

Code: 17MEMD2T3

**I M.Tech - II Semester – Regular/Supplementary Examinations
OCTOBER - 2020**

**FINITE ELEMENT METHODS IN ENGINEERING
(MACHINE DESIGN)**

Duration: 3 hours

Max. Marks: 60

Answer the following questions.

1. A rod fixed at its ends is subjected to a varying body force as shown in Figure-1. Use the Rayleigh-Ritz method with an assumed displacement field $u = a_0 + a_1x + a_2x^2$ to determine displacement $u(x)$ and stress $\sigma(x)$. Also plot variation of $u(x)$ and $\sigma(x)$ with respect to x . 15 M

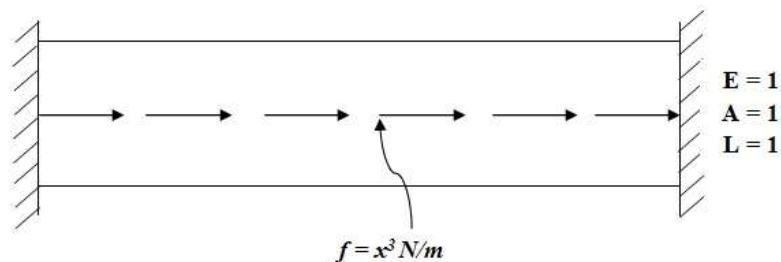


Figure-1

(OR)

2. a) What considerations are taken into account while discretizing the domain for FEA? Explain briefly. 8 M
- b) Discuss the details of various types of element shapes usually employed for modelling components. 7 M

3. Consider the bar as shown in Figure-2 is subjected to a temperature difference of 60°C . Determine the nodal displacements and stresses induced in the elements. Take the coefficient of thermal expansions as $18.9 \times 10^{-6}/^{\circ}\text{C}$ (for $E=83\text{GPa}$ element), $18.9 \times 10^{-6}/^{\circ}\text{C}$ (for $E=70\text{GPa}$ element) and $11.7 \times 10^{-6}/^{\circ}\text{C}$ (for $E=200\text{GPa}$ element) respectively.

15 M

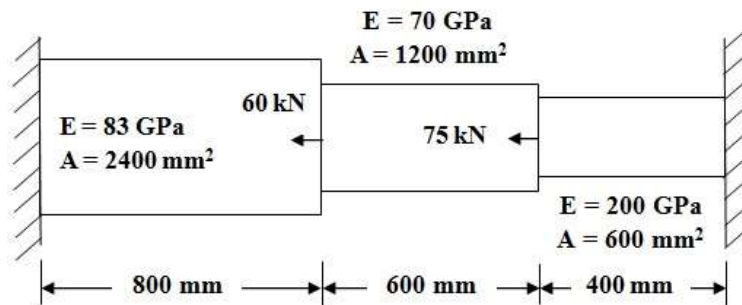


Figure-2

(OR)

4. For the two-bar truss shown in Figure-3, determine the displacements of node 1 and the stress in element 1-3.

15 M

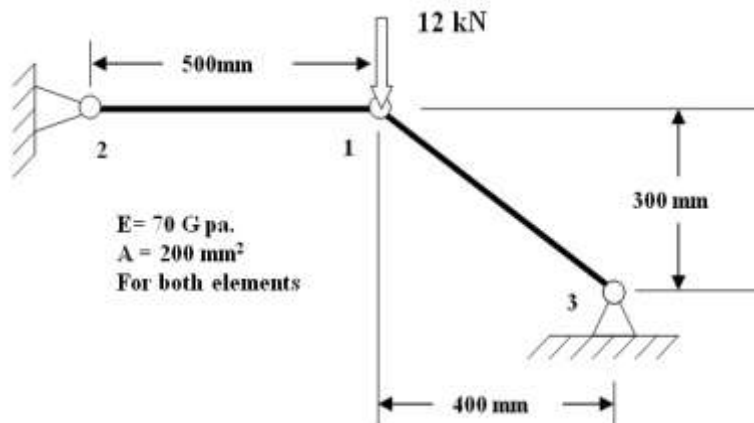


Figure-3

5. Derive the Strain displacement matrix for CST Element.

15 M

(OR)

6. a) What are isoparametric elements? Determine the shape functions for a quadrilateral isoparametric element. 7 M

b) Evaluate the following integral using one point and two-point gaussian quadrature formulae and compare the results with exact solution. 8 M

$$\int_{-1}^1 \left[3e^x + x^2 + \frac{1}{(x+2)} \right] dx$$

7. Determine the natural frequencies and mode shapes for the stepped bar shown in Figure-4. Take $E = 70 \text{ GPa}$ and specific weight 2700 kg/m^3 . 15 M

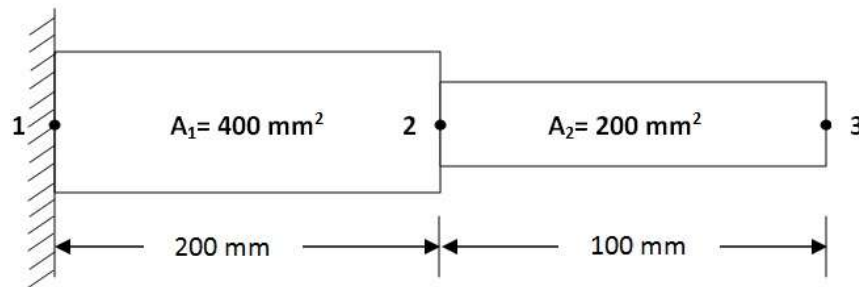


Figure-4

(OR)

8. Discuss about the requirements for convergence, h-refinement, p-refinement and Pascal triangle. 15 M