Code No: 136BW

R16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, March - 2024
FINITE ELEMENT METHODS
(Mechanical Engineering)

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 is meant by discretization? [2]
b) What is meant by stiffness matrix? [3]
c) Sketch a typical truss element showing local, global transformation. [2]
d) Write down the expressions for the element stiffness matrix and force vector of a beam element. [3]
e) How axisymmetric element can be equalized to the CST element? [2]
f) Write down the stiffness matrix equation for four noded iso-parametric quadrilateral elements. [3]
g) What is the thermal conductivity matrix for 2D heat transfer problems? [2]
h) Write down the governing differential equation for the steady-state one-dimensional conduction heat transfer. [3]
i) What is transient dynamic analysis? [2]
j) Define Eigen value and Eigen vector. [3]

PART – B

(50 Marks)

2. For the spring system shown in the figure 1. Find the displacements at the nodes and the reactions. Given K_1=100 N/mm, K_2=200 N/mm, K_3= 100 N/mm, P=500 N. [10]

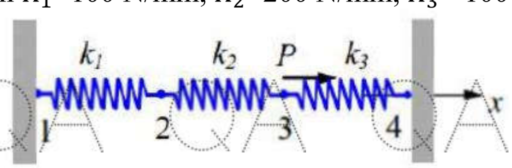

Figure 1

OR

3.a) Consider a simple one-dimension structure with three elements, explain the process of stiffness matrix and load vector assembly.
b) Explain the steps of FEM with the help of an example. [5+5]

4. For the two-bar Truss shown in the figure 2. Determine: (a) Nodal displacements (b) Element stresses (c) Reaction forces. Take E=200Gpa, A=200mm^2. [3+3+4]

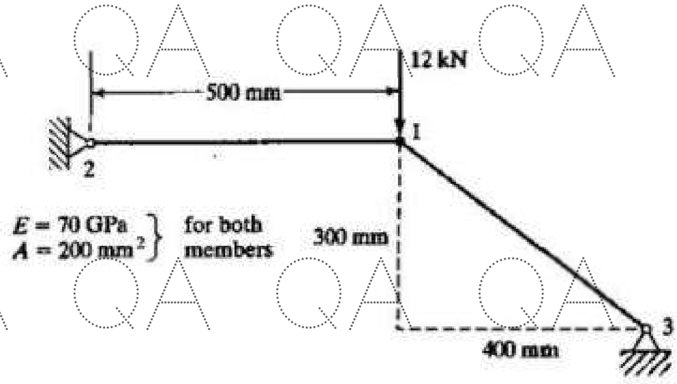

Figure 2

OR

5. For the beam having box loading on it end shown in the figure 3 determine: (a) slope at 2 and 3 (b) vertical deflection at the midpoint of the load Take E = 200GPa, I=4000000 mm^4. [5+5]

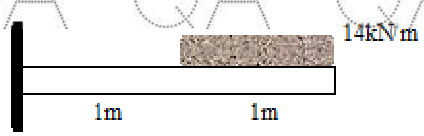

Figure 3

6.a) Briefly discuss elimination approach to handle boundary conditions for solution of system of equations.

b) Evaluate the integral by two- and three-point gauss quadrature rule. [5+5]

$$I = \int_{-1}^{1} (5x^3 - 3x^2 - 2x - 3)dx$$

OR

7. Nodal coordinates for an Axi-Symmetric element are given below figure 4. Evaluate Stiffness Matrix. E=2 $* 10^5$ N/mm^2, ʋ = 0.25. [10]

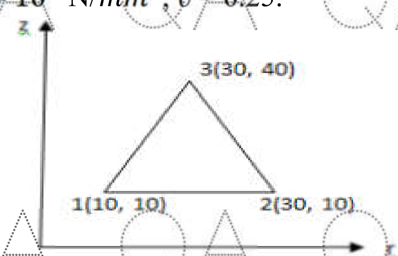

Figure 4

8.a) Determine the temperature distribution along a circular fin of length 5 cm and radius 1 cm. The fin is attached to boiler whose wall temperature 140°C and the free end is open to the atmosphere. Assume Tα = 40°C, h = 10 W/cm^2/°C, k = 70 W/cm°C.

b) Derive the consistence mass matrix of a two-node bar element. [7+3]

OR

9. A wall of 0.6m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface temperature is 1000 and outside of the insulated is exposed to atmospheric air at 30°C with heat transfer coefficient of 35 W/m^2K. Calculate the nodal temperatures. [10]

10.a) Explain the following (i) Consistent mass matrix (ii) Lumped mass matrix.

b) Determine the Eigen values and Eigen Vectors for the stepped bar as shown in figure 5. [2+8]

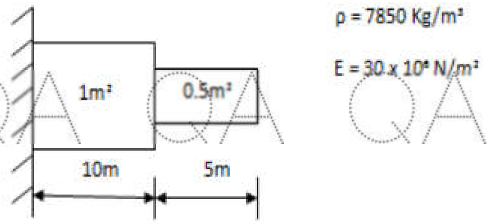

Figure 5

OR

11. Derive mass matrices for 1D Bar Element and Truss Element. [10]

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