CBCS SCHEME

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18AE/AS63

Sixth Semester B.E. Degree Examination, June/July 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. State and explain the principle of minimum potential energy. **(04 Marks)**

b. Write short notes on plane stress and plane strain with stress-strain relation. **(06 Marks)**

c. Find the displacement at the mid point of a bar shown in FigQ1 (c), using Rayleigh Ritz method. Given $E = 70 \times 10^3$ MPa, A = 100 mm^2. Use 2nd order polynomial displacement model. **(10 Marks)**

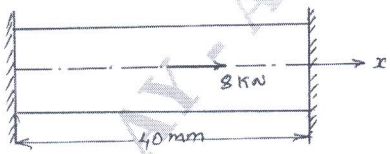

Fig. Q1 (c)

OR

2 a. Determine the displacement at node 1 and 2 in the spring system shown in Fig. Q2 (a) by using principle of minimum Energy. **(10 Marks)**

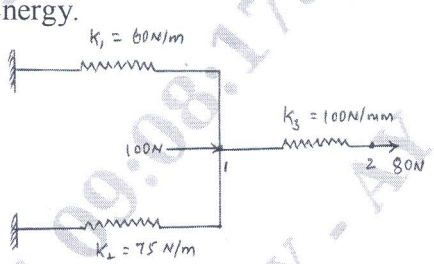

Fig. Q2 (a)

b. What are convergence requirement? Discuss the condition of convergence requirement. Also define confirming and non conforming elements. **(10 Marks)**

Module-2

3 a. Derive the elemental stiffness matrix for truss element. **(10 Marks)**

b. For the axially loaded bar shown in Fig. Q3 (b). Determine nodal displacement and stress in each element. Given $E_{steel} = 2 \times 10^5$ MPa, $E_{cu} = 1 \times 10^5$ MPa

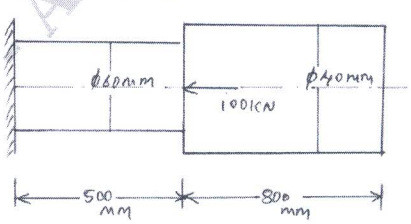

Fig. Q3 (b) **(10 Marks)**

OR

4 a. Derive the Hermite shape function of the beam element and also show their variation. **(10 Marks)**

b. For truss shown in Fig. Q4 (b), determine the nodal displacement and stresses in each element. Given $E = 2\times10^5$ N/mm^2, $A_C = 200$ mm^2. **(10 Marks)**

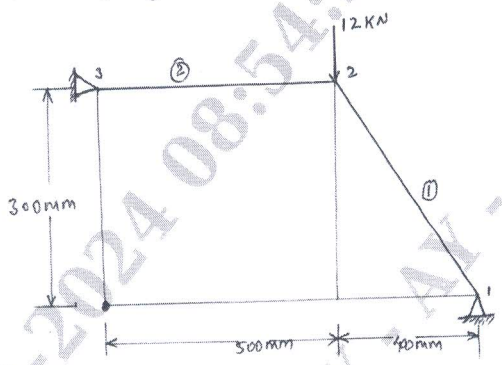

Fig. Q4 (b)

Module-3

5 a. Derive the shape function for CST element and show other variation. **(10 Marks)**

b. For the triangular element shown in Fig.Q5 (b). Determine Jacobian matrix and also shape function at points P(3.85, 4.8) **(10 Marks)**

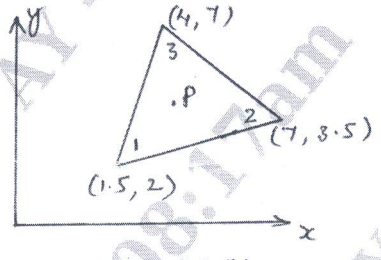

Fig. Q5 (b)

OR

6 a. Derive the expression for Jacobian matrix [J], displacement matrix [B] and stiffness matrix [K] for CST element. **(15 Marks)**

b. List the difference between CST and LST elements. **(05 Marks)**

Module-4

7 a. What are isoparametric, subparametric and super parametric elements? Explain with neat sketches. **(08 Marks)**

b. Explain 3 phases in FEA. **(08 Marks)**

c. Mention the different commercially available software used for FEA. **(04 Marks)**

OR

8 a. What are axisymmetric elements? Explain the axisymmetric triangular element with neat sketches. **(08 Marks)**

b. Derive the strain-displacement matrix for triangular element in the axisymmetric body. **(12 Marks)**

Module-5

9 a. Derive the Elemental stiffness matrix for heat conduction in 1D element. (08 Marks)

b. Find the temperature distribution in the 1D fin shown in Fig. Q9 (b).

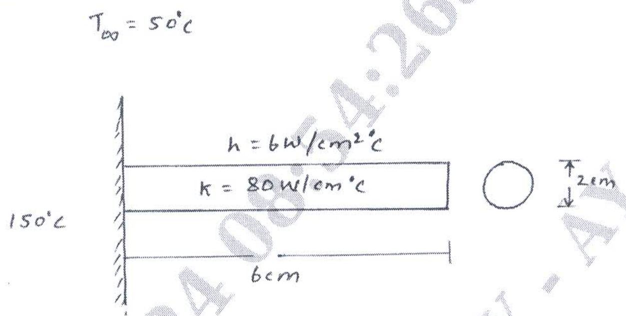

Fig. Q9 (b) (12 Marks)

OR

10 a. State and explain the Hamilton's principle. Illustrate with example. (12 Marks)

b. Derive the expression for 1-D Element mass matrices. (08 Marks)

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