

Code No: 56017

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, February/March - 2022

FINITE ELEMENT METHODS

(Common to ME, AE)

Time: 3 hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks

- 1.a) Derive element stiffness matrix for a 1-D bar using Galerkin's approach and discuss salient points.
 - b) Differentiate between plane stress and plane strain problems and derive the stress strain relation matrices. [7+8]
2. Determine the extension of the bar shown in figure 1. Due to self weight and a concentrated load of 400 N applied at its end. Given $b_1 = 150 \text{ mm}$ $b_2 = 75 \text{ mm}$ $t = 20 \text{ mm}$. $E = 2 \times 10^5$ $\rho = 0.8 \times 10^{-4} \text{ N/mm}^3$ [15]

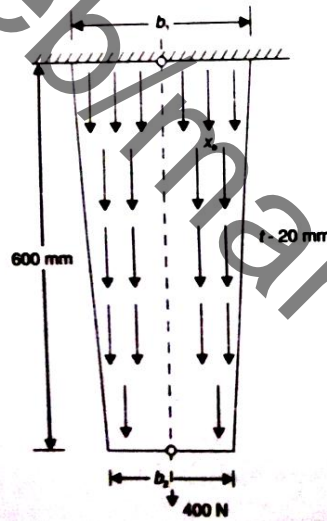


Figure 1

3. For the three-bar truss shown in figure 2, determine the nodal displacements and the stress in each member. Find the support reactions also. Take modulus of elasticity as 200 GPa and area 1000 mm^2 . [15]

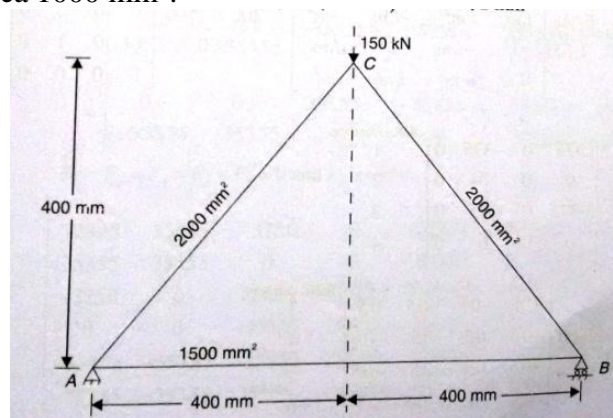


Figure 2

4. Analyse the beam shown in figure 3, by finite element method and determine the end reactions. Also determine the deflections at mid spans given $E = 2 \times 10^5 \text{ N/mm}^2$ and $I = 5 \times 10^6 \text{ mm}^4$ [15]

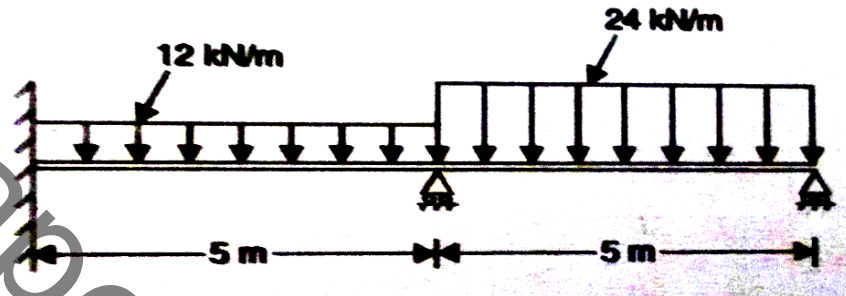


Figure 3

5. Calculate the stiffness matrix and load vector for the constant strain triangle (CST) subjected to the following loads as shown in figure 4. Take $t=5 \text{ mm}$. All dimensions are in mm. [15]

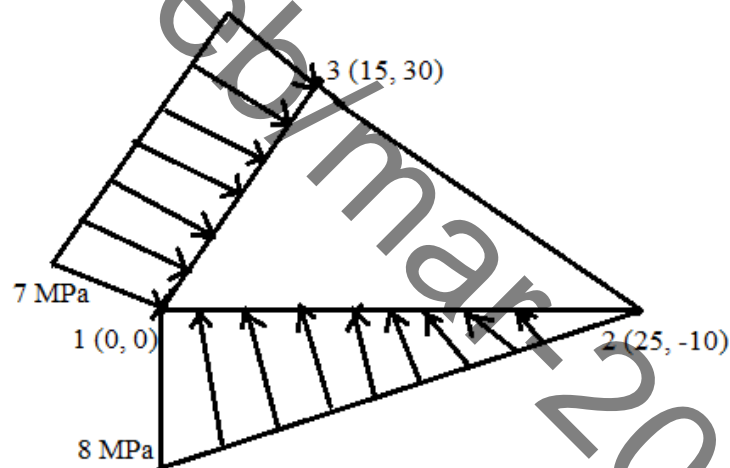


Figure 4

6. Figure 5 shows the rectangular cross section of a ring finite element for the analysis of axisymmetric solid. The element has four nodes with two degrees of freedom (u, v) at each node. Outline the development of the stiffness matrix for this element giving details of B. [15]

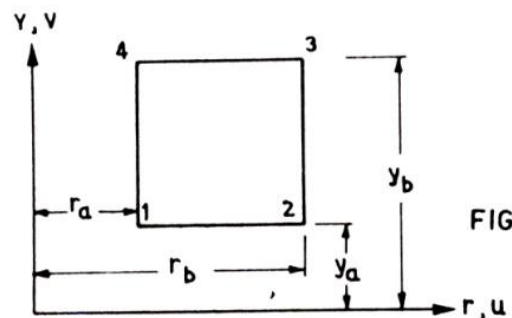


Figure 5

7. For the dimensional body shown in figure 6, determine the temperature distribution. Let the left and right ends have constant temperatures of 200°C and 100°C respectively. Take $k = 5 \text{ W/cm}^{\circ}\text{C}$. The body is insulated along the top and bottom. [15]

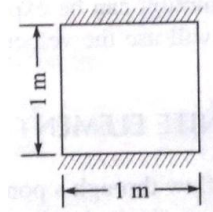


Figure 6

8. Evaluate nodal frequencies of the beam shown in figure 7. Use two element model, take $E = 210 \text{ GPa}$, weight density 7800 kg/m^3 , $A = 400 \text{ mm}^2$ and $I = 5000 \text{ mm}^4$. [15]

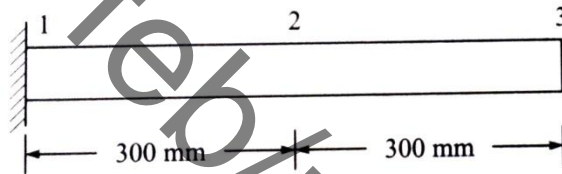


Figure 7

---ooOoo---