

Code: 9A03703

R09

B.Tech IV Year I Semester (R09) Supplementary Examinations June 2016

FINITE ELEMENT METHODS

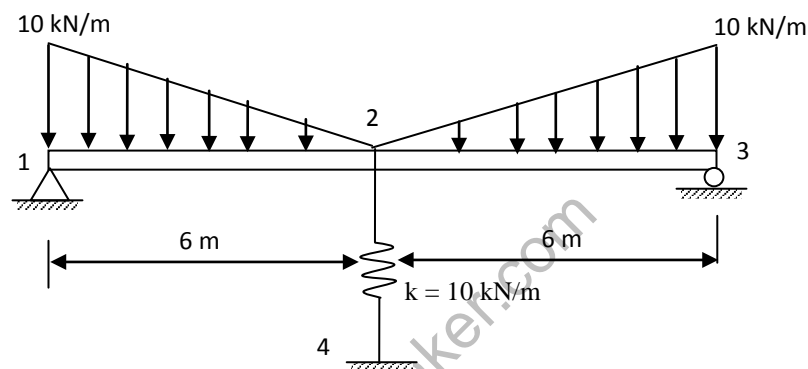
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

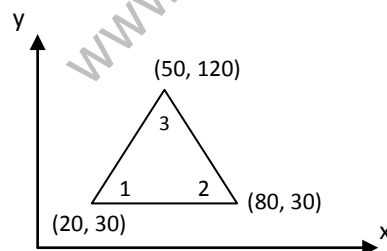
- 1 Explain the general consideration in FEM while discretization of structures.
- 2 Derive the stiffness matrix for a quadratic spar element.
- 3 For the beam shown in figure below, determine the nodal displacements and slopes.



$$E = 210 \text{ GPa}$$

$$I = 4 \times 10^{-4} \text{ m}^4$$

- 4 For the plane stress element shown in the figure below, the nodal displacements are given as: $u_1 = 2 \text{ mm}$, $v_1 = 1 \text{ mm}$; $u_2 = 0.5 \text{ mm}$, $v_2 = 0.25 \text{ mm}$ and $u_3 = 3 \text{ mm}$, $v_3 = 1 \text{ mm}$. The coordinates are given in units of mm. Assume plane stress conditions. Let $E = 210 \text{ GPa}$, $\nu = 0.3$ and thickness (t) = 10 mm. determine elements stresses. All dimensions are in mm.



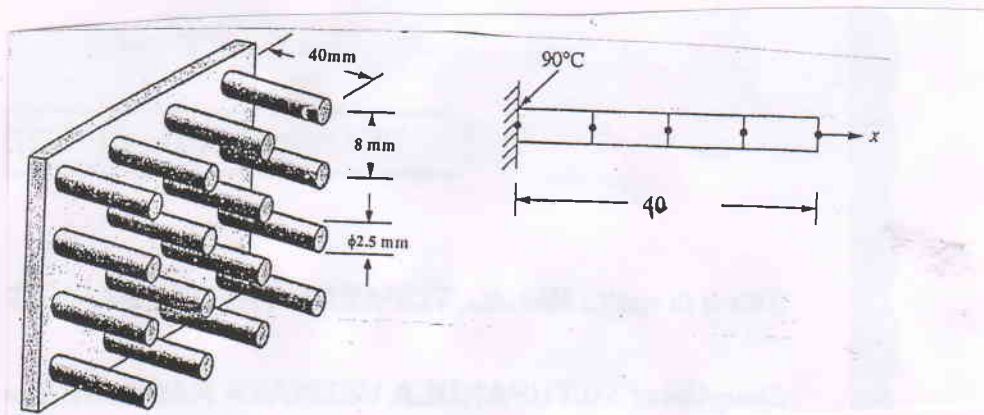
- 5 Derive the shape functions for a LST element.

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- 6 A hot surface is cooled by attaching fins to it, as shown in figure below. The surface of the plate (left end of the fin) is 90°C . The fins are 40 mm long and 2.5 mm in diameter. The fins are made of copper ($k = 400 \text{ W/m}^2\text{ }^{\circ}\text{C}$). The temperature of the surrounding air is $T_{\infty} = 25^{\circ}\text{C}$ with heat transfer coefficient on the surface (including the end surface) of $30 \text{ W/m}^2\text{ }^{\circ}\text{C}$. A model of the typical fin is also shown in figure. Use four elements in your finite element model to determine the temperature along the fin length.



- 7 Derive the stiffness matrix for one dimensional fluid flow element.
- 8 Determine the natural frequency and mode shape of transverse vibration of a cantilever beam of length 100 mm with the cross section of $7.5 \text{ mm} \times 2.5 \text{ mm}$. Take young's modulus as 200 GPa and density as 7800 kg/m^3 . Model using one element.
