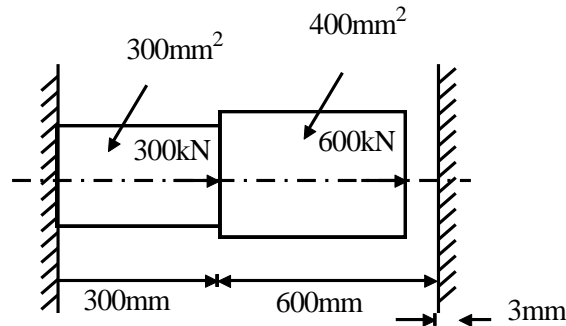


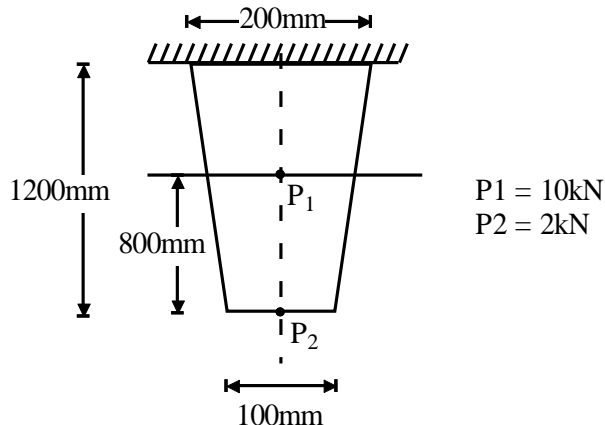


- Notes :
1. All questions carry equal marks.
  2. Due credit will be given to neatness and adequate dimensions.
  3. Assume suitable data wherever necessary.
  4. Diagrams and Chemical equation should be given wherever necessary.
  5. Illustrate your answers wherever necessary with the help of neat sketches.
  6. Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.

1. a) Explain the shape function for 1-D bar element along with their salient features. **6**  
b) List and explain in brief the properties of global Stiffness matrix. **6**  
c) Explain in brief the concept of iso-parametric representation used in Finite element method. **4**
- OR**
2. Consider the two bars shown in Fig. If the deformation of the right end is not to exceed 3 mm, find nodal displacement, element stresses and support reactions. Take  $E = 200 \text{ GPa}$ . **16**

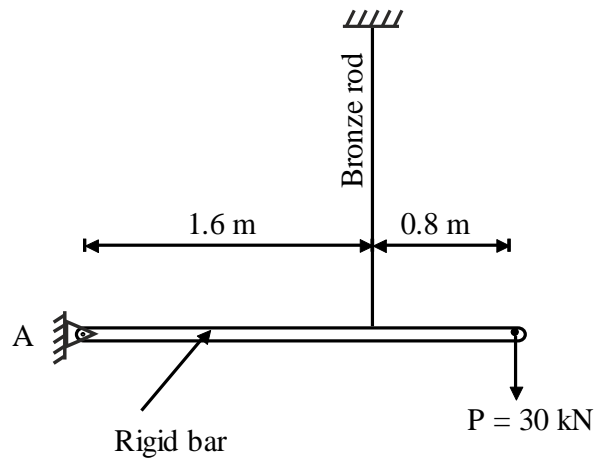


3. a) What are different solution approaches used for solving problems by using finite element method? **4**  
b) Figure shows a thin plate having uniform thickness  $t = 20 \text{ mm}$ , Modulus of elasticity,  $E = 2 \times 10^5 \text{ N/mm}^2$ . In addition to its self-weight it is subjected to two point loads as shown. The density  $= 37.86 \text{ gm/cm}^3$ . Model the plate with two one dimensional finite elements and determine: i) Stresses in each member. ii) Displacement of the bottommost point. **12**



