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Question Paper Code : 91664

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

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)

(Regulation 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. List the various weighted residual methods.

2. Compare the Ritz technique with the nodal approximation method.

3. Write the stiffness matrix for a 1D two noded linear element.

4. Give the properties of shape function.

5. Why a CST element so called?

6. What are the ways by which a 3D problem can be reduced to a 2D problem?

7. What is the advantages of Natural Co-ordinate system?

8. Write the analogies between structural, heat transfer and fluid mechanics.

9. Write the shape functions for a 1D quadratic iso parametric element.

10. Name a few FEA packages.

PART B — (5 × 16 = 80 marks)

11\. (a) Using Collocation method, find the maximum displacement of the tapered rod as shown in Fig.11(a). $E = 2\times10^7 N/cm^2, \gamma = 0.075 N/cm^3$. (16)

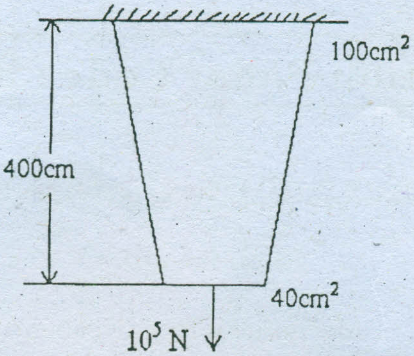

Fig. 11 (a)

Or

(b) Consider the bar shown in Fig. 11(b). Determine the nodal displacements, element stresses and support reactions (16)

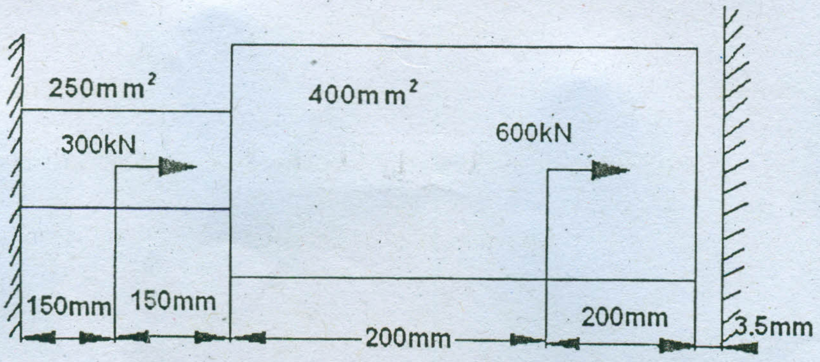

Fig. 11(b)

12\. (a) Compute the slope , deflection and reaction forces for the cantilever beam of length 'L' carrying Uniformly distributed load of intensity 'fo'. (16)

Or

(b) Determine the nodal displacements, stress and strain for the bar shown in Fig. 12(b). (16)

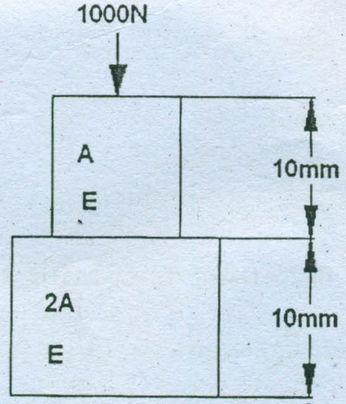

Fig. 12(b)

13. (a) (i) Derive the jacobian matrix for triangular element with the (x, y) coordinates of the nodes are (1.5,2), (7,3.5) and (4,7) at nodes i,j,k. (8)

(ii) Find the jacobian transformation for four noded quadrilateral element with the (x, y) coordinates of the nodes are (0,0), (2,0), (2,1) and (0,1) at nodes i, j,k,l. Also find the jacobian at point whose natural coordinates are (0,0) (8)

Or

(b) (i) Evaluate the Integral $I = \int_{-1}^{1}\left(e^{x} + x^{2} + \frac{1}{x+7}\right)dx$ using Gaussian Integration with one, two and three integration points. (8)

Number of points	Location	Weights
1	0	2
2	$\pm 1/\sqrt{3}$	1
3	± 0.774597	0.55555, 0.88888

(ii) Determine the stiffness matrix for the triangular elements with the (x, y) coordinates of the nodes are (0,-4), (8,0) and (0,4) at nodes i, j,k. Assume plane stress condition. E = 200 GPa, Poisson's ratio = 0.35. (8)

14. (a) Determine the first two natural frequencies of longitudinal vibration of the stepped steel bar shown in Fig.14 (a) and plot the mode shapes. All dimensions are in mm. E = 200 GPa and density 0.78 kg/cc. (16)

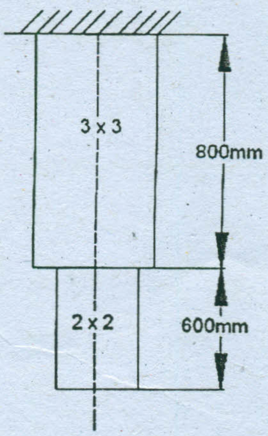

Fig. 14(a)

Or

(b) It is desired to obtain the first two critical speeds of a commercial shaft made of steel 3m long. The shaft is housed in long bearings on one end and in self-aligning bearing on the other end. It carries a rotor of 1000 kg at a distance of 1 m from the left bearing. Determine the critical speeds and plot the mode shapes. E = 210 GPa and diameter 10 mm. (16)

15. (a) Determine the temperature distribution along a circular fin of length 5 cm and radius 1 cm. The fin is attached to a boiler whose wall temperature 140°C and the free end is open to the atmosphere. Assume $T\alpha = 40°C$, $h = 10\ W/cm^2\ °C$, $k = 70W/cm\ °C$.

Or

(b) Compute the steady state temperature distributions in the plate shown in Fig. 15(b) by discretizing the domain of interest using triangular elements. Assume Thermal Conductivity k = 1.5W/m°C.

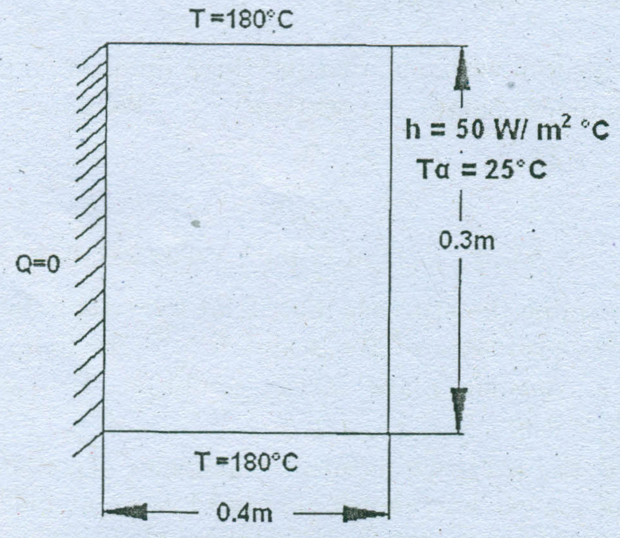

Fig. 15(b)