Registration No :

Total Number of Pages : 05 **B.Tech**
PME7D012

7th Semester Regular Examination 2018-19
FINITE ELEMENT METHOD
BRANCH : MECH
Time : 3 Hours
Max Marks : 100
Q.CODE : E461

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) What is the role of computer in FEM.
b) Derive stiffness matrix for a bar element.
c) Define direct stiffness method.
d) What is the role of transformation matrix in a beam problem?
e) How you will know whether a problem is a plane strain or plane stress problem?
f) What do you mean by boundary value problems?
g) Write four commercial computer programs available for solving problems by the finite element method.
h) What do you mean by constant-strain triangle?
i) Write the total potential energy for a single beam element subjected to both distributed and concentrated nodal Loads.
j) Write the One-Dimensional Heat Conduction equation without Convection

Part- II

Q2 **Focused-Short Answer Type Questions- (Answer Any EIGHT out of TWELVE)** **(6 x 8)**

a) Explain the general steps for the Finite Element Method.
b) For the bar assemblage shown in Figure 1, determine (a) the nodal displacements, (b) the forces/reaction in each element. Use the direct stiffness method for this problem.

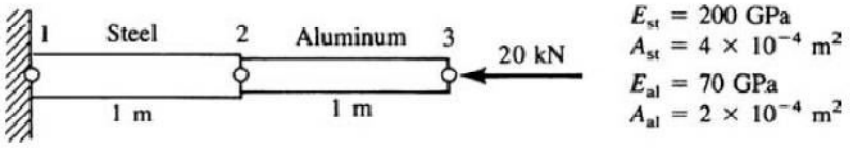


Figure 1

c) For the rod loaded axially as shown in Figure 2, determine the axial displacementand axial stress. Let E = 30 x 10^6 psi, A= 2 in.^{2}, and L = 60 in. Use (a) one and (b)two elements in the finite element solutions.

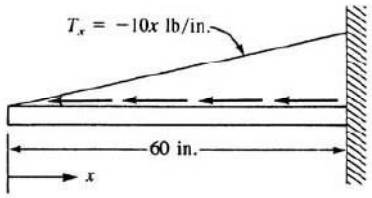


Figure 2

d) For the plane trusses supported by the spring at node 1 in Figure 3, determine (a) the nodal displacements and (b) the stresses in each element. Let Let$E$ = 210 GPa and A = 5x10^4 m^2 for both truss elements.

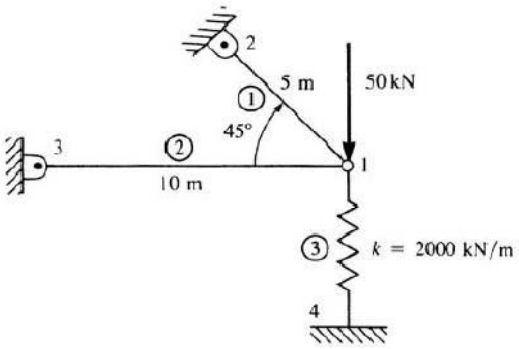


Figure 3

e) Explain the Galerkin's Residual method and its use to derive the one-dimensional Bar Element Equations.

f) Evaluate the stiffness matrix for the element shown in Figure 4. The coordinatesare shown in units of inches. Assume plane stress conditions. Let E=30x10^6 psi,μ 0.25, and thickness t=1 in. Assume the element nodal displacements have beendetermined to be u_1= 0.0, v_1= 0.0025 in., u_2= 0.0012 in., v_2= 0.0, u_3= 0.0, andv_3= 0.0025 in. Determine the element stresses.

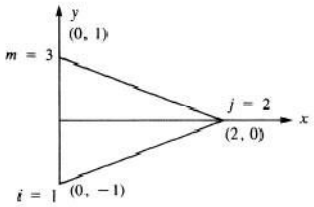


Figure4

g) For the axisymmetric elements shown in Figure 5, determine the element stresses. Let E = 210 GPa and μ = 0.25. The coordinates (in millimeters) are shown in the figure, and the nodal displacements for each element are u_1 = 0.05 mm, w_1 = 0.03 mm, u_2= 0.02 mm, w_2 = 0.02 mm, u_3 = 0.0 mm and w_3 = 0.0 mm.

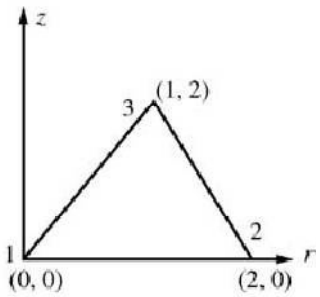


Figure 5

h) Derive the Element Stiffness Matrix and force Equations for the fluid-flow problem.

i) For the smooth pipe shown discretized in Figure 6 with uniform cross section of1 in^2, determine the flow velocities at the center and right end, knowing the velocityat the left end is v_x= 2 in./s.

