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Question Paper Code : 60861

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Sixth Semester

Mechanical Engineering

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

(Common to Automobile Engineering, Mechanical and Automation Engineering, Industrial Engineering and Management and Seventh Semester Mechanical Engineering [Sandwich])

(Regulations 2008/2010)

Time : Three hours   Maximum : 100 marks

(Any missing data may be suitably assumed)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by node?

2. What is Rayleigh- Ritz method?

3. Give the Lagrangen equation of motion and obtain the shape functions for quadratic coordinate transformation.

4. Write about the effective global nodal forces of beam element.

5. What is geometric Isotropy?

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

7. What is the principle of mode superposition technique?

8. Specify the Consistent mass matrix for a beam element.

9. Derive the convection heat transfer matrix for a 1 D linear bar element.

10. Write down the conduction heat transfer matrix for a three noded linear triangular element.

PART B — (5 × 16 = 80 marks)

11. (a) Solve the following differential equation using Galerkin's method of weighted residuals.

$$\frac{d^2y}{dx^2}+y=4x;\ 0\le x\le 1 \text{ with boundary conditions } y(0)=0,\ y(1)=1. \qquad (16)$$

Or

(b) A simply supported beam is subjected to uniformly distributed load over entire span as shown in Fig. Q. 11(b). Determine the bending moment and deflection at midspan by using Rayleigh Ritz method. (16)

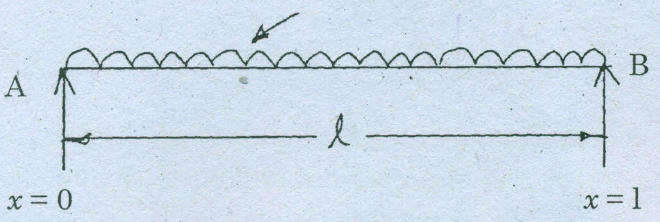

Fig Q. 11(b)

12. (a) Determine the nodal displacement, element stresses and support reactions in the truss element shown in figure 12 (a). Assume that points 1 and 3 are fixed. Take E = 70 GPa, and A = 200 mm^2

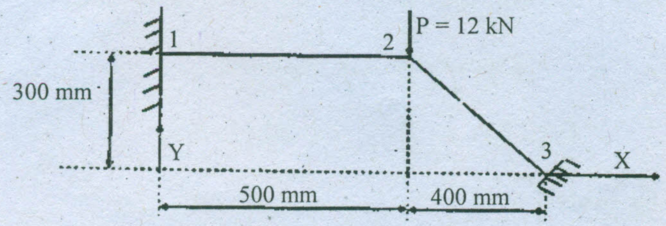

Figure 12 (a).

Or

(b) For the beam shown in figure 12 (b), determine the displacements and the slopes at the nodes, the forces in each element and the reactions. E = 200 GPa, I = 1 × 10^{-4} m^4.

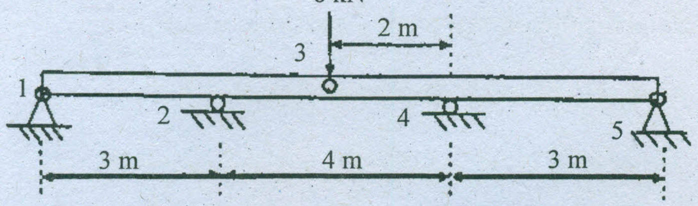

Figure 12 (b).

13. (a) Establish the body force and traction force (uniformly distributed) vector for a lower order quadrilateral element.

Or

(b) (i) Derive the expression for nodal vector in a CST element subjected to pressures P_{x1}, P_{y1} on side 1, P_{x2}, P_{y2} on side 2 and P_{x3}, P_{y3} on side 3 as shown in Fig. 13 (b). (10)

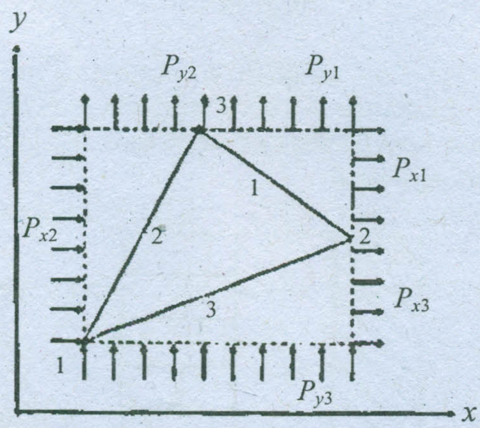

Fig. 13 (b).

(ii) Establish any two shape functions corresponding to one corner node and one mid-node for an eight node quadrilateral element. (6)

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.

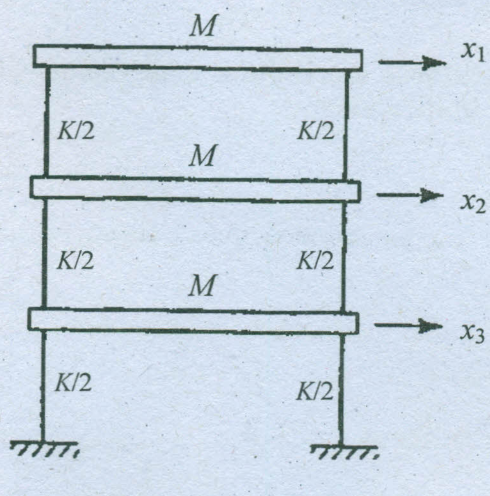

Fig. 14 (a) Three-storey shear structure

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.

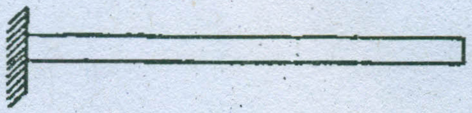

Fig. 14 (b)

15. (a) A composite wall consists of three materials as shown in Fig. 15(a). The inside wall temperature is 200°C and the outside air temperature is 50°C with a convection coefficient of 10 W/cm^2 °C. Determine the temperature along the composite wall.

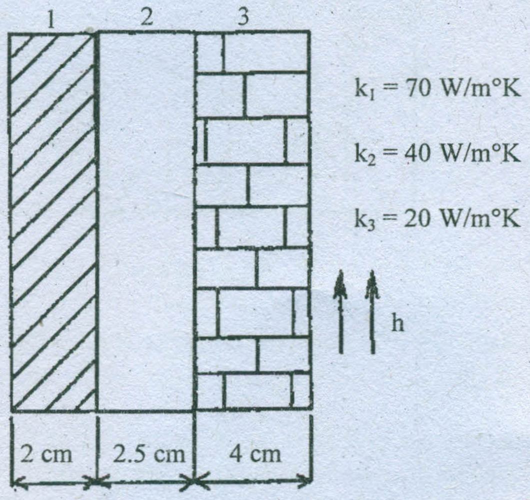

Fig. 15 (a)

Or

(b) Derive the stiffness matrix and load vectors for fluid mechanics in two dimensional finite element. (16)