

7E7011

Roll No. _____

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7E7011

B. Tech. VII Sem. (Main / Back) Exam., Nov. – Dec. - 2018

Mechanical Engineering

7ME1A Finite Element Methods

Common With ME, PI

Time: 3 Hours

Maximum Marks: 80
Min. Passing Marks: 26

Instructions to Candidates:

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL

2. NIL

UNIT-I

Q.1 (a) Explain the following –

(i) Uniqueness of a solution

[2]

(ii) Banded Symmetric Matrix

[2]

(iii) Meshing

[2]

(iv) Band width and semi band width

[2]

(b) Explain Gauss elimination method with the help of an example.

[8]

OR

Q.1 (a) Describe general procedure to solve Finite Element Method Problem.

[8]

(b) Derive global stiffness matrix for a three spring system using local stiffness matrix for each element.

[8]

UNIT-II

Q.2 (a) Explain principal of minimum potential energy. Also write an example to explain it.

[8]

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- (b) The figure 1 below shows a system of three linear spring elements connected as shown. Node 1 is fixed and node 3 is given a specified displacement δ . Determine the nodal displacement and forces required at node 3 for the specified conditions. [8]

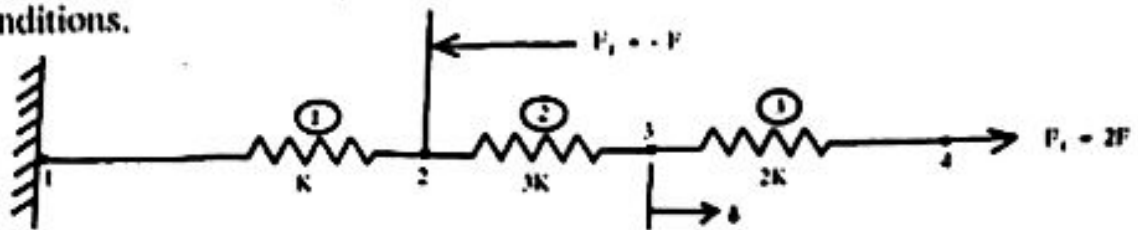


Figure - 1

OR

- Q.2 (a) Explain in detail stress and strain tensor. Support your answer with neat diagrams. [8]
- (b) Consider a stepped bar as shown in figure 2, for which $E = 200\text{GPa}$, $A_1 = 200\text{mm}^2$ and $A_2 = 10\text{mm}^2$. Determine nodal displacements, reaction forces and stresses in each element. [8]

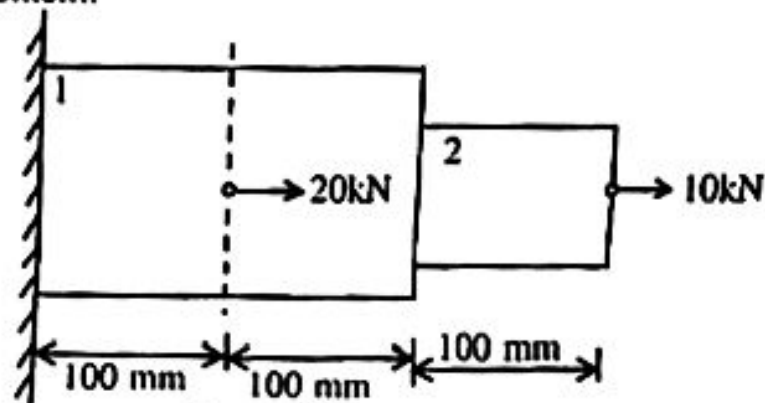


Figure - 2

UNIT- III

- Q.3 (a) Explain constant strain triangle (CST). Also formulate its shape functions. [8]
- (b) For a three bar truss system shown in figure 3, determine the nodal displacements and stresses in each member. Find the support reactions also. Take $E = 200\text{GPa}$. [8]

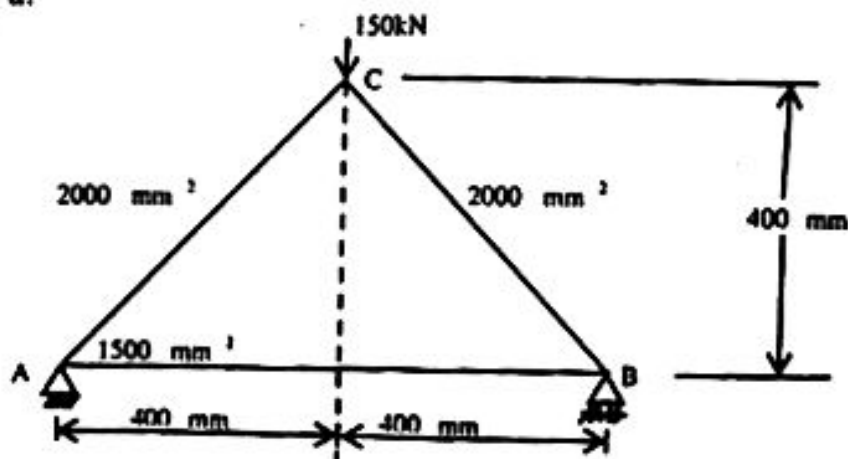


Figure 3

OR

- Q.3 (a) Describe the formulation for plane stress and plane strain problems. [4]
(b) Find the nodal displacements and element stresses in propped beam shown in figure 4. Idealize the beam into two CST elements as shown. Assume plane stress conditions. Take $\mu = 0.25$, $E = 2 \times 10^5 \text{ N/mm}^2$ and thickness (t) = 15mm. [12]

