M.E. Second Semester (Mechanical Engineering (CAD/CAM)) (F.T.) (CGS)

13493 : Finite Element Analysis : 2 MCC 1

P. Pages : 3
Time : Three Hours

* 1 0 4 9 *

AW - 3735
Max. Marks : 80

Notes :
1. All question carry indicated marks.
2. Answer **any three** question from Section A and **any three** question from Section B.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Retain the construction lines.
6. Illustrate your answer necessary with the help of neat sketches.
7. Use of pen Blue/Black ink/refill only for writing the answer book.

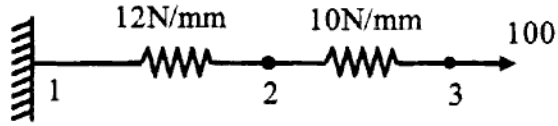
SECTION – A

1. a) Explain the meaning and scope of FEA in engineering and technology. **7**

b) Explain potential energy method in FEA with the help of suitable example. **7**

2. a) Explain the plane stress condition of solid mechanics. Give the relevant constitutive relationship. **5**

b) Fig. Q. 2 (b) shows two springs connected in series using FEM. Determine the reaction forces at the support. **8**



3. a) What do you mean by axisymmetric problems? Give constitutive relation for a 2D axisymmetric problem of elasticity. **6**

b) Derive the expression for the element strain displacement matrix (B) for the two noded 1D bar element. **7**

4. An axial load of P = 350 kN is applied at 20°C to the rod shown in fig. Q. 4. The temperature is then raised to 60°C. Determine the element stresses. **13**

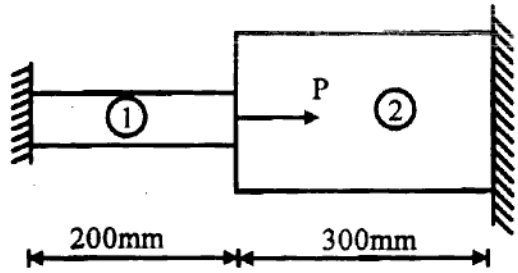


Fig. Q. 4

$E_1 = 70\,GN/m^2$ $E_2 = 200\,GN/m^2$

$A_1 = 900\,mm^2$ $A_2 = 1200\,mm^2$

$\alpha_1 = 23 \times 10^{-6}/°C$ $\alpha_2 = 11.7 \times 10^{-6}/°C$

5. The plain wall shown in fig. Q. 5 is 750 mm thick. The left surface of the wall is maintained at a constant temperature of 300°C and the right surface is insulated. The thermal conductivity is 25 W/m°C and there is a uniform generation of heat inside the wall of $400\ W/m^3$. Determine the temperature distribution through the wall thickness. Discretize the wall into three equal elements. **13**

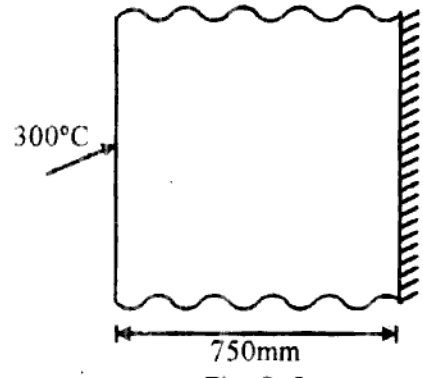


Fig. Q. 5

SECTION – B

6. a) Write the governing equations for the laminar flow of viscous incompressible fluid. **6**

b) Given that : **7**

$$A = \begin{bmatrix} 8 & -2 & 0 \\ -2 & 4 & -3 \\ 3 & -3 & 0 \end{bmatrix} \quad d = \begin{Bmatrix} 2 \\ -1 \\ 3 \end{Bmatrix}$$

Find :

i) $I - d^T d$

ii) det A

7. a) Formulate the element stiffness matrix and global stiffness matrix for 2D bar element. **8**

b) Explain the terms 'Eigen values' and 'Eigen vectors'. **5**

8. For the 2D loaded plate shown in figure Q. 8. Determine the material property matrix (D) and the strain – displacement matrix (B^e) for the two elements using plane stress condition. Take thickness of the plate = 5mm and $E = 30 \times 10^9\ N/m^2$. Assume $V = 0.25$. **14**

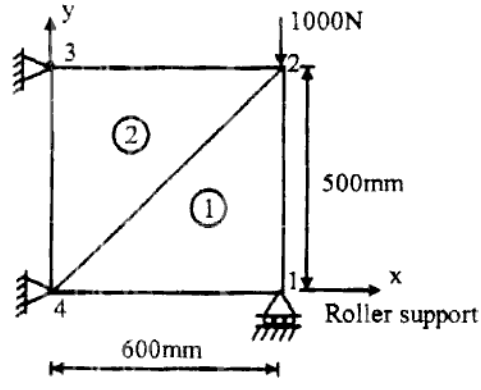


Fig. Q. 8

9. For the smooth pipe of variable cross – sections shown in fig. Q. 9, Determine the potentials at the junctions, the velocities in each section of pipes and the volumetric flow rates. The potential at the left end is $10\,m^2/s$ and at the right end is $1\,m^2/s$. **13**

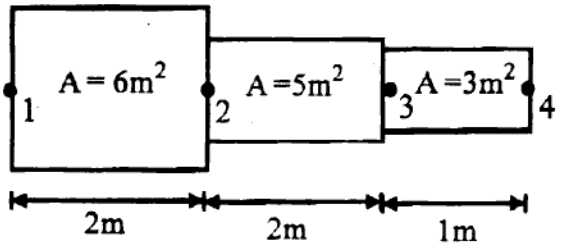


Fig. Q. 9

10. a) Derive the finite element characteristic equation for the circular bar subjected to torsion. 6

b) What are the desirable features of FEA packages? 7

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