LIB 28/5/13 FN

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 21574

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Sixth Semester

Mechanical Engineering

ME 2353/ME 63/10122 ME 605 — FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering)

(Regulation 2008/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Why are polynomial type of interpolation functions preferred over trigonometric functions?

2. What is meant by weak formulation?

3. Differentiate global and local coordinates.

4. What are the types of problems treated as one dimensional problems?

5. What is geometric Isotropy?

6. Define a plane stress problem with a suitable example.

7. What is meant by mode superposition technique?

8. Define normal modes.

9. Define element capacitance matrix for unsteady state heat transfer problems.

10. Define the stream function for a two dimensional incompressible flow.

PART B — (5 × 16 = 80 marks)

11. (a) Solve the differential equation for a physical problem expressed as $\frac{d^2y}{dx^2} + 100 = 0, 0 \leq x \leq 10$ with boundary conditions as $y(0) = 0$ and $y(10) = 0$ using .

(i) point collocation method (4)

(ii) sub domain collocation method (4)

(iii) least squares method and (4)

(iv) Galarkin's method. (4)

Or

(b) A simply Supported beam subjected to uniformly distributed load over entire span and it is subjected to a point load at the centre of the span. Calculate the deflection using Rayleigh-Ritz method and compare with exact solutions.

12. (a) Derive the shape functions for one dimensional linear element using direct method.

Or

(b) The loading and other parameters for a two bar truss element is shown in fig 12(b). Determine

(i) the element stiffness matrix for each element (4)

(ii) global stiffness matrix (3)

(iii) nodal displacements (3)

(iv) reaction forces (3)

(v) the stresses induced in the elements. Assume $E = 200$ GPa. (3)

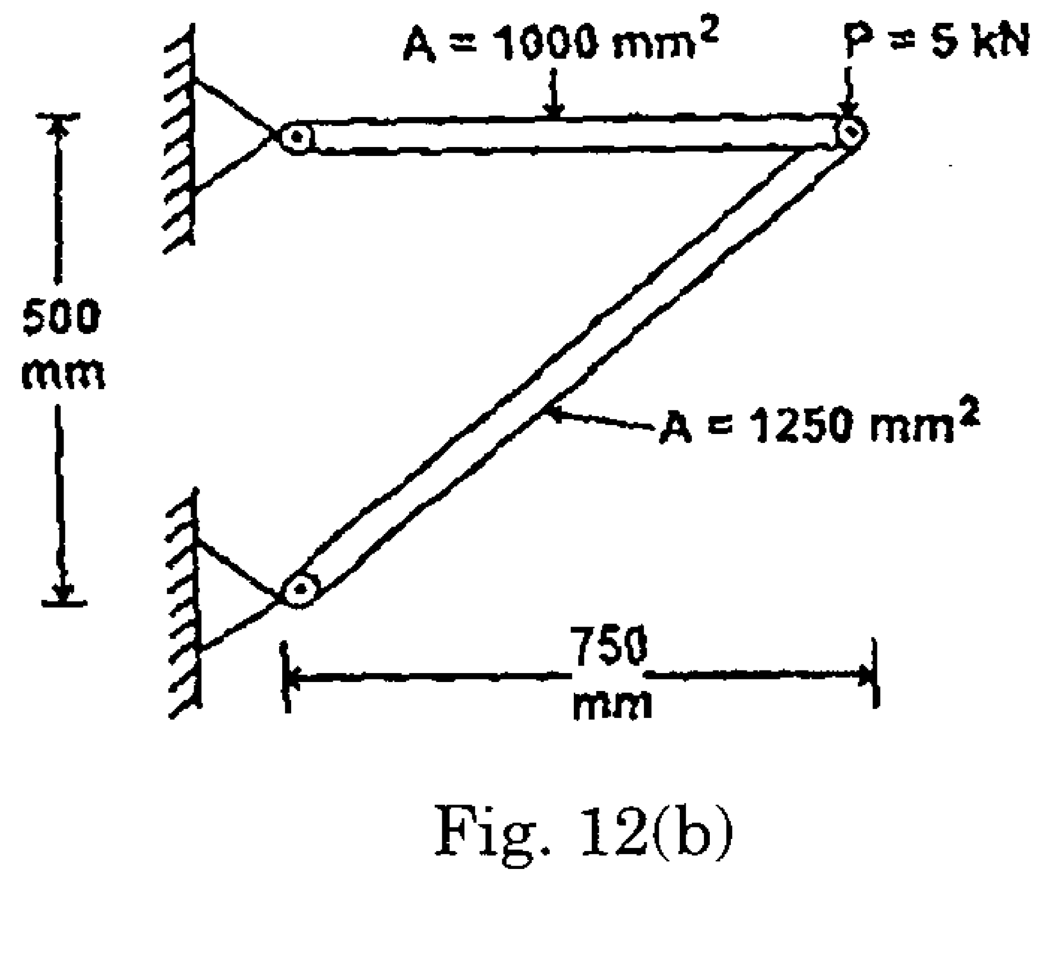

Fig. 12(b)

13. (a) Calculate the value of pressure at the point A which is inside the 3 noded triangular element as shown in fig 13(a). The nodal values are $\phi_1 = 40$ MPa, $\phi_2 = 34$ MPa and $\phi_3 = 46$ MPa, Point A is located at (2, 1.5) Assume pressure is linearly varying in the element. Also determine the location of 42 MPa contour line.

