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Question Paper Code : 62042

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

Sixth Semester

Mechanical Engineering

080120032 — FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering)

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Where does the node generally lie?

2. What are essential boundary conditions? Give examples

3. What is the need for coordinate transformation in solving truss problems?

4. Illustrate the two Hermite shape functions associated with slope as applicable for beam element.

5. List out the limitations of CST element.

6. State Fourier's law of heat conduction used in FEA.

7. Why variational formulation is called as weak formulation?

8. Differentiate between upper bound and lower bound solutions with an example.

9. When are isoparameteric elements used?

10. What are force vectors? Give an example.

PART B — (5 × 16 = 80 marks)

11. (a) An alloy bar 1 m long and 200 mm^2 in cross section is fixed at one end is subjected to a compressive load of 20 kN. If the modulus of elasticity for the alloy is 100 GPa, find the decrease in the length of the bar. Also determine the stress developed and the decrease in length at 0.25 m, 0.5 m and 0.75 m . Solve by collocation method. (16)

Or

(b) An alloy bar 1m long and 200 mm^2 in cross section fixed at one end is subjected to a compressive load of 20 kN. If the modulus of elasticity for the alloy is 100 GPa, find the decrease in the length of the bar. Also determine the stress developed and the decrease in length at 0.25 m, 0.5 m and 0.75m. Solve by Ritz method. (16)

12. (a) Determine the nodal displacement and element stresses for the bar shown in figure 12 (a).

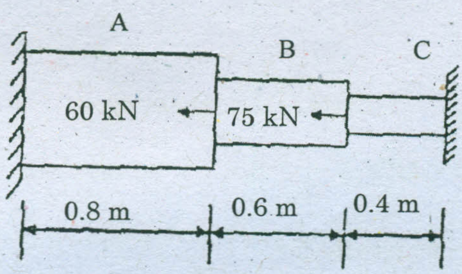

Fig. 12(a)

Portion	Material	E(GPa)	Area (mm^2)
A	Bronze	8.3	2400
B	Aluminum	70	1200
C	Steel	200	600

Or

(b) Derive the element stiffness matrix for a quadratic one dimensional bar element.

13. (a) Derive the characteristic matrix for a two dimensional heat conduction problem using triangular element by Galerkin approach.

Or

(b) Consider a rectangular plate of length 3500 mm and width 2500 mm having a thickness of 300 mm. It is subjected to a uniform heat source of 200 W/m^3 acting over the whole body. The temperature of the top side of the body is maintained at 130°C. The body is insulated on the other edges. Take the thermal conductivity of the material as 35 W/m°C Determine the temperature distribution using triangular elements.

14. (a) For the plane strain elements shown in figure 14 (a), the nodal displacements are given as u_1 = 0.005 mm, v_1 = 0.002 mm. u_2 = 0.0, v_2 = 0.0, u_3 = 0.005 mm, v_3 = 0.30 mm. Determine the element stresses and the principle angle. Take E = 70 GPa and Poisson's ratio = 0.3 and use unit thickness for plane strain. All coordinates are in mm.

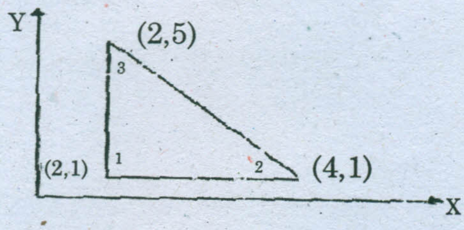

Figure. 14(a)

Or

(b) Establish the traction force vector and estimate the nodal forces corresponding to a uniform radial reassure of 7 bar acting on an axisymmetric element as shown in figure 14 (b). Take E = 200 GPa and Poisson's ratio = 0.25.

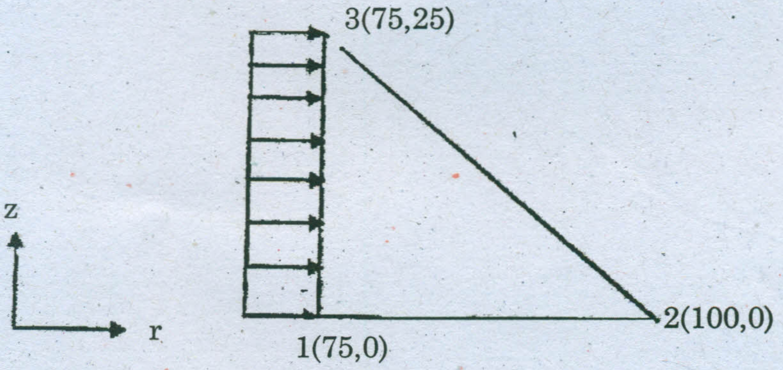

Figure. 14(b)

15. (a) (i) Consider the isoparametric quadrilateral element with nodes 1–4 at (5, 5), (11, 7), (12, 15), and (4, 10) respectively. Compute the Jacobian matrix and its determinant at the element centroid. (10)

(ii) Use Gaussian quadrature with two points to evaluate the integral $\int_{-1}^{1}\left(\cos x/\left(1-x^2\right)\right)dx$

The Gaussian points are ± 0.5774 and weights at the two points are equal to unity. (6)

Or

(b) The nodal displacements of a rectangular element having nodal coordinates (0, 0), (4, 0), (4,2) and (0,2) are : u_1 = 0 mm, v_1 = 0 mm, u_2 = 0.1 mm, v_2 = 0.05 mm, u_3 = 0.05 mm, v_3 = –0.05, u_4 = 0 and v_4 = 0 mm respectively. Determine the stress matrix at r = 0 and s = 0 using the isoparametric formulation. Take E = 210 GPa and Poisson's ratio = 0.25.