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Reg. No. | | | | | | | | | | | | |

Question Paper Code : 51861

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

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)

(Regulations 2008/2010)

Time : Three Hours **Maximum : 100 Marks**

(Any missing data may be suitably assumed)

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Write about weighted residual method.
2. State the principle of minimum potential energy theorem.
3. Give the Lagrangen equation of motion and obtain the shape functions for quadratic coordinate transformation.
4. Write about the effective global nodal forces of beam element.
5. Give the application of plane stress and plane strain problems.
6. List the applications of axisymmetric elements.
7. Consistent mass matrix gives accurate results than lumped mass matrix in dynamic analysis of bar element- Justify.
8. What type of analysis preferred in FEA when the structural member subjected to transient vibrations ?
9. What are the boundary conditions in FEA heat transfer problem ?
10. State Darcy's law of fluid flow for finite element analysis.

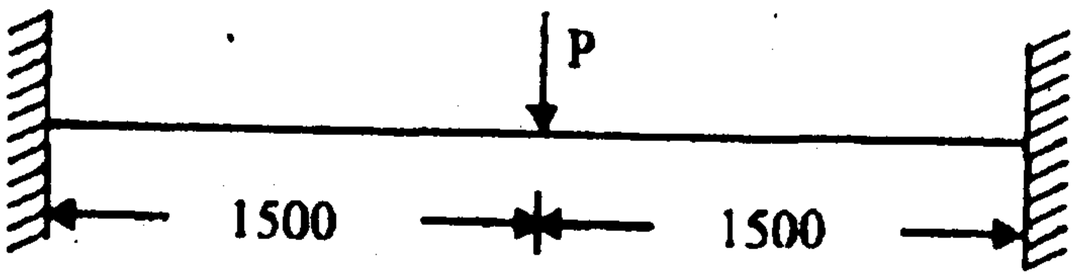
PART – B (5 × 16 = 80 Marks)

11. (a) Solve the following differential equation using Galerkin's method of weighted residuals.

$\frac{d^2y}{dx^2} + y = 4x,\ 0 \leq x \leq 1$ with boundary conditions $y(0) = 0,\ y(1) = 1$

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 $E = 2 \times 10^5$ N/mm^2



12. (a) Determine the nodal displacement, element stresses and support reactions in the truss element shown in figure 12 (a). Assume that points 1 and 3 are fixed. Take E = 70 GPa, and A = 200 mm^2

