CBCS SCHEME

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18AE/AS63

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Finite Element Method

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain Rayleigh-Ritz method and Galerkin's method applied in FEM. **(10 Marks)**

b. For the spring shown in Fig Q1(b) determine the nodal displacement using principle of minimum potential energy.

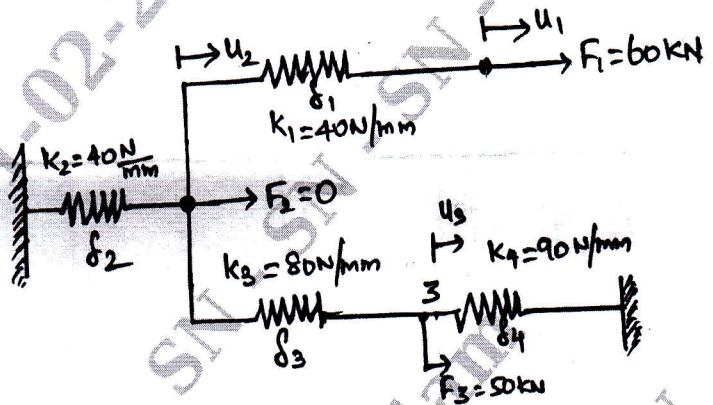

Fig Q1(b) **(10 Marks)**

OR

2 a. Derive the Relationship between the generalized coordinates and nodel displacements. **(10 Marks)**

b. Explain the convergence requirements of shape functions. **(05 Marks)**

c. Define shape function and explain the shape function of an element for different conditions. **(05 Marks)**

Module-2

3 a. Derive the shape function for a 1-D Bar element in Global and local coordinates. **(10 Marks)**

b. Find nodal displacements, stress in the thickest section and left support reaction for structure shown in Fig Q3(b)

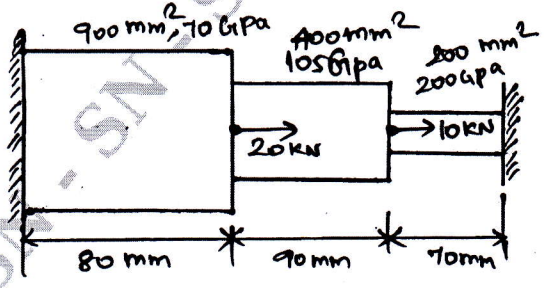

Fig Q3(b) **(10 Marks)**

OR

4 a. Consider the three bar truss shown in Fig Q4(a). Determine the nodal displacement and stress in each member. Find the support reactions. Take E = 2×10^5MPa.

$A_1 = 1500mm^2$
$A_2 = A_3 = 2000mm^2$

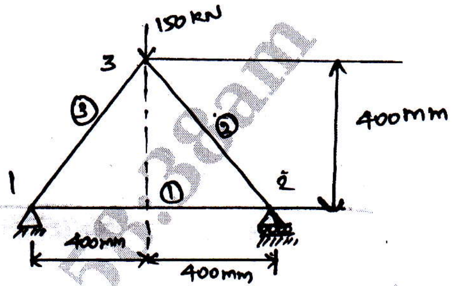

Fig Q4(a)

(12 Marks)

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

Module-3

5 a. Derive shape function of a CST element in natural coordinate systems. (10 Marks)

b. Derive stiffness matrix for A-noded Tetrahedral element. (10 Marks)

OR

6 a. Derive shape function for nine noded rectangular elements. (10 Marks)

b. Determine the Jocobian of the transformation J for the triangular element shown in Fig Q6(b)

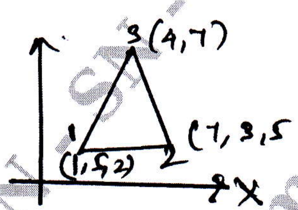

Fig Q6(b) (10 Marks)

Module-4

7 a. Draw the mapping of iso-parametric elements in global coordinate system and explain briefly. (10 Marks)

b. With a neat sketch, explain ISO, sub and super parametric elements. (10 Marks)

OR

8 a. Explain the structure of computer program for FEM Analysis. (10 Marks)

b. Explain briefly the axisymmetric formulation finite element modeling of triangular element. (10 Marks)

Module-5

9 a. 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.

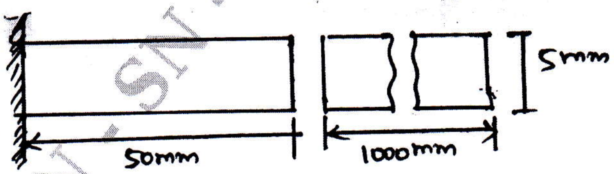

Fig Q9(a) (12 Marks)

b. Derive the governing differentiate equation for 1-D heat conduction. (08 Marks)

OR

10 a. Explain formulation of Hamilton's principle. (08 Marks)

b. Discuss the element mass matrices for the following elements in detail

i) 1 – D bar element   ii) Truss element   iii) CST element. (12 Marks)