B.E. Eighth Semester (Mechanical Engineering) (C.B.S.)

Elective - II : Finite Element Methods

P. Pages : 4 **KNT/KW/16/7582**

Time : Three Hours * 0 2 2 1 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Due credit will be given to neatness and adequate dimensions.
7. Assume suitable data whenever necessary.
8. Illustrate your answers whenever necessary with the help of neat sketches.
9. Use of non programmable calculator is permitted.

1. a) What is the difference between FEA and FEM? **3**

b) Derive the shape function for a bar member having cross sectional area 'A', length 'L' and modulus of elasticity 'E', when it is discretized using 2 nodes. **4**

c) For the step shaft shown in the figure 1 (c) calculate the following : **13**

i) Nodal displacement

ii) Stress in each section

iii) Support reaction

Given : E = 210 GPa.

$d_1 = 30\,mm;\ d_2 = 28\,mm;\ d_3 = 24\,mm$

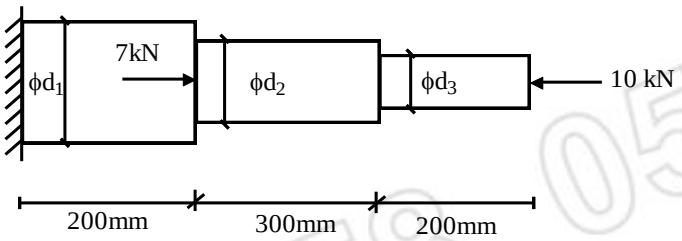


Fig. 1(c)

2. a) What is the difference between plane stress and plane strain elements. Explain with suitable examples. **5**

b) For the step shaft shown in the figure 2 (b) Calculate nodal displacement, stress in each section and support reaction when the shaft is subjected to a temperature rise of 80ºC. **15**

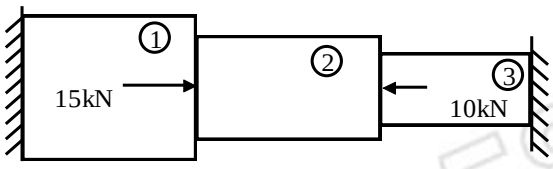


Fig. 2(b)

	(1)	(2)	(3)
AREA	$2000\,mm^2$	$1600\,mm^2$	$1200\,mm^2$
E	83 GPa	70 GPa	200 GPa
α	$18.9\times10^{-6}/^oC$	$23\times10^{-6}/^oC$	$11.7\times10^{-6}/^oC$
L	600 mm	400 mm	200 mm

3. a) For the truss shown in the figure 3 (a) having members with cross sectional area $600\,mm^2$ and Young's modulus of 70 GPa Calculate the following : **13**

i) Nodal displacement ii) Elemental stresses

iii) Support reaction

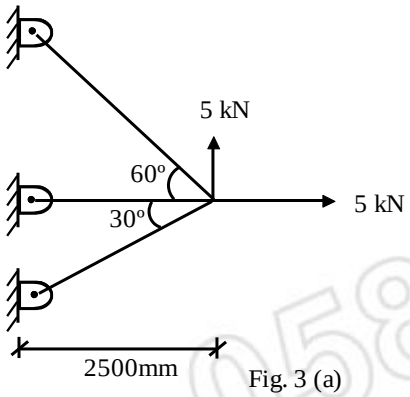


Fig. 3 (a)

b) Derive the element stiffness matrix for a truss member. **7**

4. a) For the beam shown in the figure 4 (a) calculate nodal deformations and deflection at mid span of first member. If the modulus of elasticity of members is 200 GPa and moment of inertia is $4\times10^{-4}\,m^4$. **15**

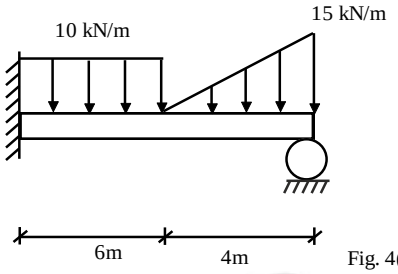


Fig. 4(a)

b) Describe the space truss along with its stiffness matrix. **5**

5. a) What is isoparametric formulation? What is the difference between super parametric and sub parametric formulations? **6**

b) For a plane stress element shown in the figure 5 (b) calculate the nodal displacements, elemental stresses and support reactions. If the thickness of the element is 10 mm. Young's modulus 200 GPa and Poisson's ratio 0.3. **14**

