B.E. Mechanical Engineering (Model Curriculum) Semester - VIII

PEC-MEL-433 : Finite Element Methods

P. Pages : 3 **GUG/S/23/14373**

Time : Three Hours * 3 0 6 1 * Max. Marks : 80

Notes : 1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.
4. Attempt Q. 1or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10

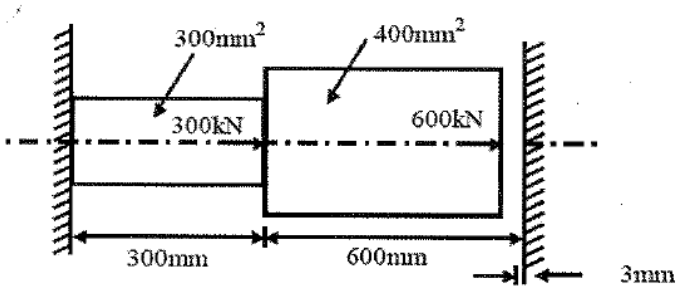
1. a) Discuss properties of stiffness matrix. **6**

b) What are shape functions for 1-D bar elements, Explain in brief. **6**

c) State different types of finite element based on geometry with suitable example for each. **4**

OR

2. Consider the two bars shown in figure, If the deformation of the right and is not to exceed 3mm, find nodal displacement, element stresses and support reactions. E = 200GPa **16**



3. a) What are different types of solution methodologies for solving of finite element problems. **4**

b) Figure – 2, shows a thin plate having uniform thickness t = 20mm, Modulus of elasticity $E = 2x10^5$ N/mm^2. In addition to its self-weight it is subjected to two point loads as shown. The density = 37.86 gm/cm^3. Model the plate with two one dimensional finite elements and determine : **12**

i) Stresses in each member.

ii) Displacement of the bottommost point.

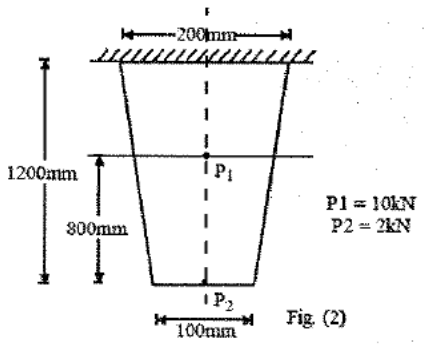
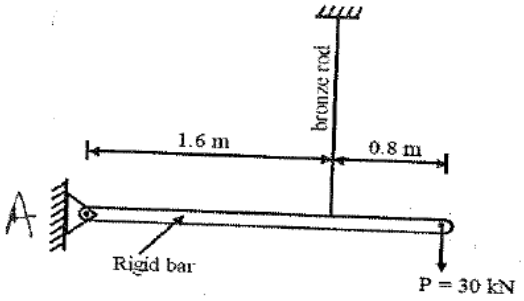


Fig. (2)

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 mm^2 and E = 83 GPa. Determine displacement at a node at which force of P = 30 kN is applied and Hence find stress in bronze rod. **16**

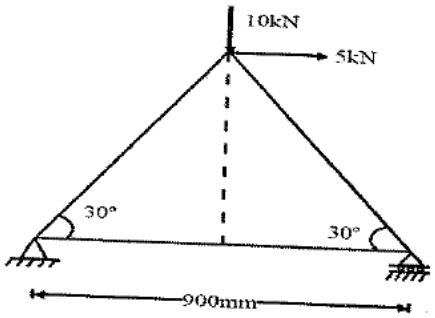


5 a) Brief out the steps involved in finite element method by flow chart. **8**

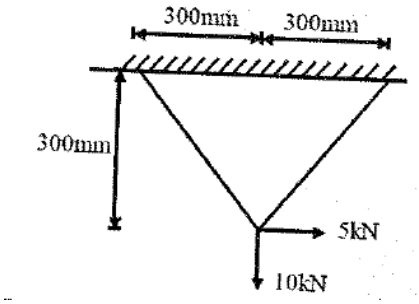
b) Explain in brief the types of element used in FEM along with their characteristics. **8**

OR

6. For the truss shown in figure, determine the displacement of nodes, stresses in members and reactions at the support, cross – sectional area of all members is 400 mm^2 and E = $200x10^9$ N/m^2. **16**



7. a) Figure shows a two dimensional plate of thickness 20mm. If load is applied as shown in figure, determine nodal displacements and stresses in the element. Take E = 200 GPa and v = 0.3. **16**

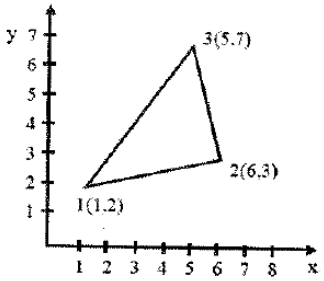


OR

8. a) Find inverse of the following matrices. **8**

i) $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ ii) $\begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$

b) The nodal co-ordinates of triangular elements are shown in Figure. At the interior point 'P' the x-Coordinate is 4 and N1 = 0.3, Determine N2, N3 and Y coordinate of P. **8**



9. For the truss shown in Figure, Determine the displacement at nodes end stresses in each member. Take E = 200GPa & A = 200mm^2 for each member **16**

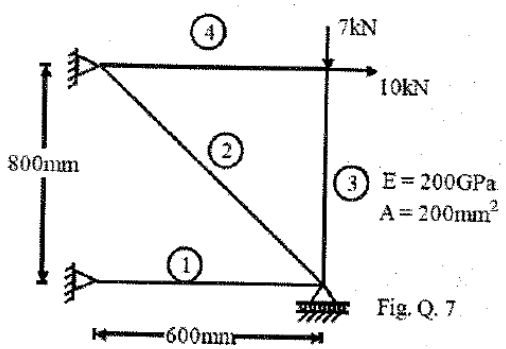


Fig. Q. 7

OR

10. Write Short Notes on **any four.** **16**

a) Interpolation Functions.

b) Natural and Essential Boundary Conditions.

c) Penalty Approach

d) Properties of Stiffness matrix

e) Mesh Convergence

****