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10AE64

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Finite Element Analysis

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain simplex, complex and multiplex elements along with suitable interpolation models. **(08 Marks)**

b. Determine nodal displacement of the spring system shown in Fig. Q1 (b) below: **(12 Marks)**

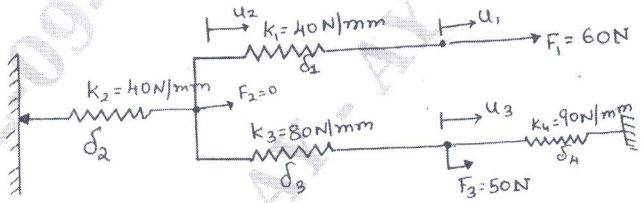


Fig. Q1 (b)

2 a. Derive shape function of 1d bar element in natural co-ordinate system and also show variation of shape function. **(10 Marks)**

b. Explain different co-ordinate systems used in finite element method. **(06 Marks)**

c. Explain convergence, requirements and compatability condition for elements used in FEM. **(04 Marks)**

3 a. A bar is having a cross sectional area of 300 mm^2 and is subjected to a load P = 600 kN as shown in Fig.Q3 (a) below. Determine nodal displacement, stress in each element and reaction at supports. Consider a bar to be a two bar element and solve by elimination method. Take E = 200 GPa. **(10 Marks)**

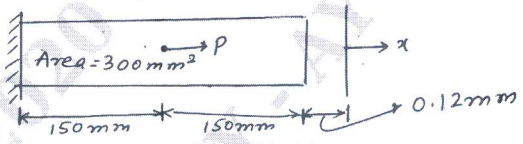


Fig.Q3 (a)

b. For a two bar truss element as shown in Fig.Q3 (b) below. Determine nodal displacements and elemental stresses. A force of P = 1000 kN is applied at node 1. Take E = 210 GPa, A = 600 mm^2 for each element. **(10 Marks)**

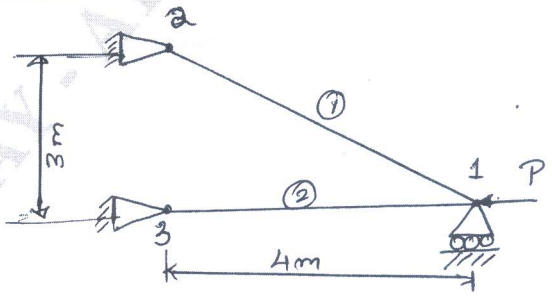


Fig. Q3 (b)

4 a. Derive shape function for a 9 noded rectangular element in natural co-ordinate system. **(10 Marks)**

b. Evaluate the shape functions N_1, N_2 and N_3 at the interior point P for the triangular element shown in Fig. Q4 (b) below. **(06 Marks)**

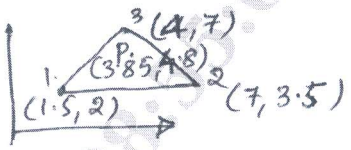


Fig. Q4 (b)

c. Differentiate CST and LST elements. **(04 Marks)**

PART – B

5 a. Differentiate between Lagrange and Serendipity family of elements with neat sketch. **(10 Marks)**

b. Derive shape function for hexahedral element. **(10 Marks)**

6 a. Explain briefly preprocessing, processing (solves) and post processing used in FEA. **(10 Marks)**

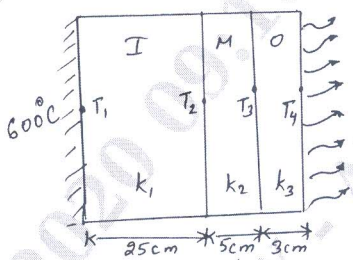
b. What are iso, sub and superparametric elements? Explain them with neat sketches. Also explain the need for isoparametric formulation. **(10 Marks)**

7 a. Explain Axis-symmetric formulation. **(05 Marks)**

b. Derive strain displacement matrix for an Axis symmetric Triangular element. **(15 Marks)**

8 a. Derive the general differential equation for 1d heat conduction. **(08 Marks)**

b. An induction furnace wall is made up of three layers, inside, middle and outer layer with thermal conductivity K_1, K_2 and K_3 respectively as shown in Fig. Q8 (b) below. Determine nodal temperature. **(12 Marks)**



$K_1 = 8.5$ W/mK
$K_2 = 0.25$ W/mK
$K_3 = 0.08$ W/mK
$h = 45$ W/m^{2}K
$T_\infty = 30°C$

Fig. Q8 (b)

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