

R13

Code No: 126EE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, July - 2023

FINITE ELEMENT METHODS

(Common to ME, AE)

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) List out the different types of boundary conditions. Give examples. [2]
- b) State the properties of stiffness matrix. [3]
- c) Write the element stiffness matrix for truss element. [2]
- d) Compare beam and truss element. [3]
- e) Define CST. [2]
- f) Write the element stiffness matrix for four noded isoparametric element. [3]
- g) What is convection matrix? [2]
- h) What do you understand by a torsion problem? [3]
- i) Define lumped mass matrix. [2]
- j) Discuss the mesh generation techniques. [3]

PART - B

(50 Marks)

- 2.a) Explain about the Numbering scheme used in Finite Element Method.
- b) Derive the shape functions of 1-D bar element. [5+5]

OR

3. A load $P=60 \times 10^3 \text{N}$ is applied on a bar as shown in Figure 1. Determine:
(a) Displacement field and (b) Stresses. Take $E= 20\text{GPa}$, $\text{Gap}=1.2\text{mm}$, $A=250\text{mm}^2$. [10]

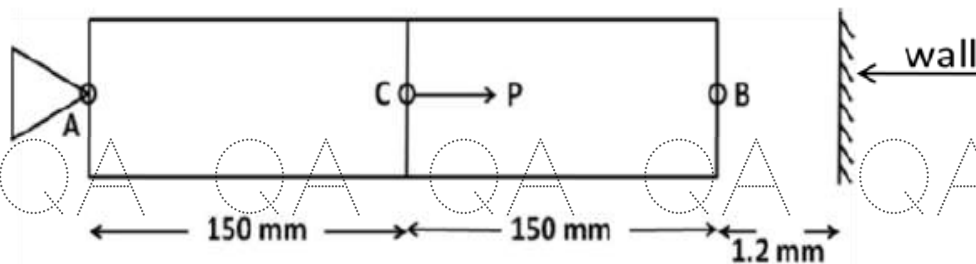


Figure 1

4. Estimate the nodal displacements in each member of the truss shown below figure 2. Take $P = 50\text{kN}$ and $E = 200\text{GPa}$. [10]

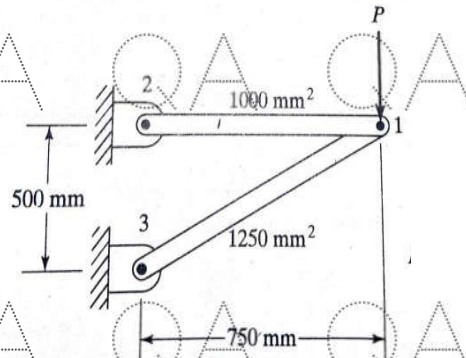


Figure 2

OR

5. A beam of 4 m length is subjected to point loads at the distances of 2 m and 4 m from the fixed end of 10 kN and 20 kN respectively. Calculate the deflection at the center of the beam, if modulus of elasticity of beam material $E = 2 \times 10^5 \text{ MPa}$ and $A = 400 \text{ mm}^2$ (figure 3). [10]

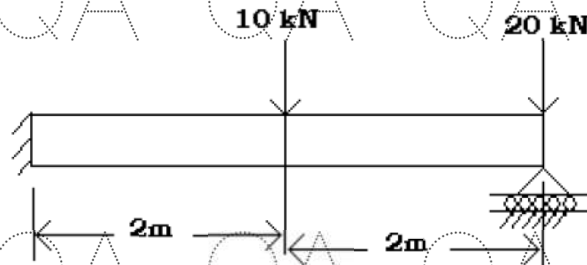


Figure 3

6. The coordinates of the nodes 1, 2 and 3 of a triangular element are (1, 1), (8, 4) and (2, 7) in mm. The displacements at the nodes are $q_1 = 1 \text{ mm}$, $q_2 = 3 \text{ mm}$, $q_3 = -2 \text{ mm}$, $q_4 = -4 \text{ mm}$, $q_5 = 2 \text{ mm}$ and $q_6 = 5 \text{ mm}$. Determine (i) Strain-Displacement matrix [B] (ii) Strains ϵ_x , ϵ_y and shear strain γ_{xy} . [10]

OR

7. Check what order of the Gauss quadrature could exactly integrate the following. [10]

$$\Phi = (2 + 3x + 5x^3 + 8x^6)$$

8. A metallic fin with thermal conductivity $k = 360 \text{ W/m}^\circ\text{C}$, 0.001 m thick and 0.1 m long, extends from a plane wall whose temperature is 235°C . Determine the temperature distribution. Take air at 20°C with $h = 9 \text{ W/m}^2\text{C}$. Take the width of fin to be 1 m. [10]

OR

9. Heat is generated in a large plate (thermal conductivity $k = 0.8 \text{ W/m}^\circ\text{C}$) at the rate of 4000 W/m^3 . The plate is 0.25 m thick. The outside surfaces of the plate are exposed to ambient air at 30°C with a convective heat transfer coefficient of $20 \text{ W/m}^2\text{C}$. Determine the temperature distribution in the wall. [10]

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10. Evaluate the eigen values, eigen vectors and natural frequencies of a beam of cross section 360 cm^2 and of length 600mm . Assume Young's modulus as 200GPa , density 7850 kg/m^3 and moment of inertia of 3000mm^4 . Make into two elements of 300 mm length each. [10]

QA QA QA OR QA QA QA QA G

- 11.a) Discuss the various FEM software's.
b) What are the convergence requirements? [5+5]

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