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Question Paper Code : 73856

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

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 — ($10 \times 2 = 20$ marks)

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

2. What is meant by weak formulation?

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. Write down the shape functions associated with the three noded linear triangular element and plot the variation of the same.

6. Give at least one example each for plane stress and plane strain analysis.

7. Define dynamic analysis.

8. What is meant by transverse vibrations?

9. What are the boundary conditions in FEA heat transfer problem?

10. State Darcy's law of fluid flow for finite element analysis.

PART B — (5 × 16 = 80 marks)

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

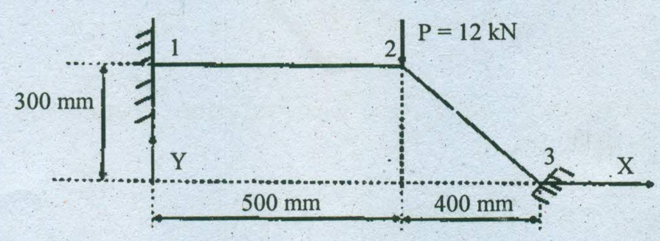

Figure 12 (a).

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

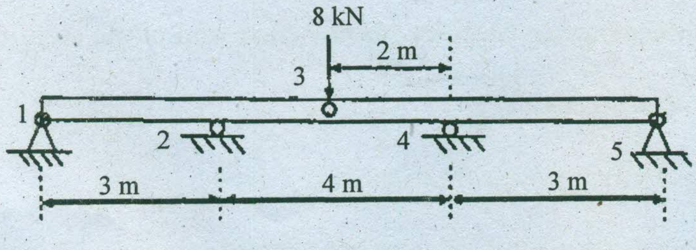

Figure 12 (b).

13. (a) For the constant strain triangular element show in fig. Q13 (a) assemble strain-displacement matrix. Take $t = 20$ mm and $E = 2 \times 10^5$ N/mm^2. (16)

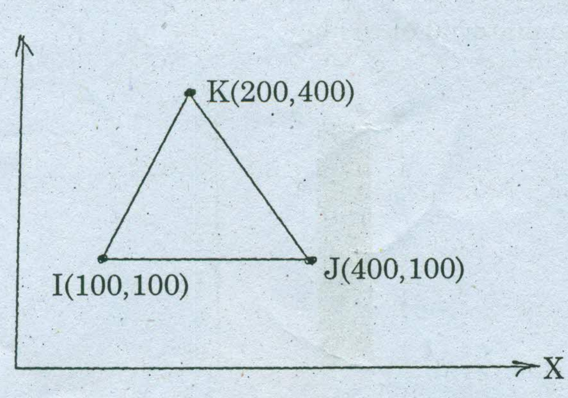

Fig. Q. 13(a)

Or

(b) For the isoparametric four noded quadrilateral element shown in figure Q13(b) determine the cartesian co-ordinates of point P which has local co-ordinates $\varepsilon = 0.5$ and $\eta = 0.5$. (16)

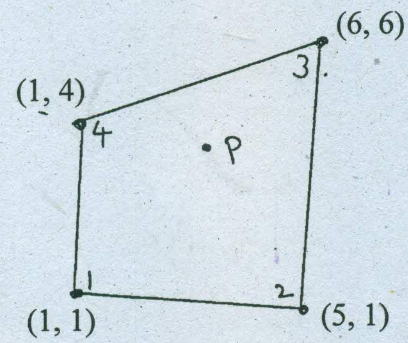

Fig. Q. 13(b)

14. (a) Determine the first two natural frequencies of transverse vibration of the cantilever beam shown in Fig.14(a) and plot the mode shapes.

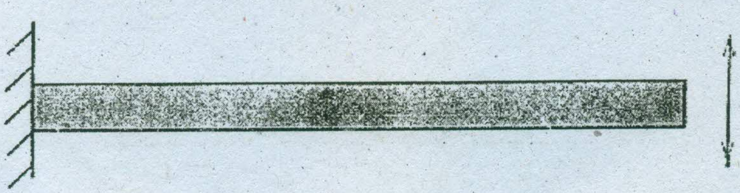

Fig 14(a)

Or

(b) Determine the first two natural frequencies of longitudinal vibration of the bar shown in Fig. 14(b) assuming that the bar is discretised into two elements as shown. E and ρ represent the Youngs Modulus and mass density of the material of the bar.

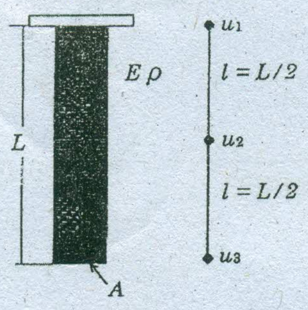

Fig 14(b)

15. (a) The figure 15 (a) shows a uniform Aluminum fin of diameter 25 mm. The root (left end) of the fin is maintained at a temperature of T_0 = 120 °C, convection takes place from the lateral (circular) surface and the right (flat) edge of the fin. Assuming k = 200 W/m °C, h = 1000 W/m^2 °C and T = 20 °C, determine the temperature distribution in the fin using one dimensional element, considering two elements.

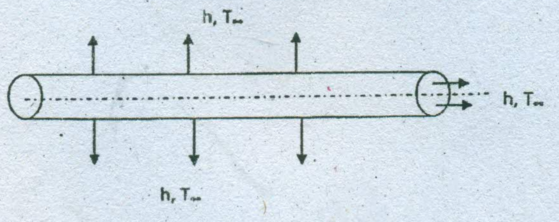

Figure 15 (a)

Or

(b) For the two dimensional sandy soil region shown in the figure 15 (b), determine the potential distribution. The potentional (fluid head) on the left side is 10 m and that on the right side is 0.0 m. The permeabilities are $K_{41} = K_{32} = 25 \times 10^{-5}$ m/s and $K_{34} = K_{12} = 0$ Assume unit thickness.

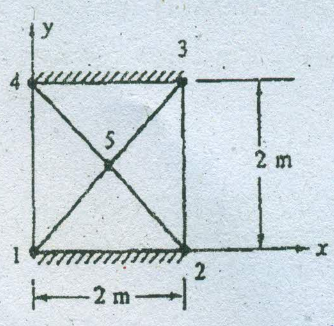

Figure 15 (b)