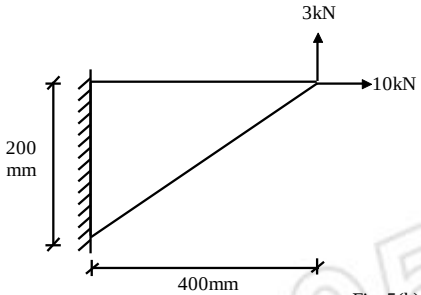


Fig. 5(b)

6. a) The rigid beam was level before the load was applied. Find stress in each vertical member. **13**

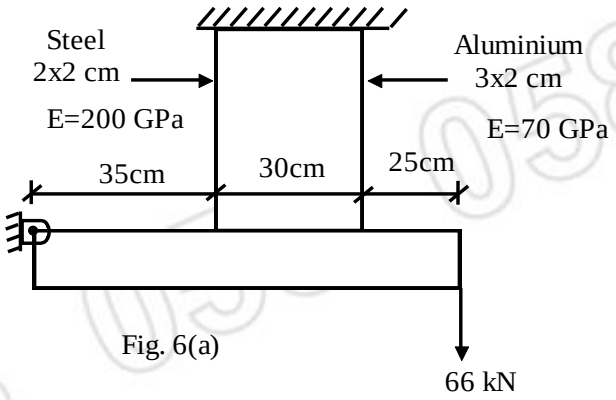


Fig. 6(a)

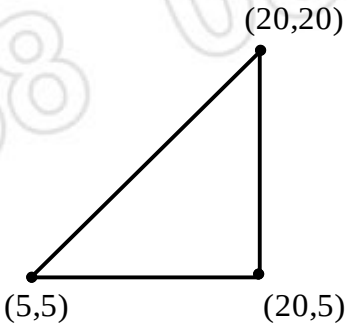
b) For a plane stress element shown in the figure the nodal displacements are **7**

$U_1 = 0.005\,\text{mm};\ V_1 = 0.002\,\text{mm}$

$U_2 = 0\,\text{mm};\ V_2 = 0\,\text{mm}$

$U_3 = 0.005\,\text{mm};\ V_3 = 0\,\text{mm}$

Calculate elemental stresses, principle stresses and principle angle thickness of plate 10 mm, E = 70 GPa, Poisson's ratio 0.29



7. a) What is pre processing, processing and solving? Explain with proper examples. **3**

b) What is finite element meshing? Explain various meshing techniques? **4**

c) For a composite wall shown in the figure 7 (c) the thermal conductivity of wall (1) is $0.012\,\text{w/cm}^{\circ}\text{C}$, wall (2) is $0.0014\,\text{w/cm}^{\circ}\text{C}$ and wall (3) is $0.0086\,\text{w/cm}^{\circ}\text{C}$. The left most wall is kept at 50°C and the right most wall is kept at - 10°C. Determine the temperature distribution within the wall. Assume cross-sectional area of the wall to be 1cm^2. **13**

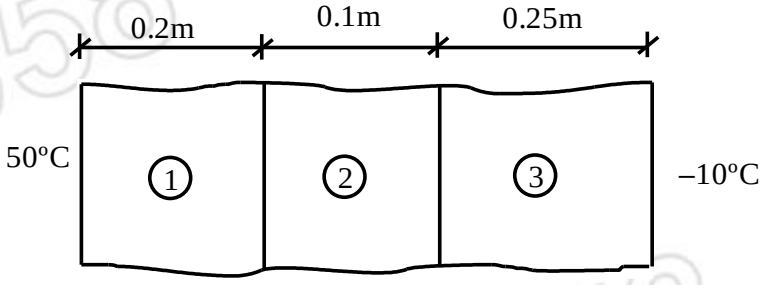


Fig. 7 (c)

8. a) What is the difference between static and dynamic finite element analysis, explain with suitable examples. **4**

b) What does mode shapes signify in an eigen value problem? **3**

c) Find the natural frequency of free vibration for the bar as shown in the figure 8 (c). Discretize the bar using 2 elements. Let $\rho = 7800\,kg/m^3$ and E = 210 GPa. **13**

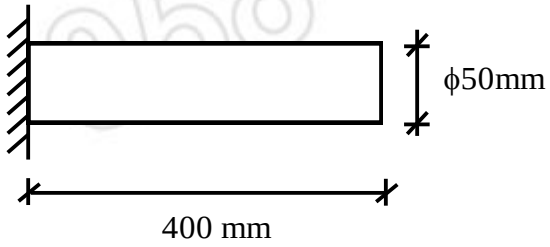


Fig. 8 (c)

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