explain two advantages of triangular elements over other elements. **[6]**

b) A CST element is defined by nodes at I (30, 40), J (140, 70) and K (80, 140) and the displacements at these nodes are (0.1, 0.5), (0.6, 0.5) and (0.4, 0.3) respectively. Determine the displacement the natural coordinates and the shape function at point P (77, 96) within the element. **[10]**

OR

Q6) a) What is mesh refinement? Explain h-refinement and p-refinement. **[7]**

b) Explain the concept of isoparametric, sub parametric and super parametric elements and their uses. **[9]**

SECTION - II

Q7) a) Explain plain stress and plain strain conditions in thermal analysis. **[6]**

b) For a one dimensional composite bar shown in Fig. 4, determine the interface temperatures. For element 1, let K_{xx} = 200 W/m°C; for element 2, let K_{xx} = 100 W/m°C; and for element 3, let K_{xx} = 50W/m°C; Let A = 0.1m^2. The left end has a constant temperature of 100°C and the right end has a constant temperature of 300°C. **[12]**

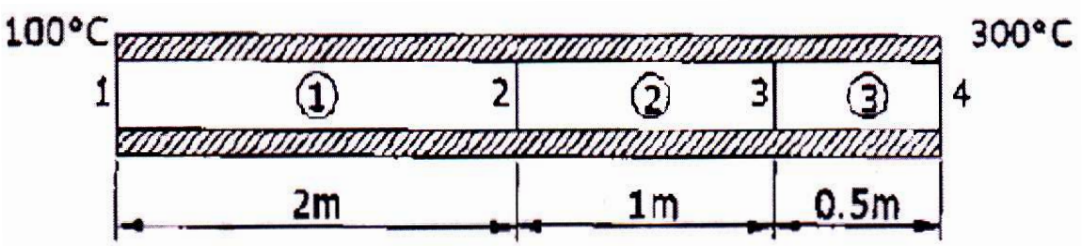

Fig. 4

OR

Q8) a) Explain the finite element modeling and shape functions for linear interpolation of temperature field of one dimensional heat transfer element. **[9]**

b) In a triangular element with the nodes are having Cartesian coordinates (50, 60), (150, 90), (100,140) respectively. At the point P (100, 90) determine its natural coordinates, shape functions and temperature. **[9]**

Q9) a) Derive the lumped element mass matrix for 1-D bar element. **[6]**

b) Find the natural frequencies of longitudinal vibration of the unconstrained steeped bar as shown in Figure 5. **[10]**

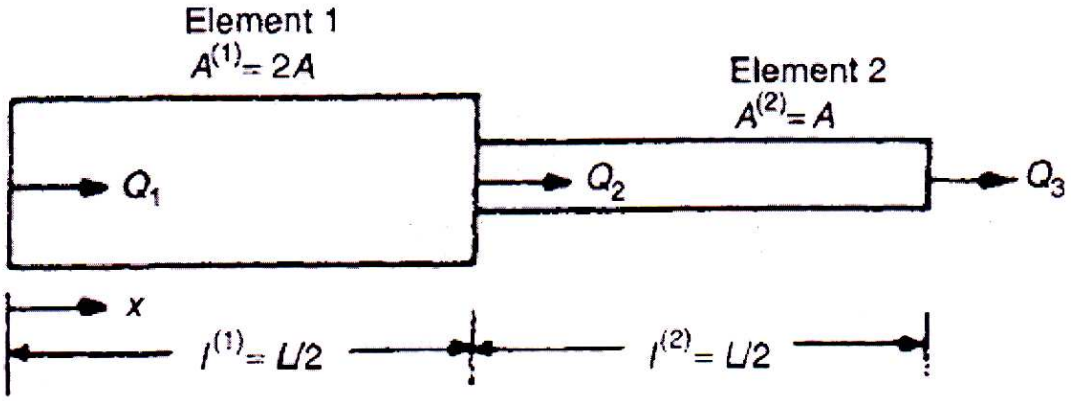

Fig. 5

OR

Q10)a) Derive the lumped element mass matrix for beam element. **[6]**

b) Explain the procedure involved in deriving the finite element equation of a dynamic problem. **[10]**

Q11)a) Explain the terms aspect ratio, warp angle and skew used for quality checks of element in FEM. **[9]**

b) Explain pre-processing in Finite element analysis. **[7]**

OR

Q12)a) Explain the terms distortion, stretch and taper used for quality checks of element in FEM. **[9]**

b) Explain post-processing in Finite element analysis. **[7]**