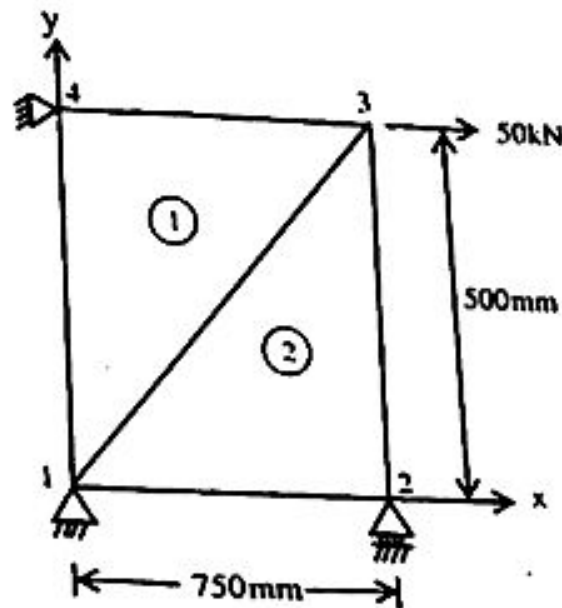


Figure - 4

UNIT- IV

- Q.4 (a) Explain 1 Dimensional heat transfer for a bar element in detail. [4]
(b) Using Rayleigh – Ritz method, determine the expression for displacement and stress in a fixed bar subjected to axial force P as shown in figure 5. Also, draw displacement and stress variation diagram. Take three terms in displacement function. [12]

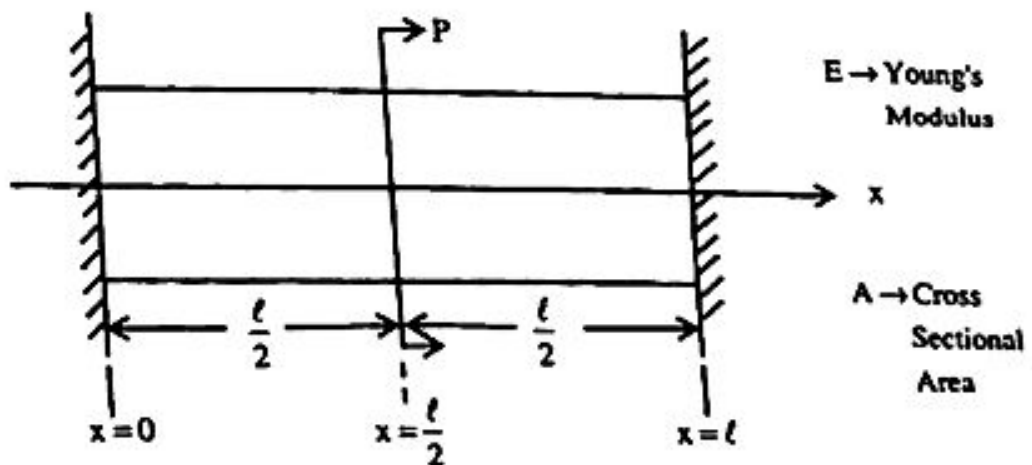


Figure - 5

OR

- Q.4 (a) Using Galerkin's approach, find element stiffness matrix and force vector for 1 dimension equilibrium equation.

$$\frac{d}{dx} \left(EA \frac{du}{dx} \right) + c Ag = 0$$

Use quadratic interpolation for displacement variable u . Explain the essential and natural boundary condition involved in this problem. [8]

- (b) Calculate the maximum deflection in a simply supported beam as shown in figure 6, subjected to concentrated load 'P' at the center of the beam. (Use collocation method) [8]

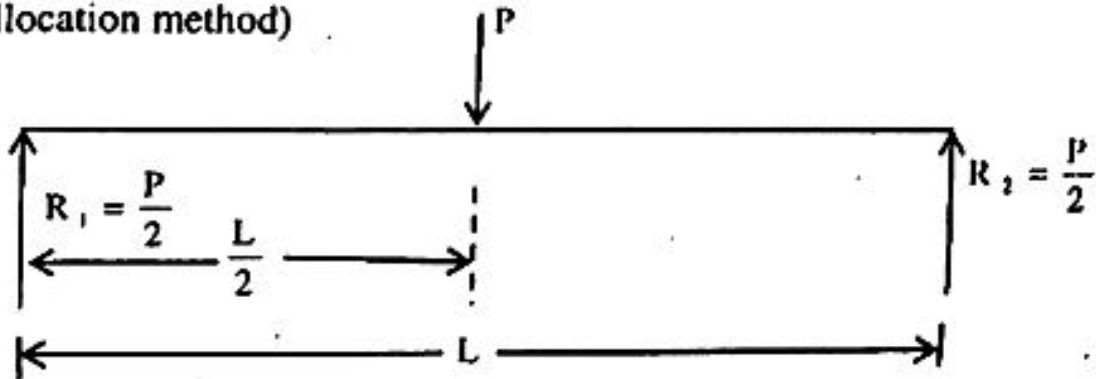


Figure - 6

UNIT- V

- Q.5 (a) Explain the following -

- (i) Convergence of solution [2]
- (ii) Compatibility [2]
- (iii) Element Continuity [2]
- (iv) Static Condensation [2]

- (b) Explain P and h methods of mesh refinement. [8]

OR

- Q.5 (a) Using Lagrange's interpolation formula, find the value of y for $x = 9.5$ from the table - [8]

x	7	8	9	10
y	3	1	1	9

- (b) Write applications and advantages of Finite Element Method. [8]