R18

Code No: 156AZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, July - 2023

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) Draw a typical three dimensional element and indicate state of stress in their positive senses. [2]
b) Discuss the advantages and disadvantages of FEM over Classical methods. [3]
c) Write a short note on Rayleigh-Ritz Method. [2]
d) Differentiate between a bar element and a truss element. [3]
e) Express the shape function of four node quadrilateral elements. [2]
f) Write down the interpolation function of a field variable for three-node triangular element. [3]
g) Write down the expression of shape function and temperature function for one dimensional heat conduction. [2]
h) Define heat flux of two dimensions with FEA. [3]
i) What do you mean by Lumped mass matrix? Draw the lumped mass matrix for the truss element. [2]
j) Determine the element mass matrix for one-dimensional dynamic structural analysis problems. [3]

PART – B

(50 Marks)

2.a) Derive the strain-displacement and stress-strain relations for a 3-D element.
b) Derive the equilibrium equations for a system of springs shown in figure 1. Using potential energy approach. [5+5]

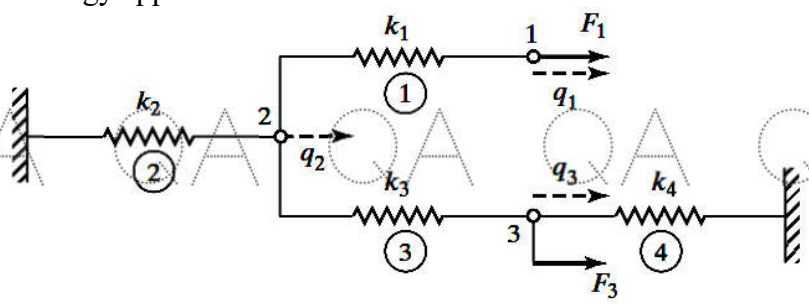

Figure 1

OR

3.a) Explain about Weighted residual methods and Galerkin's method.

b) A rod fixed at its ends is subjected to a varying body force as shown in figure 2. Use the Rayleigh–Ritz method with an assumed displacement field $u = a_0+a_1x+a_2x^2$ to determine displacement u(x) and stress σ(x). [5+5]

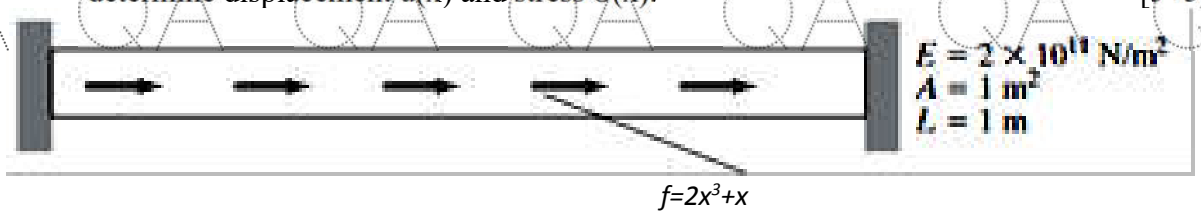

figure 2

4. For the three – bar truss shown in figure 3. Determine the nodal displacements and the stress in each member. Find the support reactions also. Take modulus of elasticity as 200 GPa. [10]

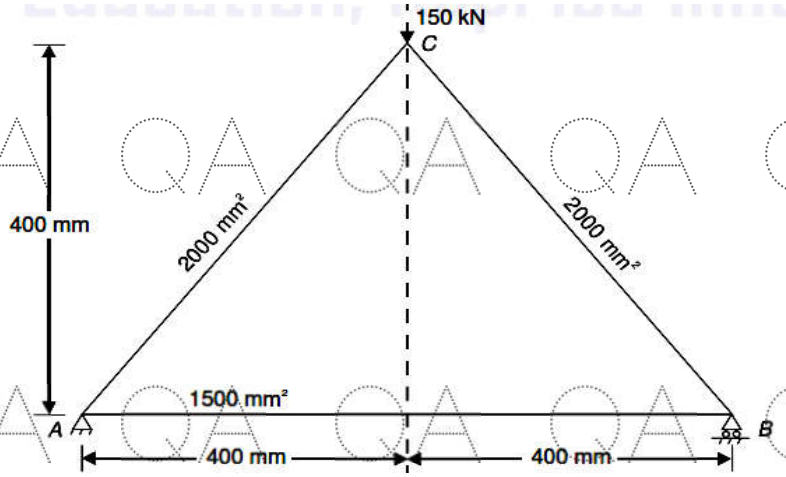

Figure 3

OR

5. The beam shown in figure 4. Determines a) slopes at 2 and 3 b) the vertical deflection at the midpoint of the distributed load. [10]

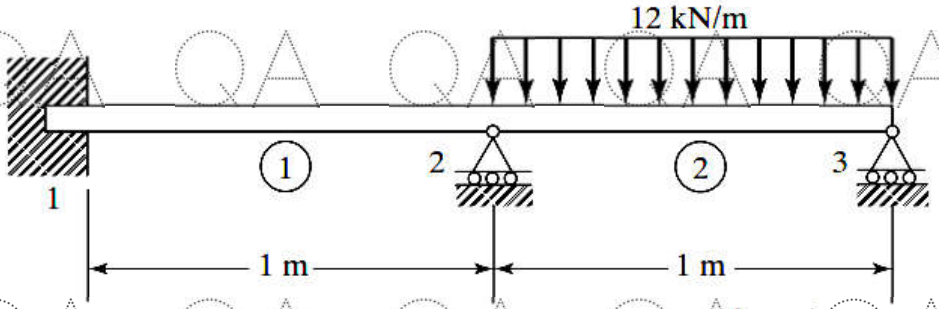

Figure 4

6. A two-dimensional plate is shown in figure 5. Determine the equivalent point loads at nodes 7, 8, and 9 for the linearly distributed pressure load acting on the edge 7–8–9. Take thickness as 10 mm. [10]