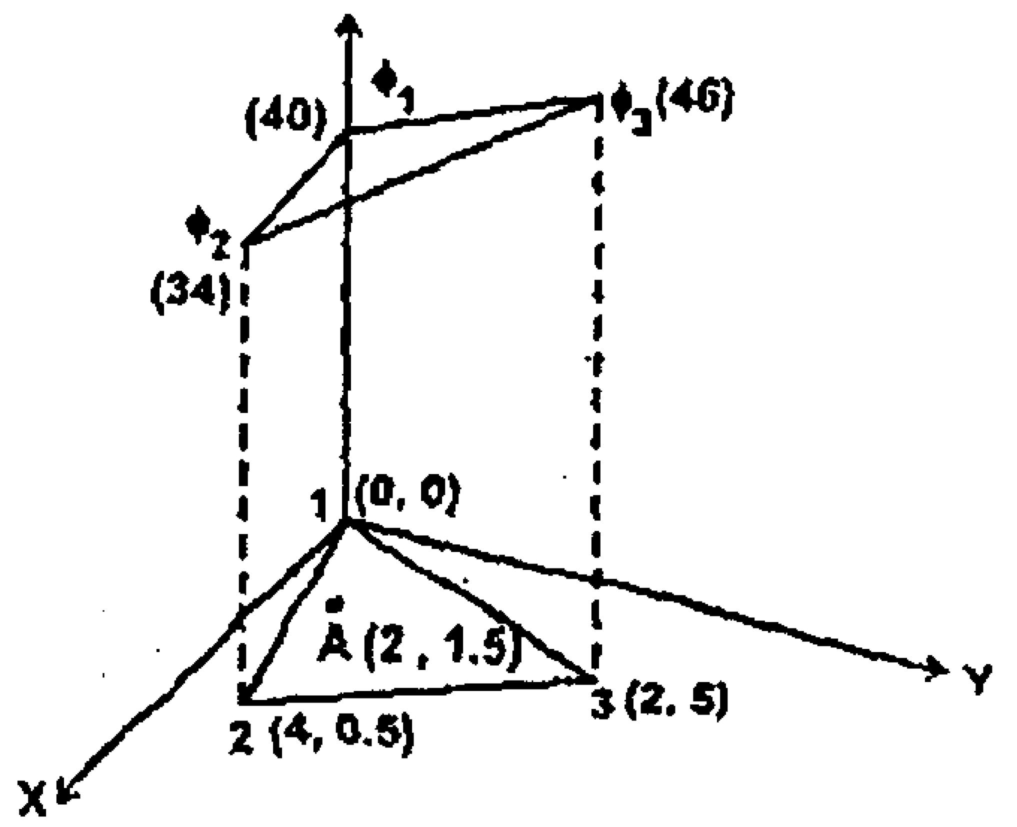

Fig. 13(a)

Or

(b) For the plane stress element whose coordinates are given by (100,100), (400, 100) and (200, 400), the nodal displacements are $u1 = 2.0\,\text{mm}$, $v1 = 1.0\,\text{mm}$, $u2 = 1.0\,\text{mm}$, $v2 = 1.5\,\text{mm}$, $u3 = 2.5\,\text{mm}$, $v3 = 0.5\,\text{mm}$. Determine the element stresses. Assume $E = 200$ GN/m², $\mu = 0.3$ and $t = 10$ mm. All coordinates are in mm.

14. (a) Use iterative procedures to determine the first and third eigen values for the structure shown in fig 14(a). Hence determine the second eigen value and the natural frequencies of building. Finally, establish the eigen vectors and check the rest by applying the orthogonality properties of eigen vectors.