OR

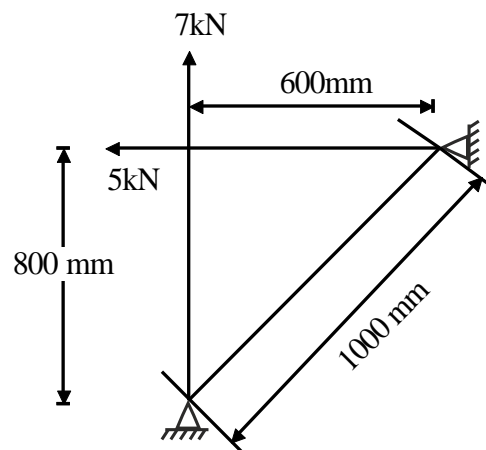
4. A horizontal rigid bar of negligible mass, hinged at A in fig., is supported by a bronze rod 2m long having cross section area  $300 \text{ mm}^2$  and  $E = 83 \text{ GPa}$ . Determine displacement at a node at which force of  $P = 30 \text{ kN}$  is applied and Hence find stress in bronze rod. **16**



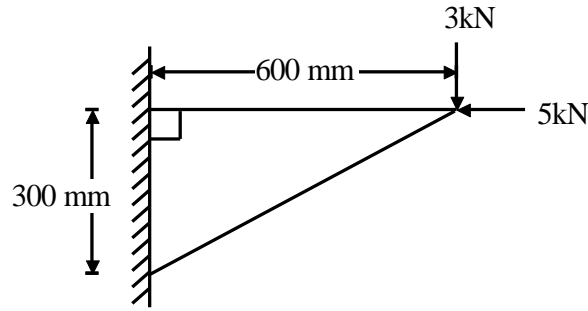
5. a) What do you understand by "post processing" in finite element analysis? **8**
- b) Explain in brief the types of element used in FEM along with their characteristics. **8**

OR

6. A truss shown in fig. The cross section area of all elements is  $450 \text{ mm}^2$  and  $E = 2 \times 10^5 \text{ N/mm}^2$  **16**
- Determine element stiffness matrix for each element.
  - Assemble the structural stiffness matrix for entire truss.
  - Find nodal displacement
  - Find stresses in all elements.
  - Calculate the reaction force.



7. A two dimensional plate shown in figure has thickness of 10 mm and modulus of elasticity  $E = 2 \times 10^5 \text{ N/mm}^2$ , and Poisson's ratio  $\nu = 0.3$ . Determine the nodal displacement using plane stress condition. **16**



**OR**

8. a) Evaluate the shape functions  $N_1$ ,  $N_2$  and  $N_3$  at the interior point P for the triangular element bound by nodes 1(2, 4), 2(7, 9) and 3(5, 11). The co-ordinates of P are P (5, 9). **8**

- b) Find the Eigen values of the matrix A. **8**

$$A = \begin{bmatrix} 2 & 3 & -2 \\ 1 & 4 & -2 \\ 2 & 10 & 5 \end{bmatrix}$$

9. For Truss shown in fig, Cross section area of all elements is  $450 \text{ mm}^2$  &  $E = 2 \times 10^5 \text{ N/mm}^2$ . **16**

- Determine element stiffness matrix for each element.
- Assemble the structural stiffness matrix for entire truss.
- Find nodal displacement.
- Find stresses in all elements.
- Calculate the reaction force.

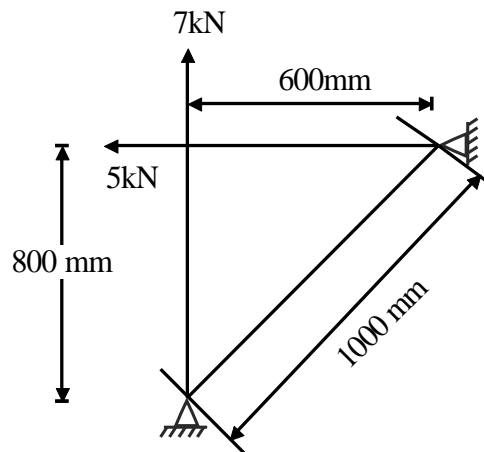


Fig.

**OR**

**10. Write Short Notes on Any Four.**

**16**

- a) Principal of minimum potential energy.
- b) Natural and Essential Boundary Conditions
- c) Penalty Approach
- d) CST and LST Elements in Finite element Discretization
- e) Discretization of the continuum.

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