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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)

1. List the various methods of solving boundary value problems.

2. What is meant by Post Processing?

3. Why polynomials are generally used as shape function?

4. What is dynamic analysis?

5. State the assumptions in the theory of pure torsion.

6. What is an LST element?

7. What is meant by plane stress analysis?

8. Write the strain-displacement matrix for a CST element.

9. What is the purpose of isoparametric elements?

10. What are the advantages of Gauss quadrature numerical integration for isoparametric elements?

PART B — (5 × 16 = 80 marks)

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.

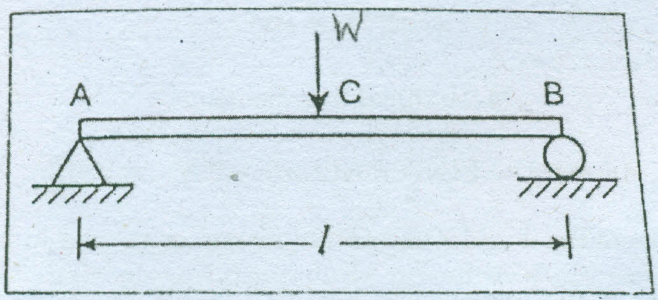

Fig. 11(a)

Or

(b) A physical phenomenon is governed by the differential equation $(d^2w / dx^2) - 10x^2 = 5$ for $0 \le x \le 1$. 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.

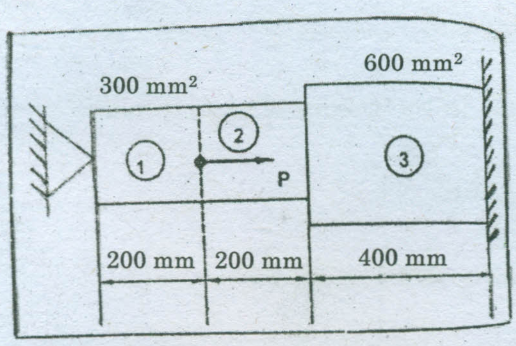

Fig. 12(a)

Or

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

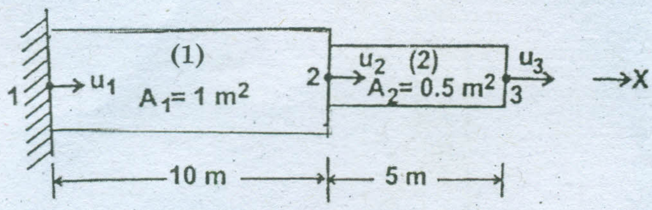

Fig. 12(b)

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.

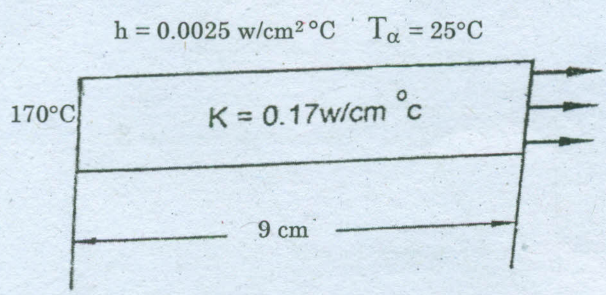

Fig. 13(b)

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 $t = 0.1$ m. Also calculate the element stiffness matrix for the triangular element.

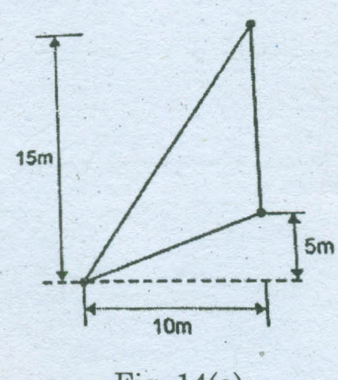

Fig. 14(a)

Or

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

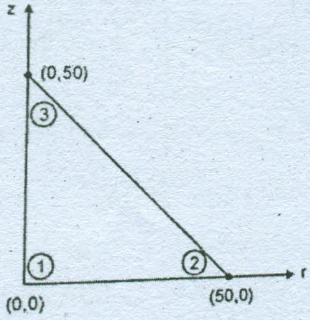

Fig. 14(b)

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

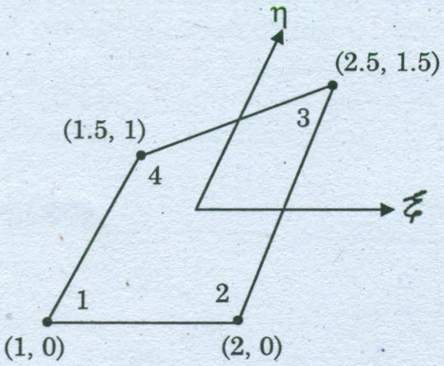

Fig. 15(a)

Or

(b) Evaluate the integral by two point Gaussian quadrature $I = \int_{-1}^{1}\int_{-1}^{1} (2x^2 + 3xy + 4y^2)\, dx\, dy$. Gauss points are +0.57735 and –0.57735 each of weight 1.0000.