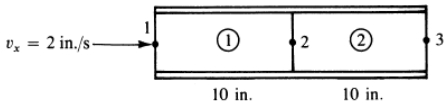


Figure 6

j) The plane wall shown in Figure 7 is 1 m thick. The left surface of the wall (x=0) is maintained at a constant temperature of 200°C, and the right surface (x=L=1 m) is insulated. The thermal conductivity is K_{xx}=25 W/(m.°C) and there is a uniform generation of heat inside the wall of Q = 400 W/m^3. Determine (a) the global stiffness matrix and (b) the temperature distribution through the wall thickness by taking 4 elements.

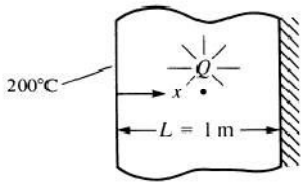


Figure 7

k) For the one-dimensional bar shown in Figure 8, determine the natural frequenciesof longitudinal vibration using first two and then three elements of equal length.Let the bar have E= 30 x10^6 psi, ρ= 0.00073 lb-s^2/in^4, A=1in^2, and L= 60 in.

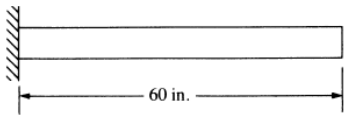


Figure 8

l) Explain theisoparametricformulationof for the bar element stiffness matrix

Part-III

Long Answer Type Questions (Answer Any TWO out of FOUR)

Q3 For a thin plate subjected to the surface traction shown in Figure 9, determine thenodal displacements and the element stresses. The plate thickness t=1 in., E=30x10^6 psi, and μ= 0.30. **(16)**

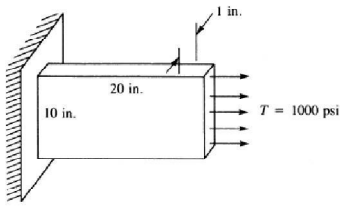


Figure 9

Q4 For the spring assemblage shown in Figure 10, obtain the global stiffness matrix andthe displacements at node 3. **(16)**

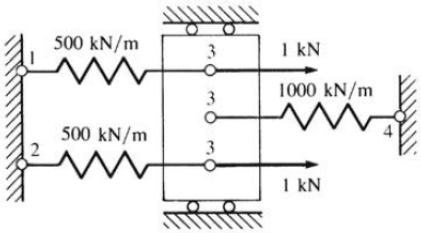


Figure 10

Q5 Evaluate the shape functions matrices [N], the [B] matrices, and the [D] matrix for the tetrahedral element shown in Figure 11. Let E = 30 x 10^6 psi, μ = 0.3. The coordinates are shown in the figurein units of inches. **(16)**

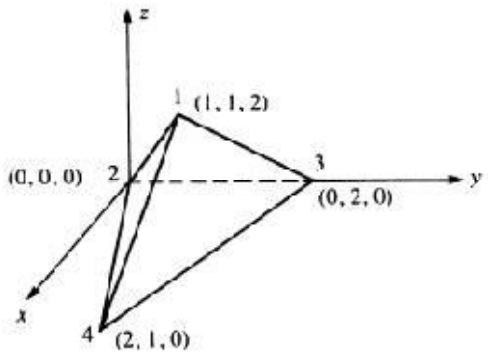
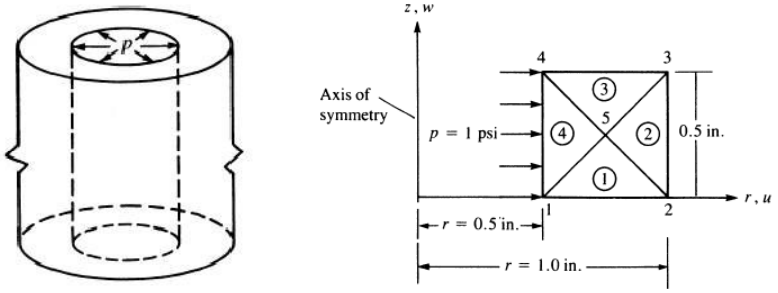


Figure 11

Q6 Determine the displacements and stresses for the long, thick-walled cylinder under internal pressure p equal to 1 psi shown inFigures 12 (a) and (b), **(16)**



Figures12 (a) and (b)