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10AE64

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Finite Element Analysis

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Enlist the steps involved in a typical Rayleigh Ritz-method. **(10 Marks)**

b. Derive the expression for potential energy of a 3D elastic body. **(10 Marks)**

2 a. Obtain the expression for shape functions of 2D triangular element using area co-ordinate method. **(08 Marks)**

b. Explain convergence criteria and its requirements. **(06 Marks)**

c. Explain the local and natural coordinate systems used in FEM. **(06 Marks)**

3 a. Using penalty method of handling boundary condition determine the nodal displacement, stress in each element and support reaction in the bar shown in Fig. Q3 (a) due to applied force P = 100 kN. Take E_{steel} = 200 GPa; E_{copper} = 100 GPa **(10 Marks)**

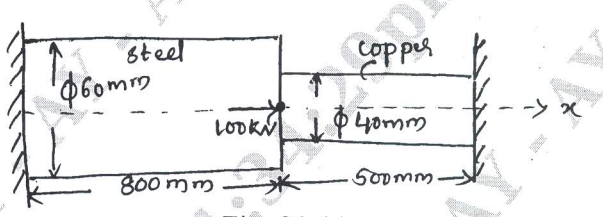

Fig. Q3 (a)

b. For the two bar truss shown in Fig. Q3 (b) determine the nodal displacement, stress in each element and reaction at the support. Take $E = 2\times10^5$ N/mm^2, A = 200 mm^2. **(10 Marks)**

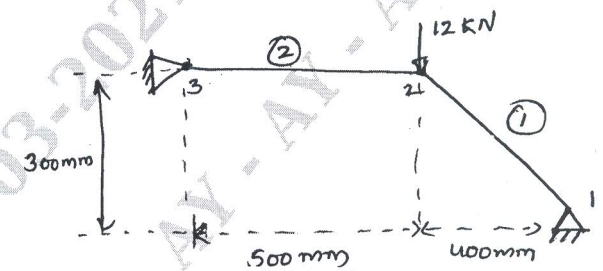

Fig. Q3 (b)

4 a. Sketch and explain CST and LST elements. Write the difference between them. **(10 Marks)**

b. Write down the shape functions for a quadrilateral element with midside nodes. **(10 Marks)**

PART - B

5 a. Write short notes on Lagrangian family of elements and serendipity – family of elements with examples. **(08 Marks)**

b. Derive the shape functions for hexahedral element. **(12 Marks)**

6 a. Briefly describe isoparametric, subparametric and super parametric elements with neat sketch. **(06 Marks)**

b. Construct shape function for nine-node quadrilateral. **(08 Marks)**

c. Explain the stages of FEA. **(06 Marks)**

7 a. Derive elemental stiffness matrix for axissymetric triangular element. **(12 Marks)**

b. What is Jacobian matrix? Prove that area of axissymetric element $[A_e] = \frac{1}{2} |\det J|$. **(08 Marks)**

8 a. Derive the shape functions for a three noded, 1D thermal element and plot the shape functions across the element. **(10 Marks)**

b. Find the temperature distribution in one dimensional fin of length 50mm and radius 10mm by taking one element model. The heat will be lost to the surroundings through the perimeter surface and at the end (tip). Thermal conductivity of the material is 7000 (watt)/(m-k) conductivity heat transfer coefficient is $50 kW/m^2$-K, film temperature is 40 degrees and the left end of the fin is maintained at a temperature of 140°C. **(10 Marks)**

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