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M.TECH
CMPE102

1st Semester Regular/Back Examination – 2014
FINITE ELEMENT ANALYSIS
BRANCH(S): CAD / CAM ENGINEERING

Time: 3 Hours
Max Marks: 70

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2x10)

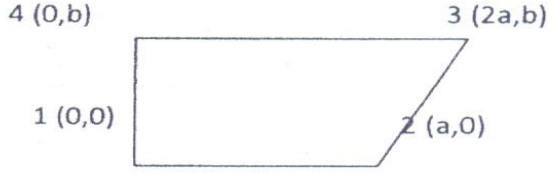
a) What are the various steps in finite element analysis.
b) Distinguish between FDM AND FEA.
c) Write down the advantages and disadvantages of FEM.
d) Find out the natural frequency of a fixed free bar with one element discretization.
e) What is a isoparametric element? Give example.
f) Find out the natural frequency of a fixed free beam with one element discretization.
g) Define shape function.
h) Give two examples of plane strain problems.
i) What are the necessary conditions for a problem to be axisymmetric?
j) What is the importance of Pascal's triangle in FE analysis?

Q2 Derive the shape function, strain displacement relation matrix [B] and element stiffness matrix for a 3-noded triangular element. (CST) (10)

Q3 A furnace wall consists of three layers. The inner layer is fire brick of thickness 13.5 cm, middle cm, outer layer is red brick having thickness layer insulating brick of thickness cm. Furnace temp is 870 °C and the outside wall temp is 40 °C. Find the heat loss and interface temp. The wall measured 5m × 2m. For fire brick K_1 = 1.2 w/m °C, For insulating brick K_2 = 0.14 w/m °C and for red brick K_3 = 0.85 w/m °C. Solve by using finite element method. (10)

Q4 a) Consider a simple supported beam, load acting at its mid point. Find out maximum deflection and slope at the supports. Solve by using finite element method. (5)

b) Derive the shape function and stiffness matrix of a typical quadrilateral element as shown in the figure. (5)



Q5 Derive the expression of mass matrix and stiffness matrix for transverse vibration of beam. (10)

Q6 The coordinates of a triangular element are given by (5,5), (7,6) and (6,8) mm respectively. Evaluate the shape function at a interior point P(5.5,5.5) mm for the element. Assuming plane strain condition find the stiffness matrix for the element. Assume Young's modulus E = 200GPa, Poisson ratio = 0.25, thickness = 15mm. (10)

Q7 Establish the relationship between $[K^e]$, [B], [D] and V^e for a three dimensional tetrahedron, where $[K^e]$ is the element stiffness matrix, [B] is strain displacement matrix, [D] is elasticity matrix and V^e is the volume of element. (10)

Q8 Find out the Jacobian matrix and strain displacement matrix for the isoparametric element. (5x2)