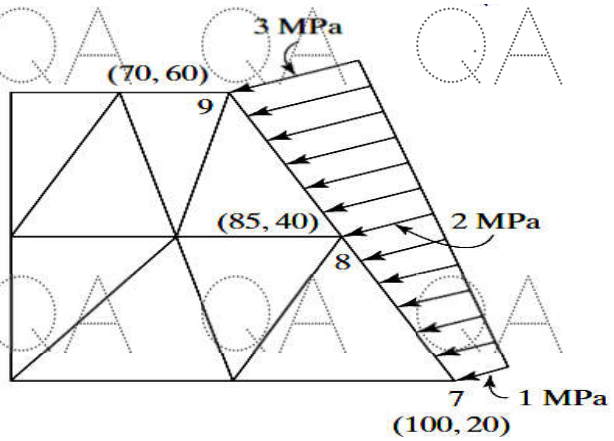

Figure 5

OR

7. In Figure 6, a long cylinder of inside diameter 80 mm and outside diameter 120 mm snugly fits in a hole over its full length. The cylinder is then subjected to an internal pressure of 2 MPa. Using two elements on the 10 mm length shown, find the displacements at the inner radius. [10]

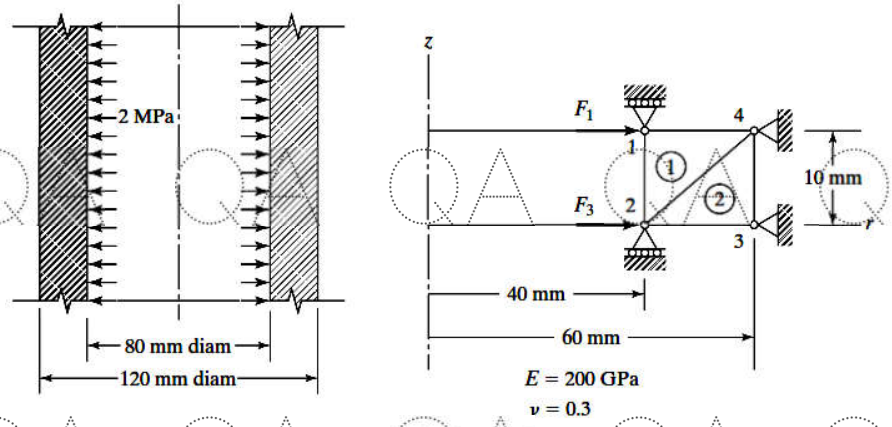

Figure 6

8. Heat is generated in a large plate (k =0.8 W/m.^{0}C) at the rate of 4000 W/m^3. The plate is 25 cm thick. The outside surfaces of the plate are exposed to ambient air at 30^{0}C with a convective heat-transfer coefficient of 20 W/m^2.^{0}C. Determine the temperature distribution in the wall (figure 7). [10]

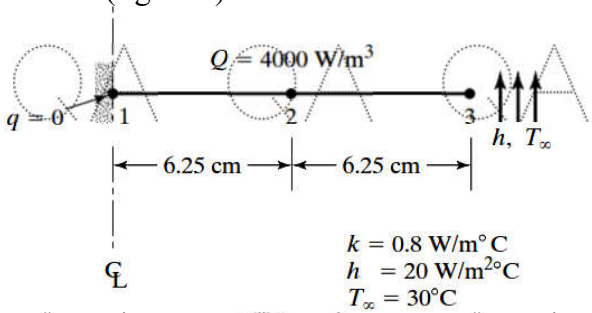

Figure 7

OR

9. A composite wall consists of three materials, as shown in figure 8. The outer temperature is $T_0 = 20^0C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800^0C$ and $h = 25\ W/m^{2\,0}C$. Determine the temperature distribution in the wall. [10]

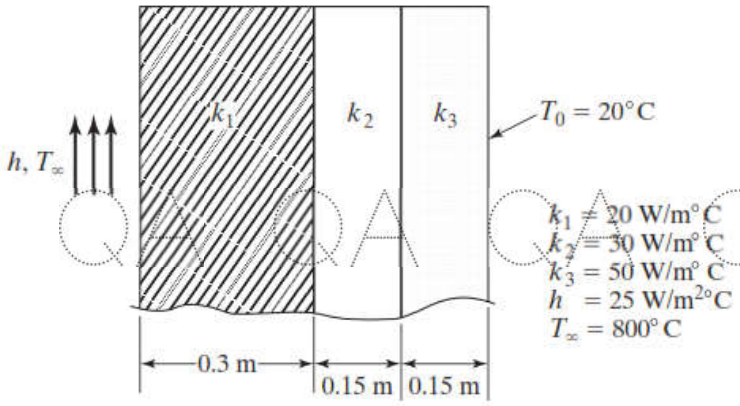

Figure 8

10. Determine the frequencies and nodal displacements of the steel cantilever beam length of 600 mm with cross section of 60 mm × 20 mm shown in figure 9. Take E = 70 GPa, ν=0.3 and ρ=7840 kg/m^3. [10]

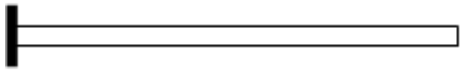

Figure 9

OR

11. Explain the step by step procedure with example to find the stresses for 3 Dimensional problems ANSYS with Hexahedral element. [10]

---ooOoo---