(b) The nodal co-ordinates for an axisymmetric triangular element are given in Fig 14(b). Evaluate the strain-displacement matrix. (16)

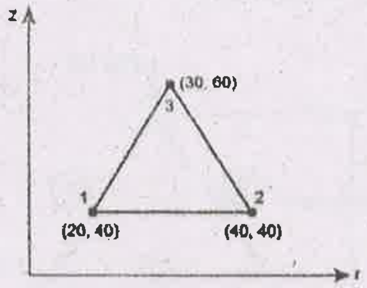

Fig 14(b)

15. (a) For the isoparametric quadrilateral element shown in Fig.15(a), the Cartesian coordinates of point 'P' are (6,4). The loads 10 kN and 12 kN are acting in x and y direction on that point P. Evaluate the nodal forces. (16)

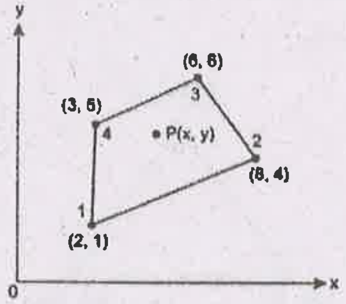

Fig 15(a)

Or

(b) Evaluate the Jacobian matrix for the isoparametric quadrilateral element shown in Fig.15(b). (16)

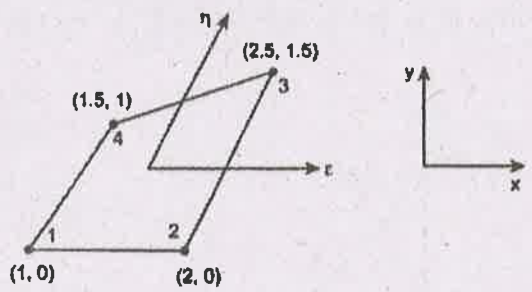

Fig. 15 (b)

Reg. No. :

Question Paper Code : 72163

20/05/2017 FN

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Sixth/Seventh Semester

Mechanical Engineering

ME 6603 — FINITE ELEMENT ANALYSIS

(Common to Mechanical Engineering (Sandwich)/Automobile Engineering/Manufacturing Engineering/Mechanical and Automation Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by constitutive law?

2. Why polynomial type interpolation functions are mostly used in FEM?

3. Write down the expression of longitudinal vibration of bar element.

4. What are the difference between boundary value problem and initial value problem?

5. What is QST Element?

6. Write down the stress-strain relationship matrix for plane strain condition.

7. What are the assumptions used in thin plate and thick plate elements?

8. What are the ways which a three dimensional problems can be reduced to a two dimensional approach?

9. What are essential and natural boundary conditions? Give some examples.

10. Write down the stiffness matrix equation for four noded isoparametric element.

PART B — (5 × 16 = 80 marks)

11. (a) The following differential equation is available for a physical phenomenon.

$$\frac{d^2y}{dx^2} + 50 = 0 \; ; \; 0 \le x \le 10 .$$

The Trial function is $y = a_1 x(10 - x)$

The boundary conditions are : $y(0) = 0$, $y(10) = 0$.

Find the value of the parameter a_1 by the following methods.

(i) Least square method

(ii) Galerkin's method. (16)

Or

(b) Find the deflection at the centre of the simply supported beam of span length 'l' subjected to uniformly distributed load throughout its length as shown in Fig. 11(b) using (i) point collocation method (ii) sub-domain method. (16)

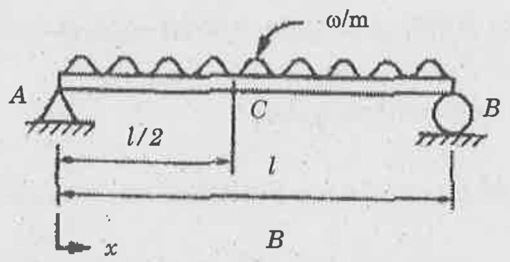

Fig. 11(b)

12. (a) Consider a bar as shown in Fig 12(a). An axial load of 200 kN is applied at point p. Take A_1 = 2400 mm², E_1 = 70 × 10⁹ N/mm², A_2 = 600 mm², E_2 = 200 × 10⁹ N/mm². Calculate the following, (i) The nodal displacement at point p, (ii) Stress in each element (iii) Reaction force. (16)

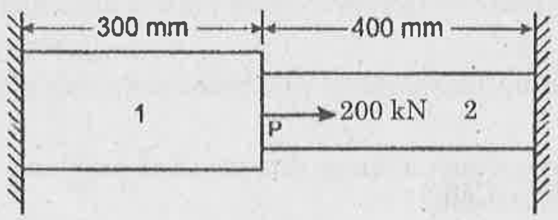

Fig.12(a)

Or

(b) Consider a three bar truss as shown in Fig.12(b). Take $E = 2 \times 10^5$ N/mm². Calculate the nodal displacement. Take $A_1 = 2000\,mm^2$, $A_2 = 2500\,mm^2$, $A_3 = 2500\,mm^2$. (16)

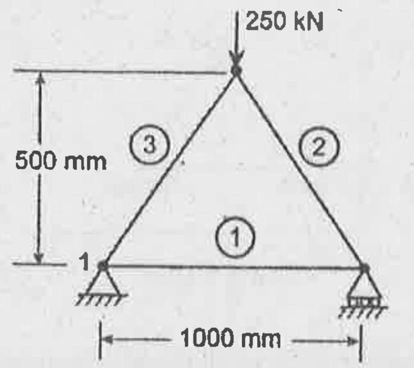

Fig. 12 (b)

13. (a) Determine the stiffness matrix for the CST Element shown in Fig 13(a). The coordinates are given in mm. Assume plane strain conditions. $E = 210\ GPa$, $\nu = 0.25$ and $t = 10\ mm$. (16)

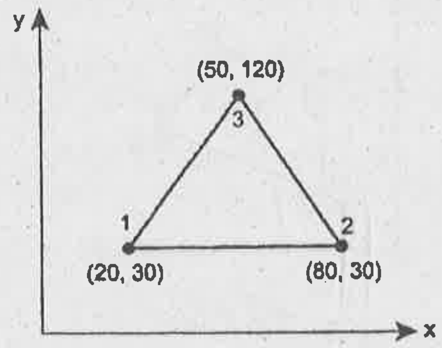

Fig 13(a)

Or

(b) Derive the expression of shape function for heat transfer in 2D element. (16)

14. (a) Determine the stiffness matrix for the axisymmetric element shown in Fig 14(a). Take E is 2.1 × 10⁵ N/mm², ν = 0.25. The coordinates are in mm. (16)

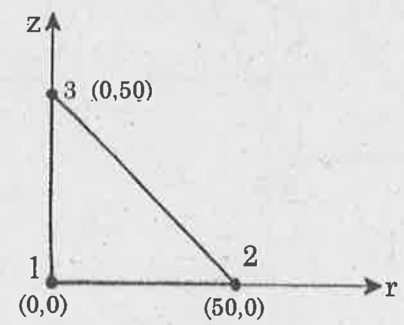

Fig 14(a)

Or