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Question Paper Code : 13055

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Sixth Semester

Automobile Engineering

080120032 — FINITE ELEMENT ALALYSIS

(Common to Mechanical Engineering)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give two sketches of structures that have both discrete elements and continuum.

2. Write about the Galerkin's residual method.

3. State the principle of minimum potential energy theorem.

4. What is the need for developing the overall stiffness matrix of the entire structure in terms of its global coordinate system? Give an example.

5. List out the limitations of CST element.

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

7. List the importance of two dimensional plane stress and plane strain analysis.

8. Give four examples of practical application of axisymmetric elements.

9. What is the salient feature of an isoparametric element?

10. Give the Lagrange equation of motion and obtain the equation of motion of a two degree of freedom system.

PART B — (5 × 16 = 80 marks)

11. (a) The differential equation for a phenomenon is given by $\frac{d^2y}{dx^2}+500x^2=0; 0\leq x\leq 5$. The boundary condition are $y(0)=0$, $y(5)=0$. Find the approximate solution using any classical technique. Start with minimal possible approximate solution.

Or

(b) (i) List and briefly describe the general steps of finite element method. (6)

(ii) Derive an equation to find the displacement at node 2 of fixed- fixed beam subjected to axial load P at node 2 using Rayleigh -Ritz method. (10)

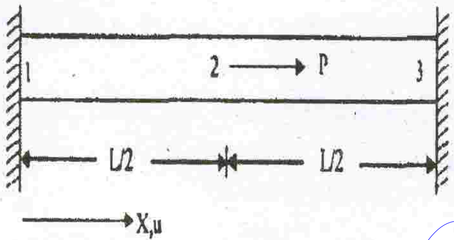

Figure 11(b)

12. (a) For the plane trusses supported by the spring at node 1 in figure 12 (a), determine the nodal displacement and stresses in each element. Let E = 210GPa and A = $5.0 \times 10^{-4}\ m^2$.

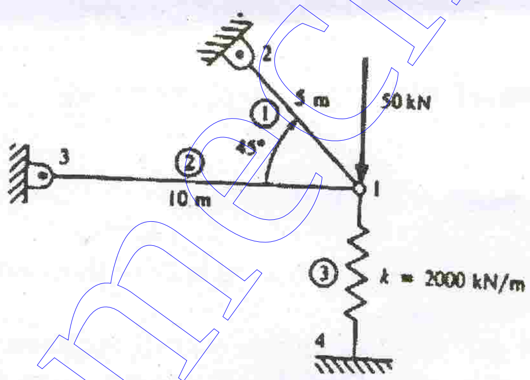

Figure 12 (a)

Or

(b) A concentrated load P = 50 kN is applied at the centre of a fixed beam of length 3 m, depth 200 mm and width 120 mm. Calculate the deflection and slope at the midpoint. Assume E = 2×10^5 N/mm²

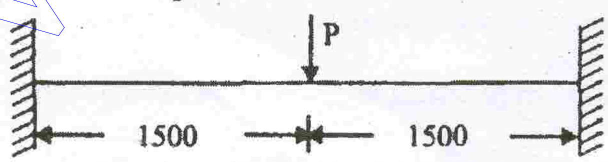

Figure 12 (b)

13. (a) Calculate displacements and stress in the given triangular plate, fixed along one edge and subjected to concentrated load at its free end. Take E = 70 GPa, thickness of the plate = 10 mm and poisson's ratio = 0.3

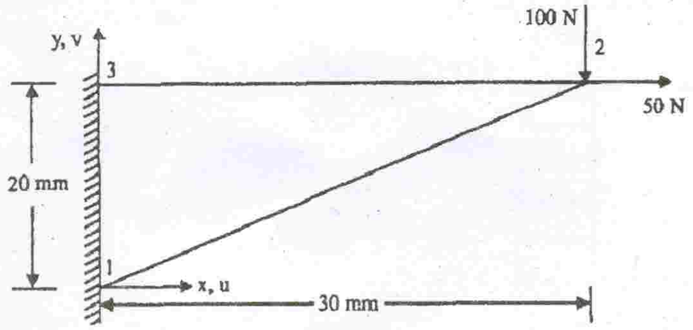

Figure 13(a)

Or

(b) A circular fin of 40 mm diameter is fixed to a base maintained at 50°C as shown in figure 13(b). The fin is insulated on the surface except the end face which is exposed to air at 25°C. The length of the pin is 1000 mm, the fin is made of metal with thermal conductivity of 37W/m K. If the convection heat coefficient with air is 15 W/m² K. Find the temperature distribution at 250,500,750 and 1000 mm from base.

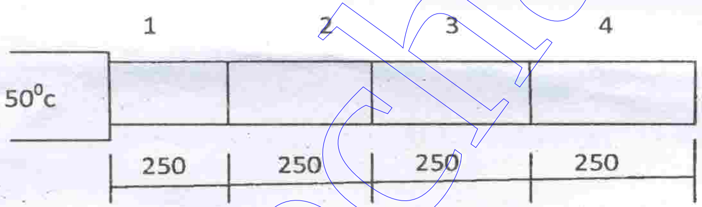

Figure 13(b)

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.

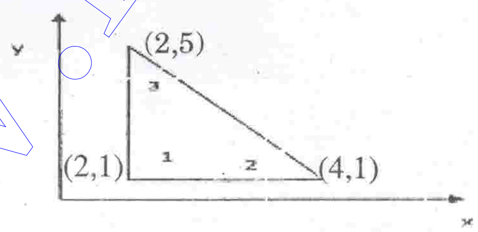

Figure 14 (a)

Or

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

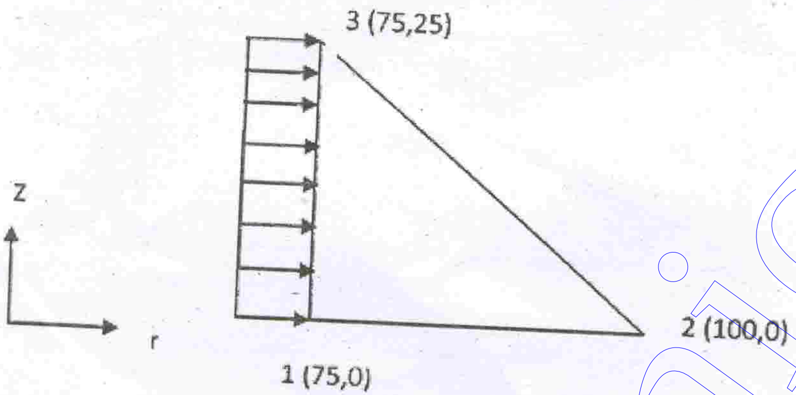

Figure 14(b)

15. (a) Derive the element characteristics of a four node quadrilateral element.

Or

(b) Evaluate the intergrals

(i) $I = \int_{-1}^{1} [x^2 + \cos(\frac{x}{2})]dx$

(ii) $I = \int_{-1}^{1} [3^x - x]dx$

Using appropriate Gaussian Quadrature.