USN | | | | | | | | | | |

10ME64

Sixth Semester B.E. Degree Examination, June/July 2015
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. Write the stress – strain relationship for both plane stress and plane strain problems. **(06 Marks)**

b. Discuss the types of elements based on geometry. **(06 Marks)**

c. Explain the various application fields of finite element method. **(08 Marks)**

2 a. Derive an expression for total potential energy of an elastic body subjected to body force, traction force and point force. **(08 Marks)**

b. Using Raleigh's Ritz method, determine the displacement at mid point and stress in linear one-dimensional rod as shown in Fig. Q2(b). Use second degree polynomial approximation for the displacement. **(12 Marks)**

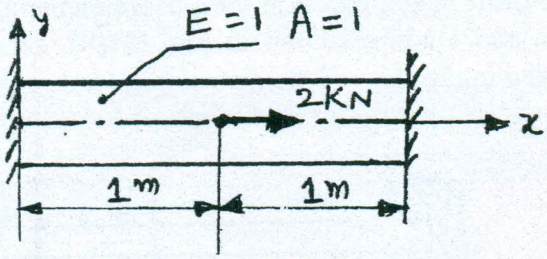

Fig.Q2(b)

3 a. Write an interpolation polynomial for linear, quadratic and cubic element. **(06 Marks)**

b. Explain simplex, complex and multiplex elements using element shapes. **(06 Marks)**

c. Derive the shape functions for a CST element. **(08 Marks)**

4 a. Solve for nodal displacement and elemental stresses for the following Fig.Q4(a), shows a thin plate of uniform thickness of 1 mm, Young's modulus = 200 GPa, weight density of the plate = 76.6×10^{-6} N/mm^3. In addition to its weight, it is subjected to a point load of 100 N at its midpoint and model the plate with 2 bar elements. **(10 Marks)**

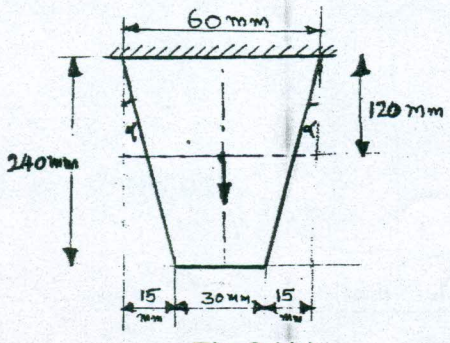

Fig.Q4(a)

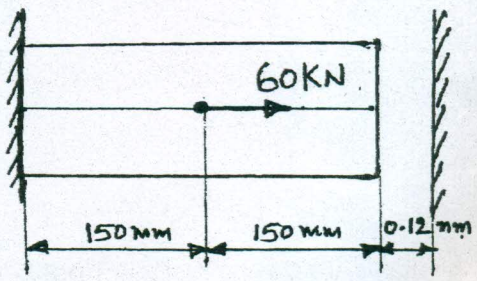

Fig.Q4(b)

b. Determine the nodal displacements, reactions and stresses for the Fig. Q4(b) using Penalty approach. Take E = 210 GPa, Area = 250 mm^2. **(10 Marks)**

PART – B

5 a. Distinguish between lower and higher order elements. **(08 Marks)**

b. Explain the concept of ISO, sub and super parametric elements and their uses. **(06 Marks)**

c. Write a note on 2 – point integration rule for 1D and 2D problems. **(06 Marks)**

6 a. Derive an expression for stiffness matrix of a truss element. **(08 Marks)**

b. For the pin-jointed configuration shown in Fig.Q6(b), formulate the stiffness matrix. Also determine nodal displacement and stress in each element. **(12 Marks)**

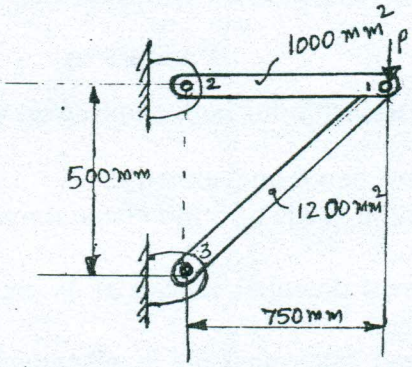

Fig.Q6(b)

7 a. Derive the Hermite shape function for a beam element. **(08 Marks)**

b. For the beam and loading shown in Fig. Q7(b), determine the slopes at 2 and 3, vertical deflection at the mid points of the distributed load. Take E = 200 GPa, $I = 4 \times 10^6$ mm^4. **(12 Marks)**

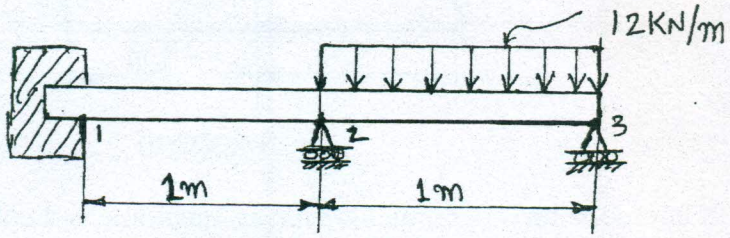

Fig.Q7(b)

8 a. Discuss the derivation of one dimensional heat transfer in thin fin. **(08 Marks)**

b. Determine the temperature distribution through the composite wall, subjected to convection heat transfer on the right side surface, with convective heat transfer co-efficient shown in Fig.Q8(b). The ambient temperature is – 5°C. Assume unit area. **(12 Marks)**

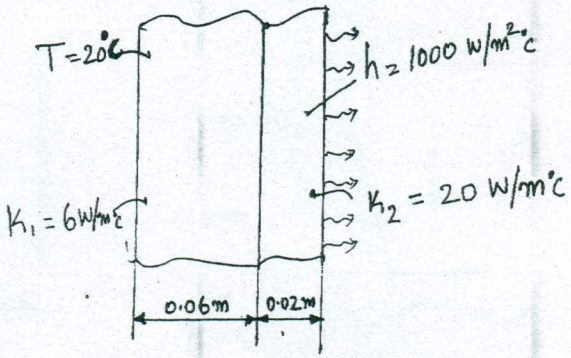

Fig.Q8(b)

* * * * *