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10ME64

Sixth Semester B.E. Degree Examination, June/July 2018
Finite Element Methods

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Write the equilibrium equations in elasticity subjected to body force. **(04 Marks)**

b. Describe the steps involved in FEM. **(08 Marks)**

c. Write a note on node numbering and half Band width. **(08 Marks)**

2 a. For the spring system shown in Fig. Q2 (a), using the principle of minimum potential energy. Determine the nodal displacement. **(10 Marks)**

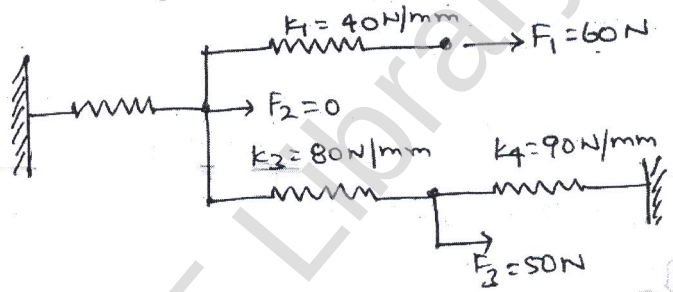


Fig. Q2 (a)

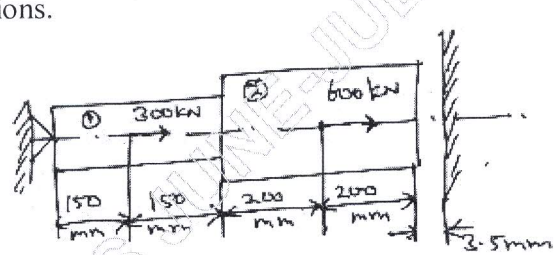
b. A simply supported beam of length 'L' is subjected to UDL of P_0 N/m. Determine the maximum deflection using Galerkin's method. **(10 Marks)**

3 a. Derive the shape functions of CST element in natural coordinate. **(10 Marks)**

b. What is the purpose of Pascal's triangle? Represent the 2D Pascal's triangle upto 5th order. **(05 Marks)**

c. Write a note on simplex, complex and multiplex elements. **(05 Marks)**

4 a. For the Bar shown in Fig. Q4 (a), determine the nodal displacement, element stresses and support reactions. **(12 Marks)**



$A_1 = 250\ mm^2$
$A_2 = 400\ mm^2$
$E_1 = E_2 = 200\ GPa$

Fig. Q4 (a)

b. Solve the following equations using Gauss-elimination technique.

$$5x_1 - 4x_2 + x_3 = 0$$
$$-4x_1 + 6x_2 - 4x_3 + x_4 = 1$$
$$x_1 - 4x_2 + 6x_3 - 4x_4 = 0$$
$$x_2 - 4x_3 + 5x_4 = 0$$

(08 Marks)

PART – B

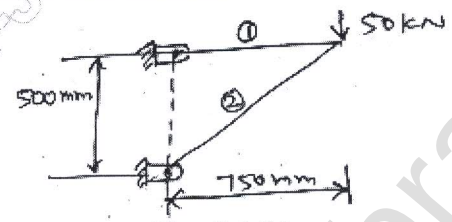
5 a. Obtain the shape functions of 8-noded rectangular element in Lagrangian. **(08 Marks)**

b. Explain the following with neat sketches:-
   (i) Iso-parametric element.
   (ii) Sub-parametric element.
   (iii) Super-parametric element. **(06 Marks)**

c. Find $I = \int_{-1}^{1} (a_0 + a_1\xi + a_2\xi^2 + a_3\xi^3)\,d\xi$. Use 2-point formula a's are constants. **(06 Marks)**

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

b. A truss shown in Fig. Q6 (b), is made of 2 bars, determine
   (i) Nodal displacement.
   (ii) Stresses in each element. **(10 Marks)**



$E_1 = E_2 = 200$ GPa
$A_1 = 1000$ mm^2
$A_2 = 1200$ mm^2

Fig. Q6 (b)

7 a. Derive the Hermite shape function for a beam element. **(12 Marks)**

b. A Cantilever beam subjected to point load of 250 KN as shown in Fig. Q7 (b). Determine deflection at tip and support reactions.
$E = 200$ GPa, $I = 4 \times 10^6$ mm^4, $l = 0.8$m. **(08 Marks)**

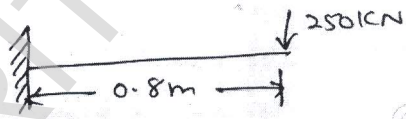


Fig. Q7 (b)

8 a. Calculate the temperature distribution in a 1-D fin with the physical properties given in Fig. Q8 (a). There is a uniform generation of heat inside the wall of $\bar{Q} = 400$ W/m^3. **(10 Marks)**

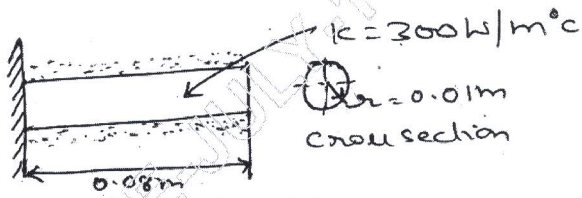


Fig . Q8 (a)

b. Determine the temperature distribution through the composite wall as shown in Fig. Q8 (b). Convection heat loss occurs on the right surface. Assume a unit area. **(10 Marks)**

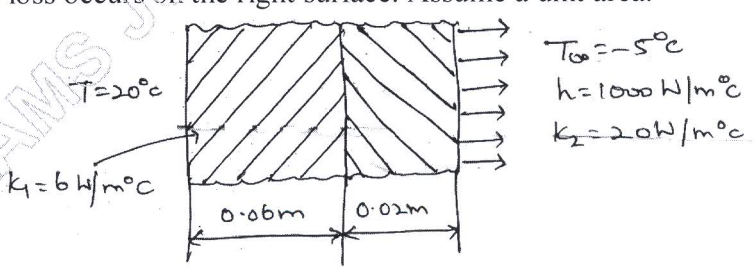


Fig. Q8 (b)

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