CBCS SCHEME

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15AE651

Sixth Semester B.E. Degree Examination, July/August 2022
Finite Element Method

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive the relationship between the generalized coordinates and nodal displacements. **(08 Marks)**

b. Define shape function and explain the shape function of an element for different coordinates. **(04 Marks)**

c. Explain the convergence requirements of shape functions. **(04 Marks)**

OR

2 a. For the spring shown in Fig.Q.2(a) determine the nodal displacements using principle of minimum potential energy.

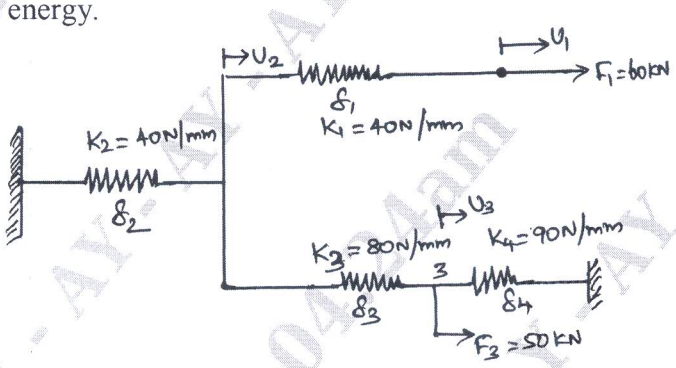

Fig.Q.2(a)

(08 Marks)

b. Explain Rayleigh-Ritz method and Galerkin's method applied in FEM. **(08 Marks)**

Module-2

3 a. Consider the three bar truss shown in Fig.Q.3(a). Determine the nodal displacement and stress in each members. Find the support reactions. Take $E = 2 \times 10^5$MPa, $A_1 = 1500mm^2$, $A_2 = A_3 = 2000mm^2$. **(08 Marks)**

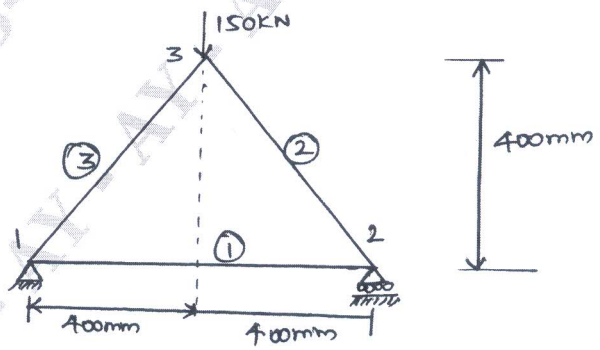

Fig.Q.3(a)

b. Obtain Hermite shape function for beam element. **(08 Marks)**

OR

4 a. Find nodal displacements, stress in the thickest section and left support reaction for structure shown in Fig.Q.4(a). **(08 Marks)**

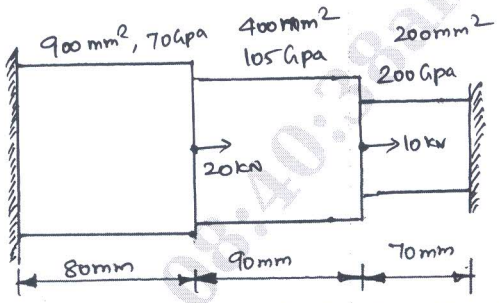

Fig.Q.4(a)

b. Derive the shape function for a 1-D bar element in global and local coordinates. **(08 Marks)**

Module-3

5 a. Derive the stiffness matrix for 4-noded tetra hedral element. **(08 Marks)**

b. Derive shape function of a CST element in natural coordinate system. **(08 Marks)**

OR

6 a. Determine the Jacobian of the transformation J for the triangular element. Shown in Fig.Q.6(a). **(08 Marks)**

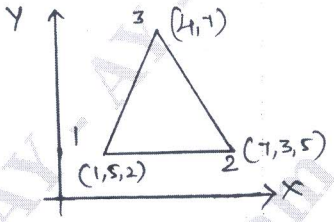

Fig.Q.6(a)

b. Derive shape function for nine-noded rectangular element. **(08 Marks)**

Module-4

7 a. Explain the structure of computer program for FEM analysis. **(08 Marks)**

b. With neat sketch, explain ISO, sub and super parametric elements. **(08 Marks)**

OR

8 a. Explain the axisymmetric formulation finite element modeling of triangular element. **(08 Marks)**

b. Draw the mapping of Isoparametric elements in global coordinate system and explain. **(08 Marks)**

Module-5

9 a. Derive the governing differential equation for 1-D heat conduction. **(08 Marks)**

b. Discuss the element mass matrices for i) 1-D bar element ii) Truss element in detail. **(08 Marks)**

OR

10 Find the temperature distribution and heat transfer through an iron fin of thickness 5mm, height 50mm, and width 1000mm. The heat transfer coefficient around the fin is $10W/m^2$-K and ambient temperature is 28°C. The base of fin is at 108°C. Take K = 50W/m-K. Use two elements. **(16 Marks)**

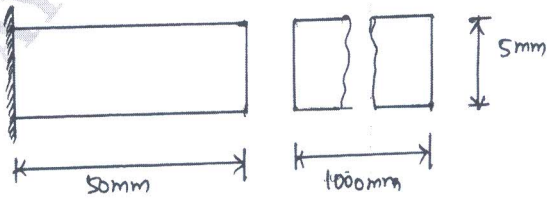

Fig.Q.10

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