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

PEC-MEL-433 : Finite Element Methods

P. Pages : 3 **GUG/S/25/14373**

Time : Three Hours * 2 6 2 9 * Max. Marks : 80

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. Answer Q. no. 1 or 2, 3 or 4, 5 or 6, 7 or 8, 9 or 10.

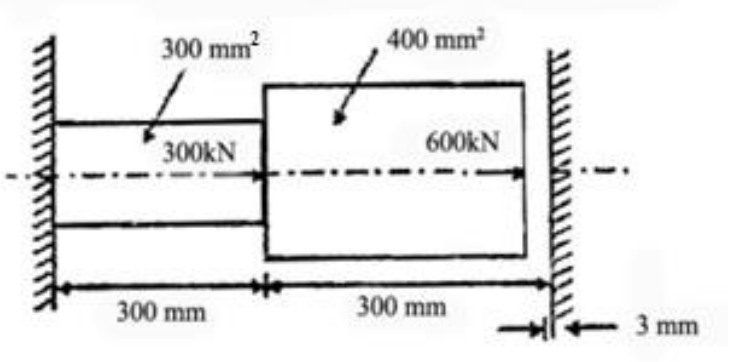
1. a) With suitable example explain body force and traction force. **8**

b) Explain steps in Finite Element Method. **4**

c) State different types of finite element based on geometry with suitable example for each. **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 GPa **16**



3. a) What are different types of errors of finite element method solutions? **4**

b) Figure-2, shows a thin plate having uniform thickness t = 20mm, Modulus of elasticity $E = 2\times10^5\ N/mm^2$. 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: i) Stresses in each member. ii) Displacement of the bottommost point. **12**

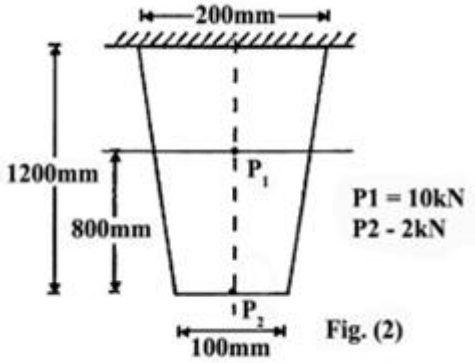
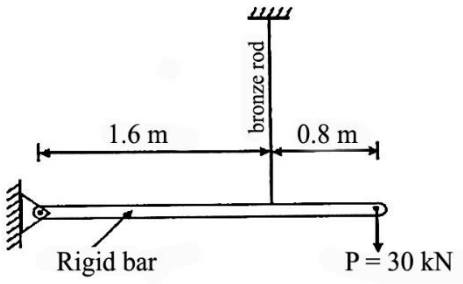


Fig. (2)

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**

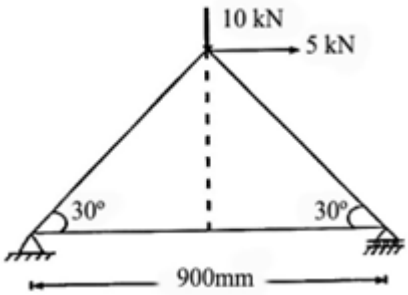


5. a) What do you understand by "post processing" in finite element analysis? **8**

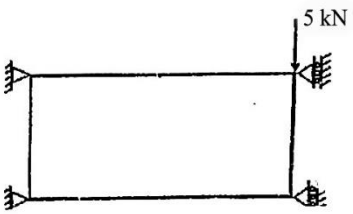
b) Explain in brief the shape functions used in FEM. **8**

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= 200 x 10^9 N / m^2. **16**



7. A rectangular plate having 10mm thickness shown in figure is subjected in-plane point load as shown. If E = 200 GPa and v = 0.3, Determine the nodal displacement, stress and strain field. **16**



OR

8. a) Evaluate the shape functions Nl, N2 and N3 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 (4), Cross section area of all elements is 250 mm^2 & E = 200 GPa **16**

i) Determine element stiffness matrix for each element.

ii) Assemble the structural stiffness matrix for entire truss.

iii) Find nodal displacement.

iv) Find stresses in all elements.

v) Calculate the reaction force.

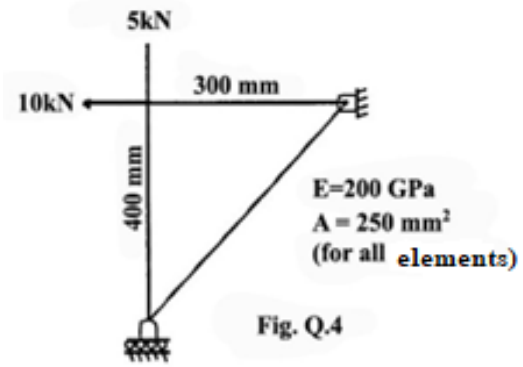


Fig. Q.4

OR

10. Write short notes on **any four.** **16**

a) Solution methodologies in Finite Element Method

b) Principle of Minimum Potential Energy

c) Constant strain Triangle

d) Properties of Stiffness matrix

e) Discretization of the continuum

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