Code No: 5221AY

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech II Semester Examinations, February - 2017
ADVANCED FINITE ELEMENT ANALYSIS
(Thermal Engineering)

Time: 3hrs **Max.Marks:75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART – A

5 × 5 Marks = 25

1.a) State and explain the basic equations of elasticity for 3D coordinates in space. [5]
b) How the temperature field affects the stiffness matrix? [5]
c) What boundary conditions are considered in a triangular element? [5]
d) What elements and boundary conditions are considered in 2D and 3D fin? [5]
e) Describe the importance of modal analysis. [5]

PART - B

5 × 10 Marks = 50

2. Derive the equilibrium equation using virtual energy principle for a bar element. [10]

OR

3. Derive the equilibrium equation using principle of minimum potential energy for a bar or beam with temperature effects. [10]

4. Determine the stresses and reaction forces for the following truss element (figure 1). Given, A=30 × 10^{-4} m^2, E=70 GPa and L=2.5 m. [10]

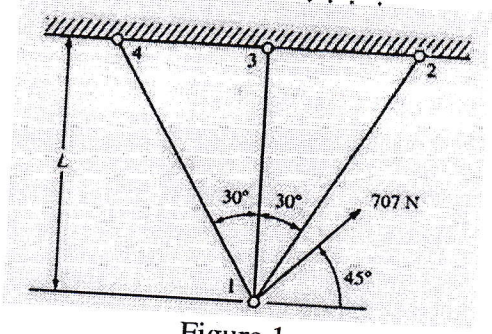

Figure 1

OR

5. Determine the nodal displacements for the following beam (figure 2). Given E=200 GPa, I=8000 cm^4. [10]

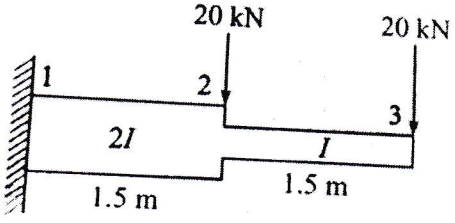

Figure 2

6. Derive the jacobian matrix for the tetrahedron element. [10]

OR

7.a) Use Gaussian quadrature with 2 and 3 gauss points to evaluate the following integrals.

i) $\int_{-1}^{1} \cos\frac{s}{2}\,ds$ ii) $\int_{-1}^{1} (4s^2 - 2s)\,ds$

b) Model the finite element equation for an axisymmetric solid with triangular element. [5+5]

8. Determine the temperature distribution in the circular fin as shown in Figure 3 the convection heat loss takes place at the end of the fin. Take h=0.2 W/cm^2 ^{0}C and T_∞=100^{0}C and k= 2 W/cm^{0}C. [10]

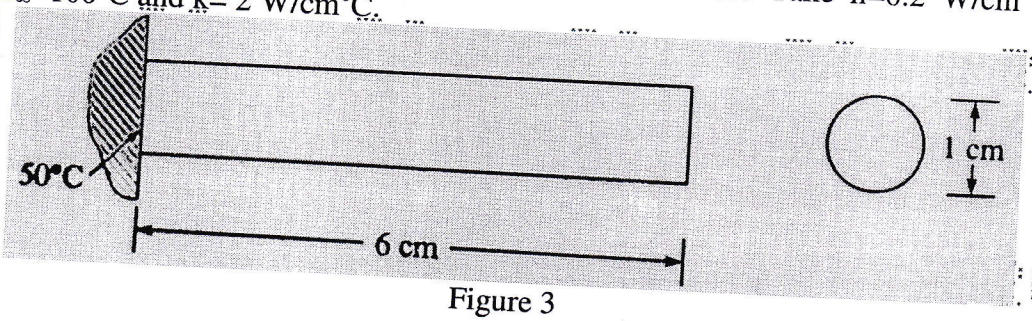

Figure 3

OR

9. For two dimensional body, determine the temperature distribution. Assume k_x=k_y. Use three element model (figure 4). [10]

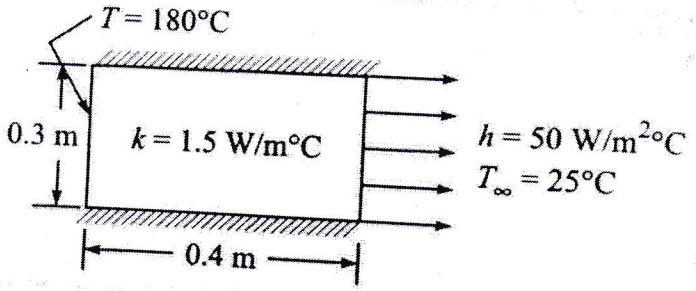

Figure 4

10. Find the mode shapes of the stepped bar. The element 1 has an area of 2400 mm^2 and length of 300 mm, elements 2 has an area of 600 mm^2 and length of 400 mm, E = 200 GPa, and the weight density of the stepped bar is 7850 kg/m^3 (figure 5). [10]

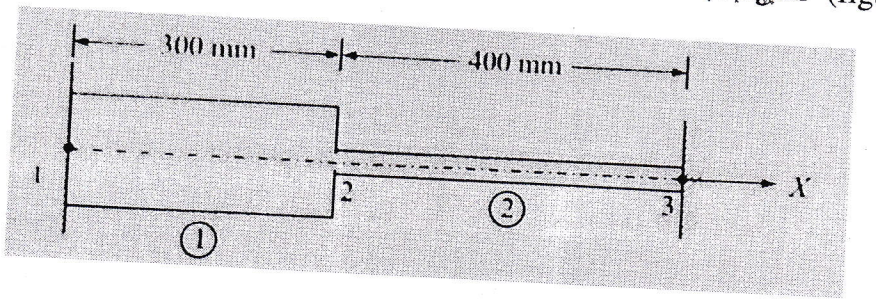

Figure 5

OR

11. Determine the eigen value of the following beam subjected to uniformly distributed load of q = 20 kN/m as shown in Figure 6. Given L = 4 m, E = 200 GPa, I = 0.5 m^4 and density is 7850 kg/m^3. [10]

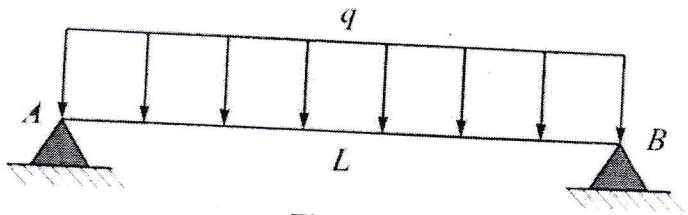

Figure 6

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