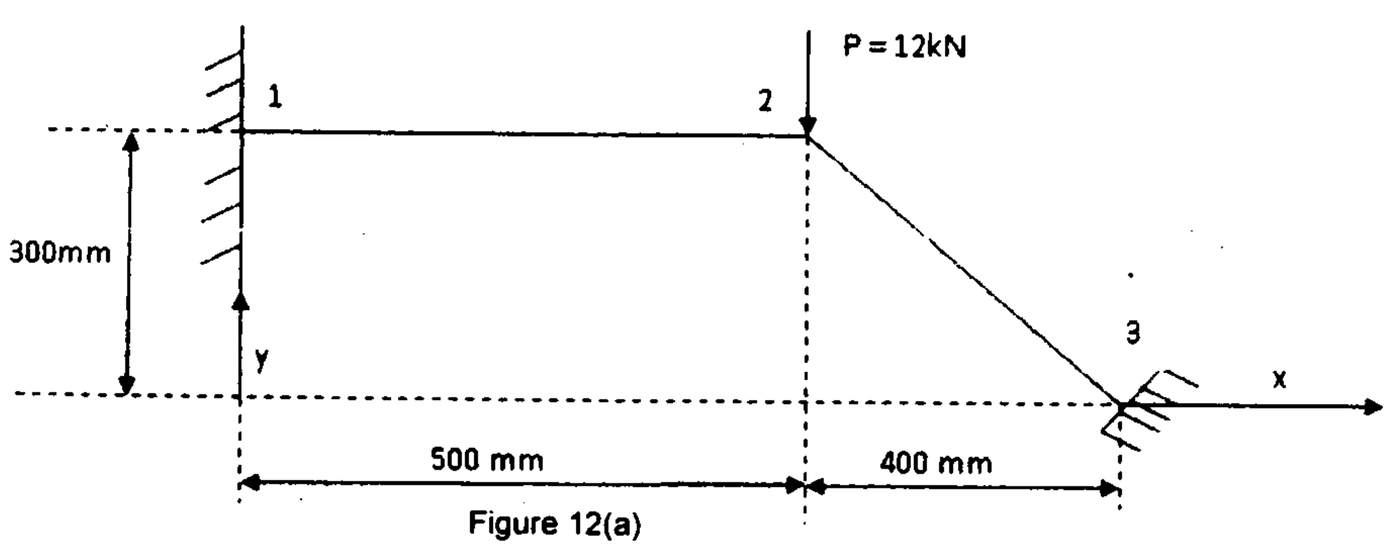


Figure 12(a)

OR

(b) For the beam shown in figure 12 (b), determine the displacements and the slopes at the nodes, the forces in each element and the reactions. E = 200 GPa, $I = 1 \times 10^{-4}$ m^4.

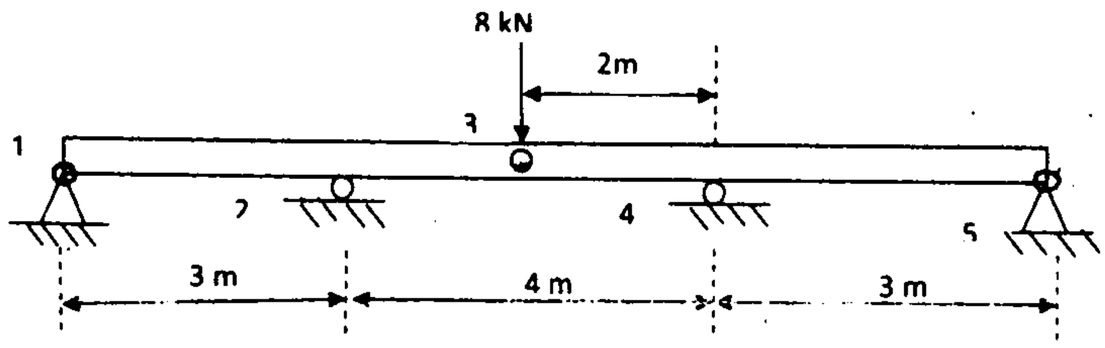


Figure 12(b)

13. (a) For the plane strain elements shown in figure 13(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 Poision's ratio = 0.3 and use unit thickness for plane strain. All coordinates are in mm.

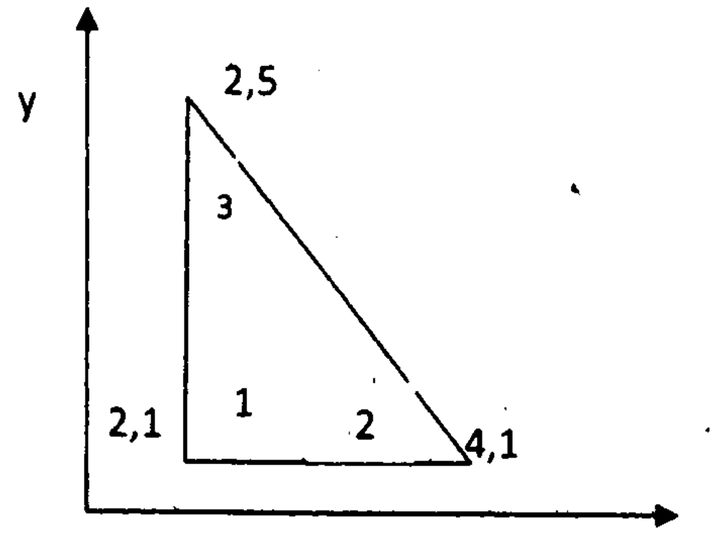


Figure 13 (a)

OR

(b) Derive the element characteristics of a nine node quadrilateral element.

