R18

Code No: 156AZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, February - 2023
FINITE ELEMENT METHODS
(Common to ME, MCT)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) Differentiate one- dimensional and two – dimensional elements. [2]
b) Clearly point out the situations in which FEM is preferred over other methods. [3]
c) Define degrees of freedom in FEM. [2]
d) Briefly explain Timoshenko beam theory. [3]
e) With suitable sketch briefly explain axi-symmetric loading. [2]
f) Explain the isoparametric elements and their advantages. [3]
g) What is fin in heat transfer? [2]
h) Discuss about heat transfer with convection. [3]
i) List the desirable features of FEA packages. [2]
j) With a neat sketch, briefly explain about tetrahedral element. [3]

PART – B

(50 Marks)

2.a) With suitable examples, differentiate linear and quadratic elements.
b) Briefly discuss about Interpolation elements. [5+5]

OR

3. For the spring assemblage with arbitrarily numbered nodes shown in figure 1, obtain (a) the global stiffness matrix, (b) the displacements of nodes 3 and 4. A force of 5000 N is applied at node 4 in the x direction. The spring constants are given in the figure. Nodes 1 and 2 are fixed. [10]

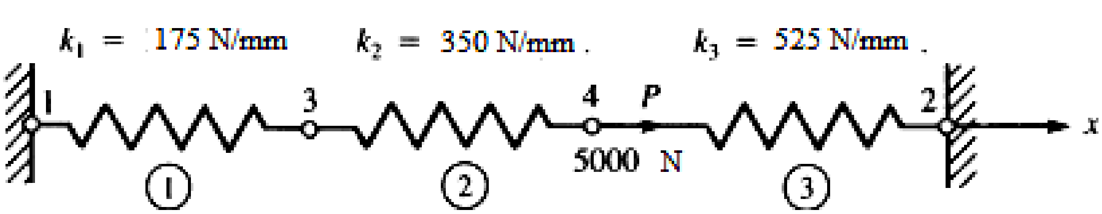

Figure 1

4. For the plane truss shown in Figure 2, determine the nodal displacements, the element forces and stresses, and the support reactions. All elements have E = 70 GPa and A = 3.0 $\times 10^{-4}$ m^2. Verify force equilibrium at nodes 2 and 4. Use symmetry in your model. [10]

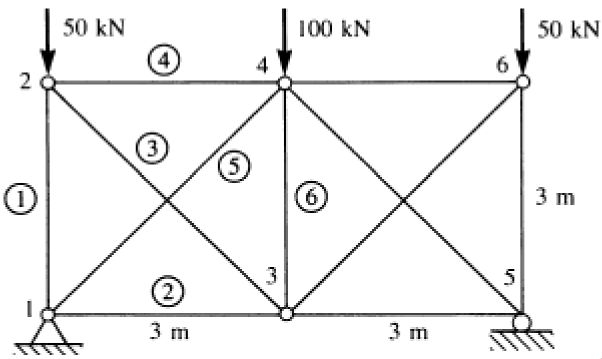

Figure 2

OR

5.a) Differentiate between a bar element and a truss element.

b) Derive element stiffness matrix of plane truss element. [5+5]

6. Assemble Jacobian matrix and strain displacement matrix corresponding to the Gauss point (0.57735, 0.57735) for the element shown in figure 3. [10]

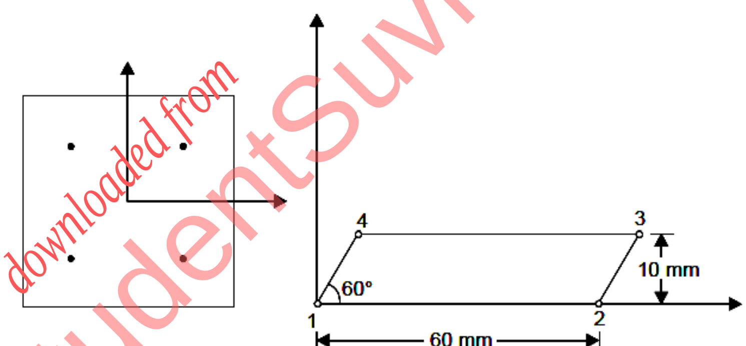

Figure 3

OR

7. What are axisymmetric elements and explain its applications. [10]

8. Figure 4 shows a thin-walled tube that is part of an oil cooler. Engine oil enters the tube at the left end at temperature 50 ^{0}C with a flow rate of 0.2 kg/min. The tube is surrounded by air flowing at a constant temperature of 15 ^{0}C. The thermal properties of the oil are as follows: Thermal conductivity: kx = 0.156 W/(m-^{0}C), Specific heat: c = 0.523 W-hr/(kg-^{0}C). The convection coefficient between the thin wall and the flowing air is h = 300 W/(m^2-^{0}C). The tube wall thickness is such that conduction effects in the wall are to be neglected; that is, the wall temperature is constant through its thickness and the same as the temperature of the oil in contact with the wall at any position along the length of the tube. Using four two-node finite elements, obtain an approximate solution for the temperature distribution along the length of the tube and determine the heat removal rate via convection. [10]

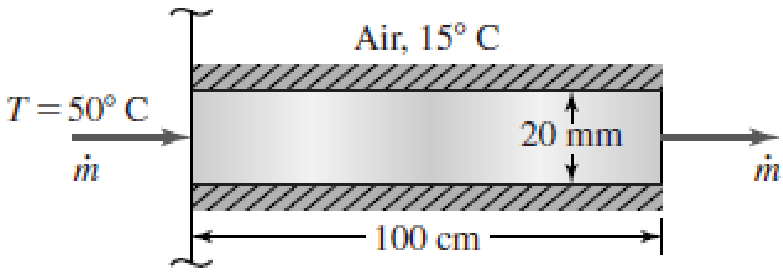

Figure 4

OR

9. Derive the basic differential equation for one-dimensional heat conduction. [10]

10. Determine the Eigen values and Eigen vectors for the stepped bar shown in the figure 5. Given E = 100 GPa and Specific weight=0.025 kg/mm^3. [10]

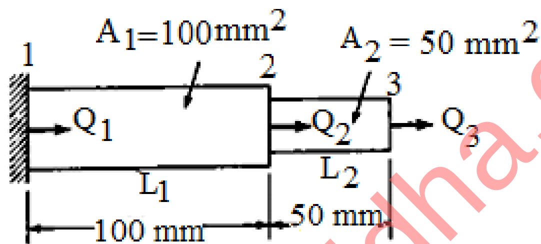

Figure 5

OR

11. Find the natural frequencies and modes of vibration for one-element cantilever beam. [10]

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