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

13493 : Finite Element Analysis : 2 MCC 1

P. Pages : 3 | **AW - 3464**

Time : Three Hours | Max. Marks : 80

* 0 3 3 1 *

Notes :
1. All question carry marks as indicated.
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 Galarkins method in FEA, with the help of suitable example. **7**

b) Differentiate between FEM and FDM. **4**

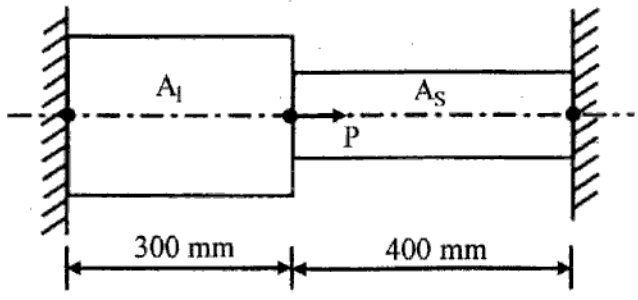
c) State and explain Saint Venant's principle. **3**

2. a) Use Galarkins method and trial function $T_R = a_0 + a_1 x + a_2 x^2$ to obtain the approximate solution of $\frac{d^2T}{dx^2} = \frac{Q}{K}$ with boundary condition $T(0) = 0, T(L) = 0$. Obtain parameter a_1. **9**

b) Explain the plane stress condition of solid mechanics. Give the relevant constitutive relationship. **4**

3. An axial load of 200 kN is applied at 25°C to the bar as shown in fig. (3.1). The temp. as then raised to 50°C. The coefficient of thermal expansion for aluminum rod is 23×10^{-6} /°C and steel are 11.7×10^{-6} /°C. Using Finite element method. **13**

Determine :
i) The nodal displacement
ii) The stresses in each material and
iii) The reaction forces at supports.



(Fig - 3.1)

$\alpha_A = 23\times10^{-6}$ /°C ; $\alpha_S = 11.7\times10^{-6}$ /°C

$E_A = 70\times10^3$ N/mm^2 ; $E_S = 200\times10^3$ N/mm^2

$A_1 = 2400$ mm^2 ; $A_S = 600$ mm^2

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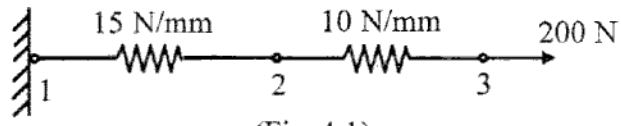
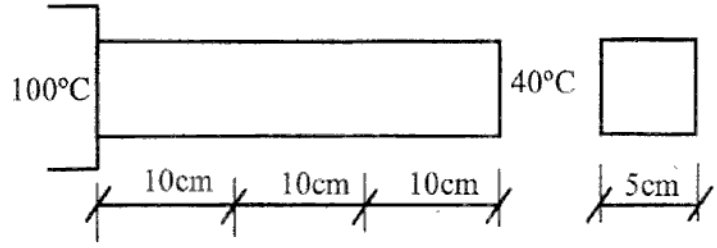
4. (Fig. 4.1) shows two springs connected in series using FEM, Determine : **13**



(Fig. 4.1)

i) The deflection of individual spring and
ii) The reaction force at the support.

5. A square fin is attached to a base at a temp. of 100°C as shown in (fig. 5.1). The length of the fin is 30 cm and has square section of side 5 cm. Assume the thermal conductivity of fin is 37 W/m°k and convention heat transfer coefficient is 10 W/m^{2}k. Find the temp. at 10 cm, 20 cm and 30 cm. From base if it is exposed at 40°C. **13**



(Fig. 5.1)

SECTION – B

6. a) What are the desirable features of FEA packages. **7**

b) Write one dimensional Finite Element formulation for heat conduction. **6**

7. a) In a triangular element the nodes 1, 2 and 3 have Cartesian co-ordinates (20, 30), (130, 60) and (70, 130) respectively. The displacement in mm at nodes 1, 2 and 3 are (0.05, 0.25), (0.3, 0.25) and (0.2, 0.15) respectively. The point 'X' within the element has Cartesian co-ordinates (68, 86). **9**

Determine for point 'X'

i) The natural co-ordinates,
ii) Shape functions, and
iii) The displacements.

b) Explain the preprocessor steps. **4**

8. a) Derive the Finite Element characteristic equation for the circular bar subjected to torsion. **8**

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

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9. For the smooth pipe of variable cross section shown in (figure 9.1). Determine potential at the junction, the velocities in each section of pipe and volumetric flow rates. The potential at left end is $10\,m^2/sec$ and right end is $1\,m^2/sec$. **13**

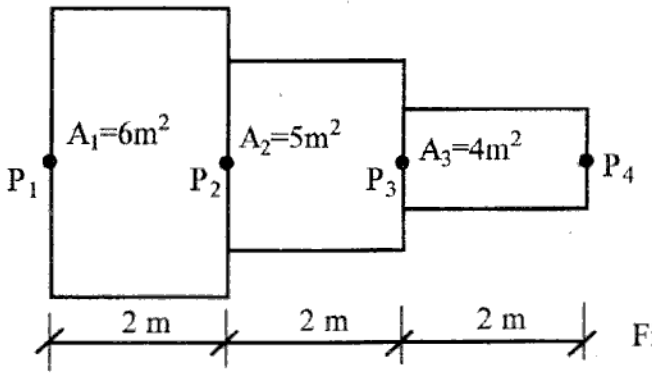
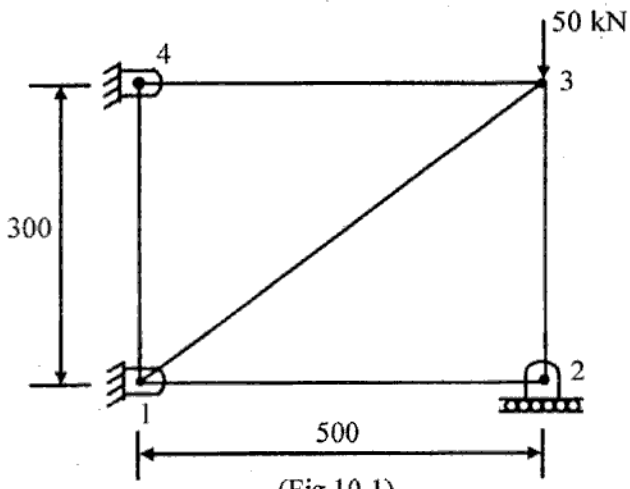


Fig. 9.1

10. For the 2D loaded plate of thickness 20 mm. Determine displacement at node 2 and 3 and element stresses by considering plate assembly two triangular element as shown in (figure 10.1). **14**



(Fig 10.1)

Take : $\nu = 0.3$, $E = 200\times10^9\ N/m^2$

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