14. (a) Set up the system of equations governing the free transverse vibrations of a simply supported beam modeled by two finite elements. Determine the natural frequency of the system.

OR

(b) Find the eigen value and the corresponding eigen vector of $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$.

15. (a) The figure 15 (a) shows a uniform Aluminum fin of diameter 25 mm. The root (left end) of the fin is maintained at a temperature of $T_\infty = 120$ °C, convection takes place from the lateral (circular) surface and the right (flat) edge of the fin. Assuming k = 200 W/m °C, h = 1000 W/m^2 °C and T = 20 °C, determine the temperature distribution in the fin using one dimensional element, considering two elements.

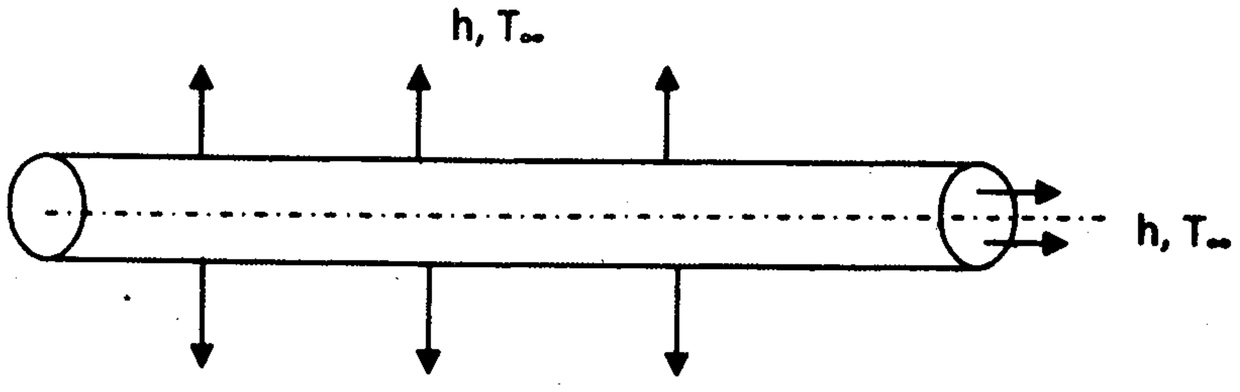


Figure 15 (a)

OR

(b) For the two dimensional sandy soil region shown in the figure 15 (b), determine the potential distribution. The potentional (fluid head) on the left side is 10 m and that on the right side is 0.0 m. The permeabilities are $K_{41} = K_{32} = 25 \times 10^{-5}$ m/s and $K_{34} = K_{12} = 0$. Assume unit thickness.

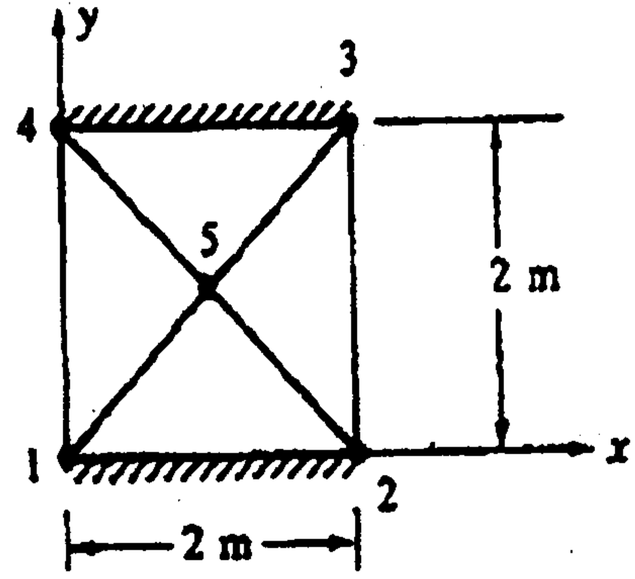


Figure 15 (b)