Code No: 156AZ **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, March - 2024
FINITE ELEMENT METHODS
(Common to ME, MCT)

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

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) What are the basic approaches to improving a finite element model? [2]
b) Write the advantages and applications of FEM. [3]
c) Write the equation for transforming the local stiffness equation into the global stiffness equation. [2]
d) Write down the essential and natural boundary conditions of the problem (figure 1). [3]

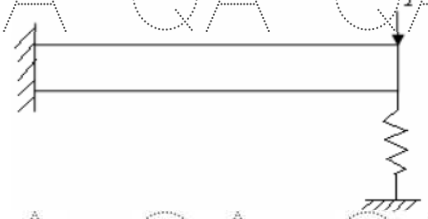

Figure 1

e) Differentiate among the Iso-parametric and Sub-parametric formulations. [2]
f) How axisymmetric elements can be equalized to the CST element? [3]
g) What do you mean by steady state heat transfer analysis? [2]
h) Define heat transfer? Write the finite element equation for 1-D heat conduction with free end convection? [3]
i) Explain mesh generation techniques in FEM. [2]
j) Discuss the NASTRAN software used to evaluate the problems in FEM hexahedral and tetrahedral elements. [3]

PART – B

(50 Marks)

2. Discuss the following methods to solve the given differential equation with the boundary condition y(0) = 0 and y (x) = 0, (a) Subdomain method (b) Weighted residual method. [10]

$$EI\frac{d^2y}{d^2x}M(x) = 0$$

OR

3.a) Explain the potential energy formulation for obtaining element equations in Finite element methods.
b) With a suitable example, explain any weighted residual method. [5+5]

4. For the two-bar truss shown in the figure 2, determine the displacements and stress. A_1=500mm^2, A_2=1200mm^2, E=2×10^5 N/mm^2. [10]

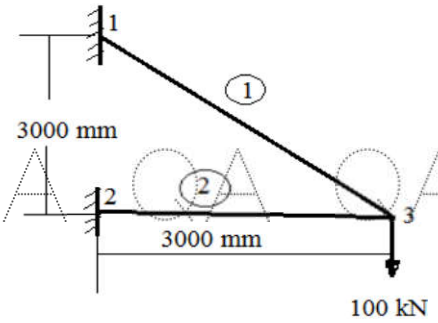

Figure 2

OR

5.a) Mention an expression for stiffness matrix for 2D-truss element.

b) For the beam and loading shown in figure 3. Determine: (i) slope at 2 and 3 (ii) vertical deflection at the midpoint of the load Take E=200GPa, I= 4×10^6 mm^4. [2+8]

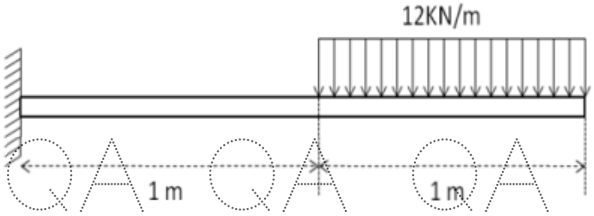

Figure 3

6. Determine the stiffness matrix for the axisymmetric element shown in the figure 4. Take E = 2.1×10^6 N/mm^2 and Poisson's ratio as 0.3. All dimensions are in mm only. [10]

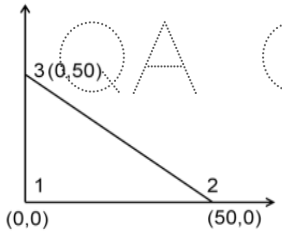

Figure 4

OR

7.a) Derive the stiffness matrix for the four-noded quadrilateral element in terms of natural coordinate system.

b) Differentiate between CST and LST with respect to the triangular element. [6+4]

8. For the composite wall shown in the figure 5 determine the interface temperatures considering three elements. [10]

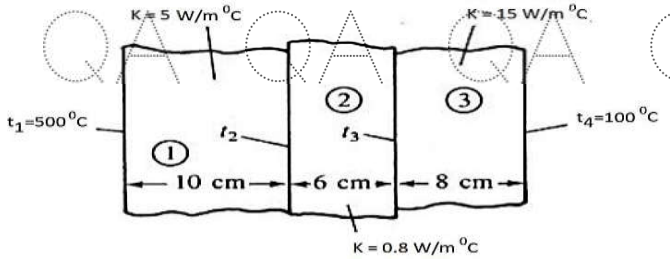

Figure 5

OR

9. Determine the temperature distribution in a 1D rectangular cross section fin with 8cm long, 4cm wide, 1cm thick. Assume that convective heat loss occurs from the end of the fin. Take K = 3W/cm K, h = 0.1W/cm^2k and Tα = 200°C. Tip temperature is 1000°C. [10]

10. Determine the Eigen values and Eigen vectors of the bar shown in figure 6. Take E=200 Gpa, ρ = 7862 kg/m^2 , A=6 cm^2 and L=2.5 m. [10]

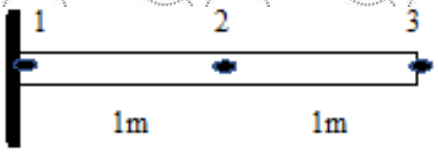

Figure 6

OR

11. Discuss Eigen value and Eigen vector analysis of stepped bar and truss. [10]

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