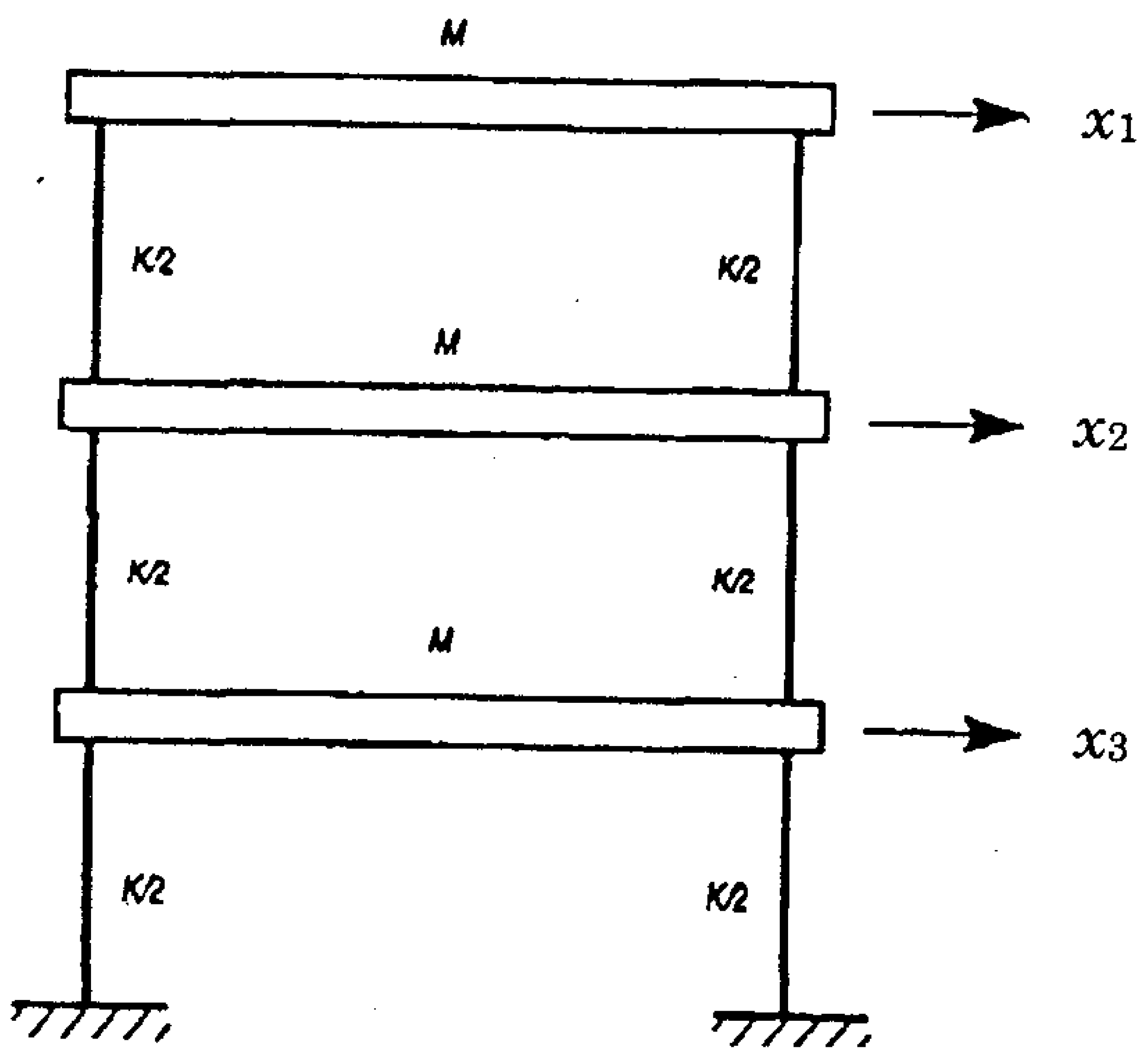

Fig. 14(a) Three-storey shear structure

Or

(b) Consider a uniform cross section bar, as shown in fig 14(b) of length L made up of material whose young's modulus and density is given by E and ρ. Estimate the natural frequencies of axial vibration of the bar using both consistent and lumped mass matrices.

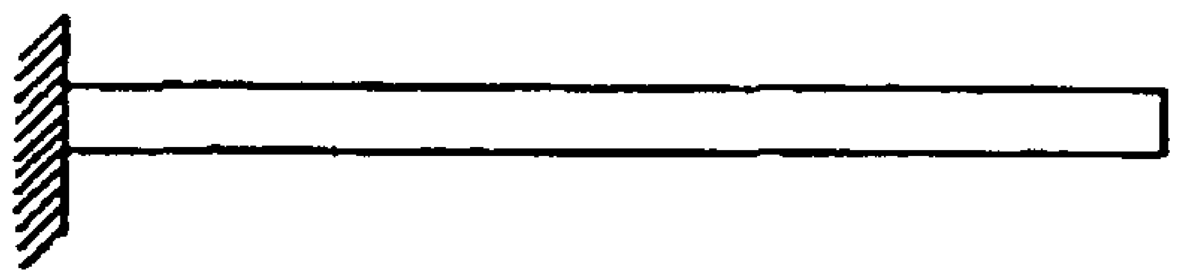

Fig. 14(b)

15. (a) Derive a finite element equation for one dimensional heat conduction with free end convection.

Or

(b) (i) In the finite element analysis of a two dimensional flow using triangular elements, the velocity components u and v are assumed to vary linearly within an element(e) as

$$u(x,y) = a_1 U_i^{(e)} + a_2 U_j^{(e)} + a_3 U_k^{(e)}$$

$$v(x,y) = a_1 V_i^{(e)} + a_2 V_j^{(e)} + a_3 V_k^{(e)}$$

where $\left(U_i^{(e)}, V_i^{(e)}\right)$ denote the values of (u, v) at node i. Find the relationship between $\left(U_i^{(e)}, V_i^{(e)} \ldots V_k^{(e)}\right)$ which is to be satisfied for the flow to be incompressible. (8)

(ii) Explain the potential function formulation of finite element equations for ideal flow problems. (8)