R13

Code No: 126EE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech III Year II Semester Examinations, May - 2016

FINITE ELEMENT METHODS

(Common to ME, AE, MSNT)

Time: 3 hours **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 (25 Marks)

1.a) What is the principle of finite element method? [2]
b) Write the stress strain relations for 2 D plane stress and plane strain conditions. [3]
c) Differentiate between truss and beam element based on degree of freedom. [2]
d) What is Hermite shape function? [3]
e) Write the formula for the load vector of a triangular element subjected to body force. [2]
f) What is the size of the stiffness matrix for axisymmetric triangular element? [3]
g) What is the degree of freedom for the thermal problems? [2]
h) Where do you apply finite element analysis for thermal problems? [3]
i) Explain convergence requirement. [2]
j) Explain the importance of lumped mass matrix. [3]

PART - B (50 Marks)

2.a) Why polynomial type of interpolation function is preferred over trigonometric functions? Explain.
b) Draw the Pascal's triangle and Pascal's tetrahedron for understanding the interpolations functions. Explain the salient features. [5+5]

OR

3.a) Explain the steps involved in obtaining an approximate solution using finite element method.
b) Explain the equilibrium state of the system, when the system is subjected to different types of loads and explain the stress and equilibrium relations. [5+5]

4. For a two-dimensional truss structure, as shown in the figure 1, determine displacements of the nodes and normal stresses developed in the members using FE. Use $E = 30\times10^6$ N/cm^2 and a diameter of the circular cross-section of 0.25 cm. [10]

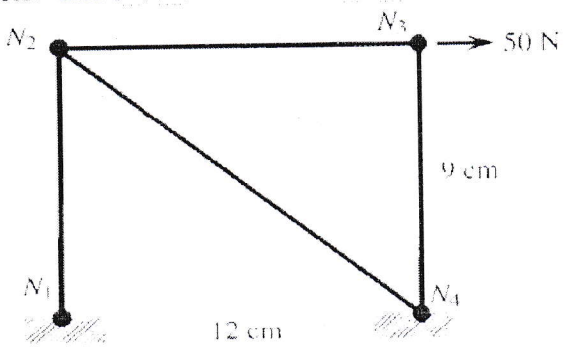

Figure 1

OR

5. A beam is fixed at one end and supported by a roller at the other end, has a 20 kN concentrated load applied at the centre of the span of 10 m. Calculate the deflection and

6.a) Evaluate the axisymmetric stiffness matrix $\boldsymbol{K}$ of the triangular element shown in the figure 2. Consider the coordinates of nodes as 1 (2, 1), 2 (4, 0), and 3 (3, 2). Also assume $E = 2.6$ GPa and $\nu = 0.2$.

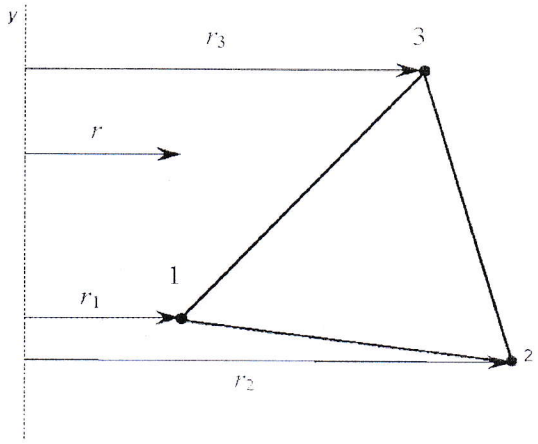

Figure 2

b) Differentiate between CST and LST with respect to the triangular element. [5+5]

OR

7. Derive the stiffness matrix for the four noded quadrilateral element in terms of natural coordinate system. [10]

8. Consider a brick wall of thickness 0.3 m , k=0.7 W/m K . The inner surface is at 28^0C and the outer surface is exposed to cold air at -15^0C. The heat transfer coefficient associated with the outside surface is 40W/m^2 K. Determine the steady state temperature distribution within the wall and also the heat flux through the wall. Use two elements and obtain the solution. [10]

OR

9. Derive the conductivity matrix for two dimensional triangular element subjected to convection on one face of the element. [10]

10. For the stepped bar shown in the figure 3. Develop the global stiffness and mass matrices and also determine the natural frequencies and mode shapes. Assume E = 200 GPa and mass density = 7850 kg/m^3. $L_1 = L_2 = 0.3$ m, $A_1 = 350$ mm^2, $A_2 = 600$ mm^2. [10]

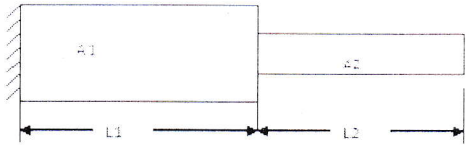

Figure 3

OR

11.a) Derive the shape functions for the four noded tetrahedron element from the first principles.

b) Discuss the importance of semi automatic meshing and auto mesh along with the practical applications. [5+5]

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