FACULTY OF ENGINEERING

B.E. 4/4 (Mech./Prod.) I – Semester (New) (Main) Examination, December 2013

Subject : Finite Element Analysis

Time : 3 hours   **Max. Marks : 75**

Note: Answer all questions from Part-A. Answer any FIVE questions from Part-B.

PART – A (2.5 x 10 = 25 Marks)

1. In a plane strain problem $\sigma_{xx} = 2 \, x \, 10^5$ N/m^2, $\sigma_{yy} = 10 \, x \, 10^5$ N/m^2;
    $E = 0.8 \times 10^9 \; N/m^2$ and $\nu = 0.3$. Determine the value of σ_{z2} ?

2. The strain at any point in a rod which is subjected to axial loading is given by
    E_{xx} = 1 + 2x^2. Determine the displacement at force end. Take length of the rod is
    L and is fixed at one end.

3. Draw neatly the shape functions of bar element.

4. Explain how the displacement boundary condition can be handled by penalty approach.

5. Discuss in what way a frame element will differ from beam element.

6. State strain displacement relations of an axi-symmetric body subjected to axi-symmetric loading.

7. Represent constant strain triangle element isoparametrically.

8. State the boundary conditions incase of one-dimensional heat transfer in a fin?

9. State the governing differential equation of heat transfer in three dimensional bodies in Cartesian co-ordinates.

10. Discuss the convergence requirements of finite element method.
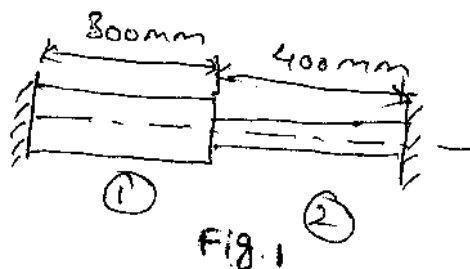
PART – B (50 Marks)

11. For the following state of smell and strain determine
    a) Whether the equilibrium equations are satisfied (or) not?   (6)
    b) Whether the compatibility equations are satisfied (or) not?   (4)

$$\sigma_{xx} = x^2, \qquad \sigma_{yy} = y^2, \qquad \sigma_{zz} = 0$$
$$v_{xy} = -2xy, \qquad v_{xz} = v_{yyz} = 0$$

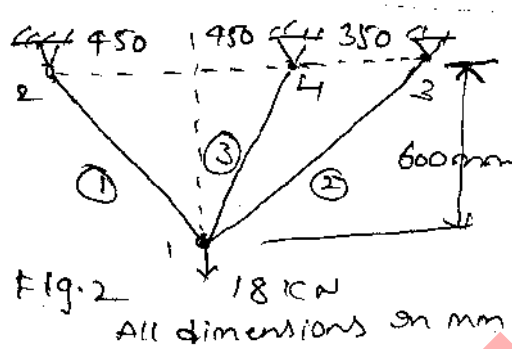12. An axial load P = 200 x 10^{3}N is applied as shown in fig.1. Determine.

    a) Modal displacements
    b) Stress in each material
    c) Reaction forces

Fig. 1

A$_1$ = 2400 mm^2 A$_2$ = 600 mm^2
G = 70 x 10^9 N / m^2 E$_2$ = 200 x 10^9 N / m^2

13. For the three bas truss shown in fig.2 determine the displacement of node 1 and the stress in element 3. Take A = 250 mm^2 E = 200 GPa.

Fig.2

All dimensions on mm

14. Determine the deflection at the midpoint of the fixed-fixed beam subjected to uniformly distributed load qN/m over length by finite element method?

15. Determine the element stiffness matrix for the plane stress element shown in fig.3. Take E = 15 x 10^6 N/cm^2 v = 0.25 , t = 0.5 cm

Fig.3
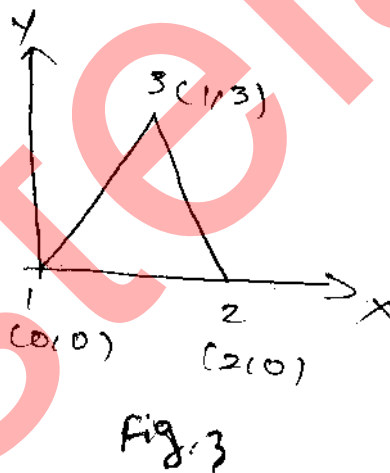
16. A metallic fin which is 1 mm thick and 600mm long extends from a plane wall whose temperature is 300^{0}c. Determine the temperature distribution from the fin to the air at 20^{0}c with h = 9 W / m^2 ^{0}c. Take thermal conductivity of fin K = 20 W/m ^{0}c width of fin is 100 mm.

17. Derive the consistent mall matrix for truss element.

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