USN | | | | | | | | | | | **06ME63**

Sixth Semester B.E. Degree Examination, June/July 2013
Modeling and 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. State the principle of minimum potential energy. Explain the potential energy with usual notation. **(06 Marks)**

b. For the spring system shown in Fig. Q1 (b), using the principle of minimum potential energy. Determine the nodal displacements. Take $F_1 = 75$ N and $F_2 = 100$ N. **(06 Marks)**

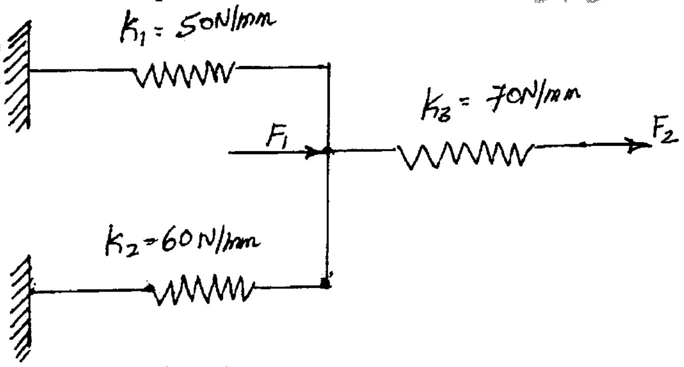


Fig. Q1 (b)

c. Solve the following system of simultaneous equation by Gaussian elimination method.
$x_1 - 2x_2 + 6x_3 = 0$, $2x_1 + 2x_2 + 3x_3 = 3$, $-x_1 + 3x_3 = 0$ **(08 Marks)**

2 a. Explain the basic steps involved in FEM. **(08 Marks)**

b. Explain the concepts of iso, sub and super parametric elements. **(06 Marks)**

c. Using potential energy approach, obtain the element stiffness matrix for a 1 D bar element. **(06 Marks)**

3 a. Derive the shape function for CST element. **(12 Marks)**

b. What are convergence requirements? Discuss three conditions of convergence requirements. **(08 Marks)**

4 a. What are properties of shape functions? **(05 Marks)**

b. Derive the hermit shape function for a 2 noded beam element. **(08 Marks)**

c. Derive the shape functions using Lagrangian interpolation for linear quadrilateral element. **(07 Marks)**

PART – B

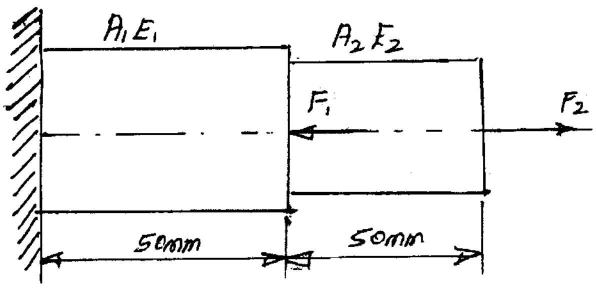
5 a. Derive inverse of Jacobian transformation matrix for quadrilateral element. **(10 Marks)**

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

6 a. Explain the types of boundary conditions in heat transfer problems. **(10 Marks)**

b. Discuss the various steps involved in the finite element analysis of a one dimensional heat transfer problem with reference to a straight fin. **(10 Marks)**

7 a. Using the direct stiffness method, determine the nodal displacements of a stepped bar shown in Fig. Q7(a) and also determine the stresses in each element. **(10 Marks)**



$E_1 = 200$ GPa
$E_2 = 70$ GPa
$A_1 = 150$ mm^2
$A_2 = 100$ mm^2
$F_1 = 10$ kN
$F_2 = 5$ kN

Fig. Q7 (a)

b. For the two bar truss shown in Fig. Q7 (b), determine the nodal displacement, stresses in each element and reaction at the support. Take $E = 2\times10^5$ N/mm^2, $A_r = 200$ mm^2. **(10 Marks)**

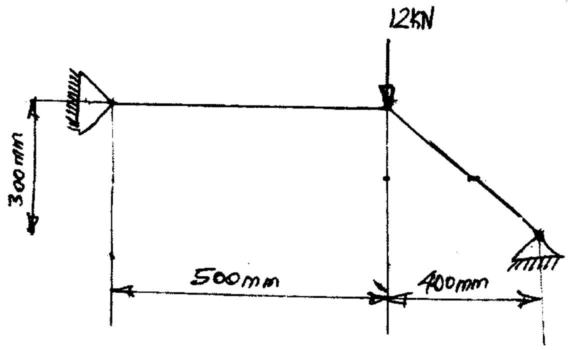


Fig. Q7 (b)

8 a. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right surface with convective heat transfer coefficient shown in Fig. Q8 (a). Take ambient temperature as -5°C. **(10 Marks)**

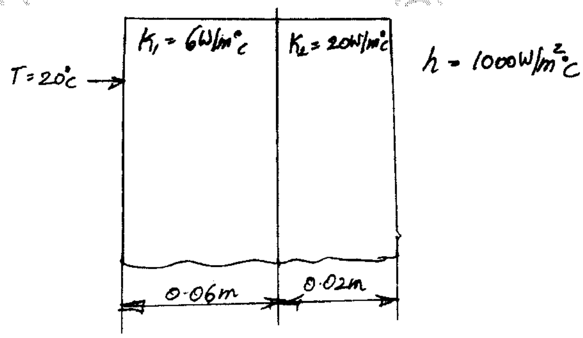


Fig. Q8 (a)

b. For the beam element shown in Fig. Q8 (b), determine the deflection under the given load. Take $E = 2\times10^8$ kN/m^2 and $I = 4\times10^{-6}$ m^4. **(10 Marks)**

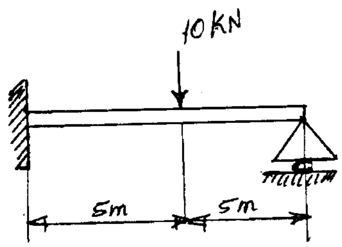


Fig. Q8 (b)

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