

USN

--	--	--	--	--	--	--	--	--	--

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)

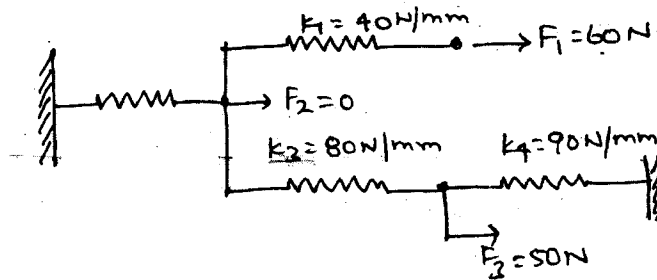
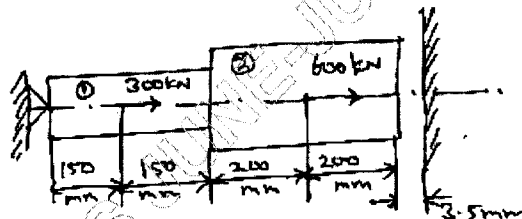


Fig. Q2 (a)

- 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)



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

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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages

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)

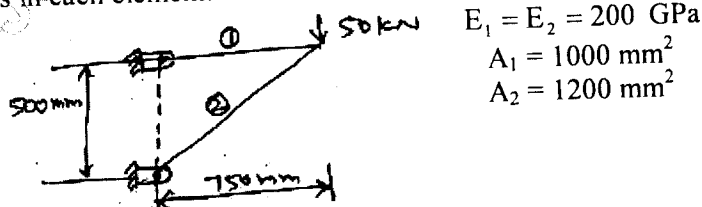


Fig. Q6 (b)

- 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. (08 Marks)
 $E = 200 \text{ GPa}$, $I = 4 \times 10^6 \text{ mm}^4$, $l_e = 0.8 \text{ m}$.

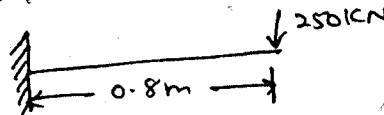


Fig. Q7 (b)

- 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 $\bar{Q} = 400 \text{ W/m}^3$. (10 Marks)

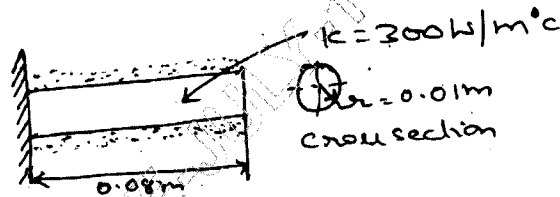


Fig. Q8 (a)

- 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)

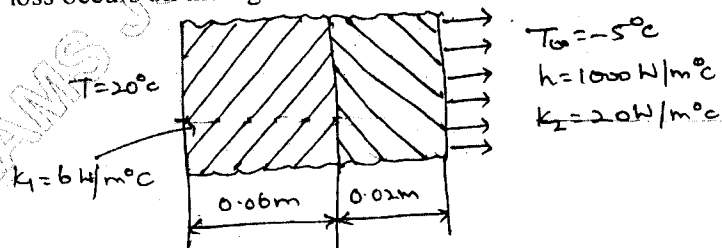


Fig. Q8 (b)
