

Code: 17MEMD2T3

**I M.Tech - II Semester – Regular/Supplementary Examinations
July 2019**

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

Duration: 3 hours

Max. Marks: 60

Answer the following questions.

1. a) Explain about the Variational method in FEM. 5 M

b) Discuss Rayleigh –Ritz method of formulation by taking an example. 10 M

(OR)

2. a) Discuss the various points to be considered while discretizing a structure for finite element analysis. 7 M

b) Elucidate the numbering scheme used in finite element analysis. 8 M

3. Estimate the displacements, stresses and reactions at the supports in the bar subjected to axial loads of $P_1=3000\text{N}$ (Tensile) and $P_2=2000\text{N}$ (Compression) as shown in Figure1. $E=2.1\times 10^5\text{MPa}$. 15 M

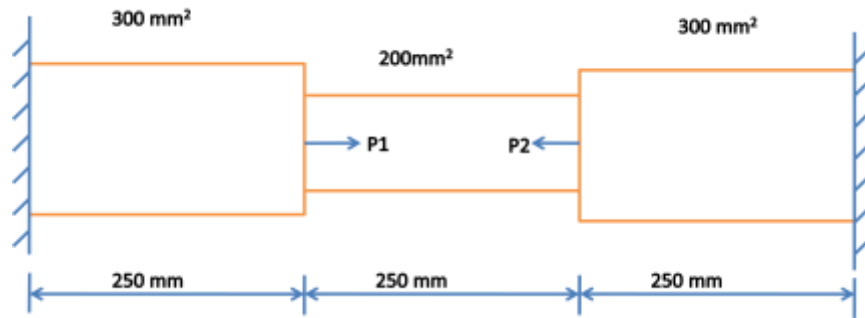


Figure1

(OR)

4. For the three bar truss shown in Figure2, compute the nodal displacements and the stresses in each member. Take the modulus of elasticity as 200 GPa. 15 M

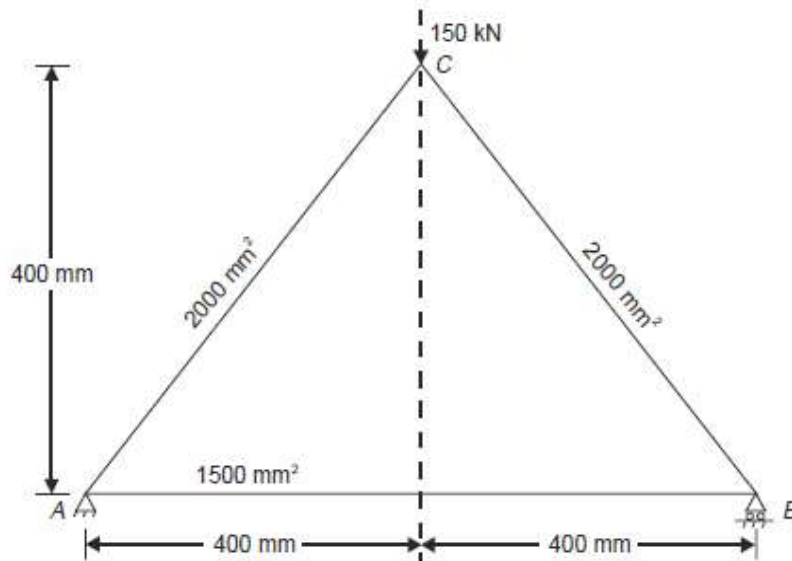


Figure2

5. a) The (x, y) coordinates of the nodes i, j and k of a triangular element are $(1, 1)$, $(4, 2)$ and $(3, 5)$ respectively. The shape functions of a point P located inside the element are given by $N_1 = 0.15$ and $N_2 = 0.25$. Estimate the x and y coordinates of the point P . 5 M

b) 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 $q_1 = 1$ mm, $q_2 = 3$ mm, $q_3 = -2$ mm, $q_4 = -4$ mm, $q_5 = 2$ mm and $q_6 = 5$ mm. Determine (i) Strain-Displacement matrix $[B]$ (ii) Strains ϵ_x , ϵ_y and shear strain γ_{xy} . 10 M

(OR)

6. a) Discuss sub, iso and super parametric elements in finite element analysis with neat sketches. 7 M

b) Evaluate $\int_{-1}^{+1} [3e^x + x^2 + 1 / (x + 2)] dx$ over the limits -1 and $+1$ using one point and two point Gauss quadrature formulae and compare with the exact solution. 8 M

7. Discuss the methodology to solve the Eigen value problem for the estimation of natural frequencies of a stepped bar? 15 M

(OR)

8. a) Compare the complete and incomplete interpolation functions in FEM. 4 M

b) What are the various refinement techniques in finite element method? Explain h-refinement method. 4 M

c) Explain the requirements for the convergence of a FE solution. 7 M