

- (b) For the axisymmetric element shown in the Fig. 14(b), determine the stiffness matrix. Let $E = 2.1 \times 10^5 \text{ N/mm}^2$ and $\mu = 0.25$. The co ordinates are in mm.

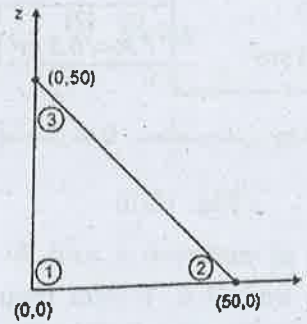


Fig. 14(b)

15. (a) Evaluate the Jacobian matrix for the linear quadrilateral element as shown the Fig. 15(a).

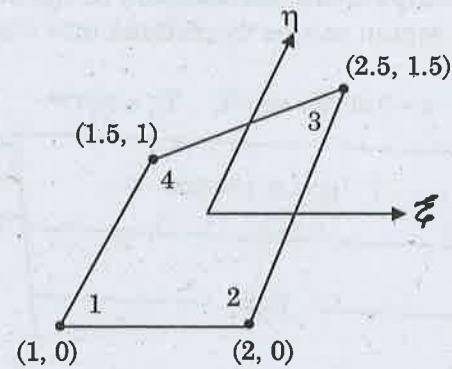


Fig. 15(a)

Or

- (b) Evaluate the integral by two point Gaussian quadrature

$$I = \int_{-1}^1 \int_{-1}^1 (2x^2 + 3xy + 4y^2) dx dy \text{ . Gauss points are } +0.57735 \text{ and } -0.57735 \text{ each of weight } 1.0000.$$

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F.N

Question Paper Code : 80668

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

Sixth Semester

Mechanical Engineering

ME 6603 — FINITE ELEMENT ANALYSIS

(Common to Mechanical and Automation Engineering and Manufacturing Engineering and Seventh Semester Mechanical Engineering (Sandwich) and Automobile Engineering)

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

- List the various methods of solving boundary value problems.
- What is meant by Post Processing?
- Why polynomials are generally used as shape function?
- What is dynamic analysis?
- State the assumptions in the theory of pure torsion.
- What is an LST element?
- What is meant by plane stress analysis?
- Write the strain-displacement matrix for a CST element.
- What is the purpose of isoparametric elements?
- What are the advantages of Gauss quadrature numerical integration for isoparametric elements?

11. (a) A beam AB of span ' l ' simply supported at ends and carrying a concentrated load W at the centre ' C ' as shown in Fig. 11(a). Determine the deflection at midspan by using Rayleigh-Ritz method and compare with exact solution.

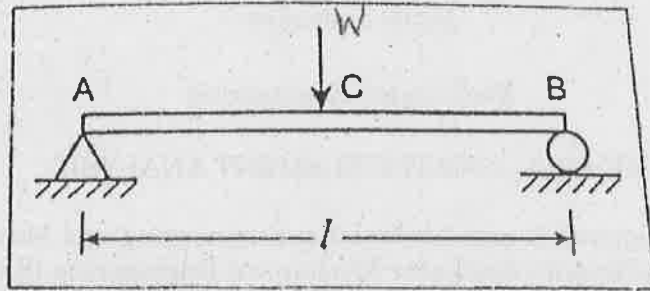


Fig. 11(a)

Or

- (b) A physical phenomenon is governed by the differential equation $(d^2w/dx^2) - 10x^2 = 5$ for $0 \leq x \leq 1$. The boundary conditions are given by $w(0) = w(1) = 0$. Assuming a trial solution $w(x) = a_0 + a_1x + a_2x^2 + a_3x^3$ determine using Galerkin method the variation of ' w ' with respect to x .
12. (a) For the bar element as shown in the Fig. 12(a). Calculate the nodal displacements and elemental stresses.

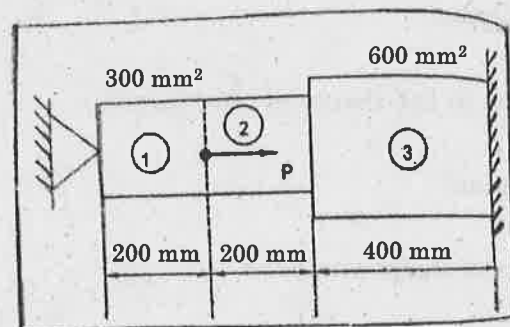


Fig. 12(a)

Or

- (b) Determine the eigen values for the stepped bar shown in Fig. 12(b).

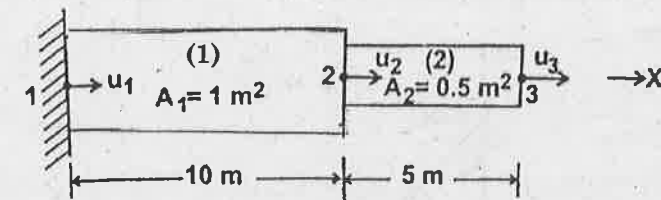


Fig. 12(b)

13. (a) The x, y coordinates of nodes i, j and k of a triangular element are given by $(0, 0)$, $(3, 0)$ and $(1.5, 4)$ mm respectively. Evaluate the shape functions N_1, N_2 and N_3 at an interior point $P(2, 2.5)$ mm of the element. Evaluate the Strain-displacement relation matrix B for the above same triangular element and explain how stiffness matrix is obtained assuming scalar variable problem.
- Or
- (b) Calculate the temperature distribution in the stainless steel fin shown in Fig. 13(b). The region can be discretized into 3 elements of equal size.

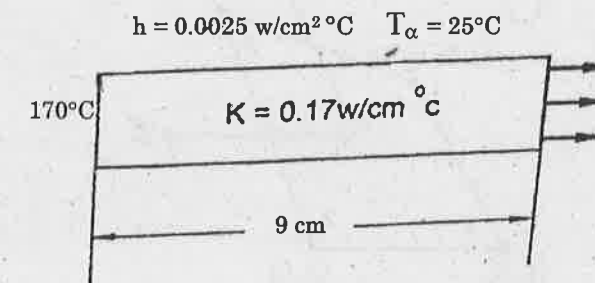


Fig. 13(b)

14. (a) For the triangular element as shown in the Fig. 14(a) determine the strain-displacement matrix $[B]$ and constitutive matrix $[D]$. Assume plane stress conditions. Take $\mu = 0.3$, $E = 30 \times 10^6 \text{ N/m}^2$ and thickness $t = 0.1 \text{ m}$. Also calculate the element stiffness matrix for the triangular element.

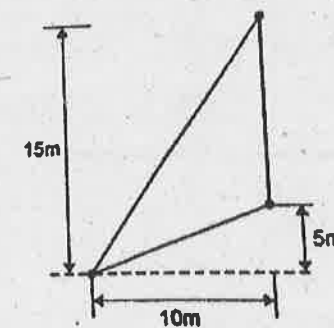


Fig. 14(a)

Or