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M.Tech (ME) (2017 Batch) (Sem.–1)

FINITE ELEMENT ANALYSIS

Subject Code : MTME-102

M.Code : 74716

Time : 3 Hrs. Max. Marks : 100

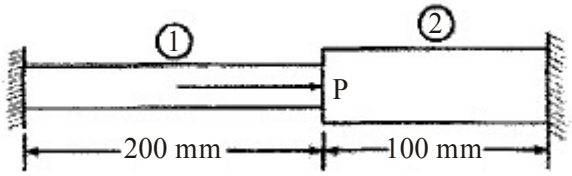
INSTRUCTIONS TO CANDIDATES :

1. **Attempt any FIVE questions in all.**
2. **Each question carries TWENTY marks.**

1. Discuss the general procedure for finite element analysis of physical problems. How does FEA differ from exact solutions approach for solving boundary value problems in engineering?

2. Derive relation for expressing strain energy as product of strain energy density and total volume of deformed material for a fixed bar element subjected to load. Using the work-strain energy relation, obtain the governing equations for the bar element using Castigliano's theorem.

3. A structure consisting of two bars is shown in Fig. 1. An axial load P = 200 kN is applied as shown. Determine the (a) element stiffness matrix (b) global stiffness matrix (c) global load vector (d) stress in each bar and (e) reaction forces.



Steel	Bronze
$A_1 = 1000\ mm^2$	$A_1 = 2000\ mm^2$
$E_1 = 200$ Gpa	$E_1 = 83$ Gpa

FIG. 1

4. Analyze a simply supported beam subjected to a uniformly distributed load throughout using Rayleigh Ritz method. Adopt one-parameter trigonometric function. Evaluate the maximum deflection and bending moment and compare with the exact solution.

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

6. Develop a one-dimensional finite element model of heat transfer including both conduction and convection for a solid cylindrical body surrounded by a fluid medium. Assume boundary conditions.

7. A fin having rectangular cross-section 4 cm wide and 1 cm thick is 8 cm long. The fixed end of the fin is exposed to a temperature of 100°C. Determine the temperature distribution along the length of the fin, assuming that convection heat loss occurs from the fin. Given $k = 3$ W/cm°C, $h = 0.1$ W/cm^2 °C and surrounding fluid temperature is 20°C.

8. Discuss the use of stream functions and velocity potential functions in solving two-dimensional, incompressible flow problems.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.