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10ME64

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Finite Element Methods

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Obtain an equilibrium equations of a 3-D elastic body subjected to a body force. **(08 Marks)**

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

c. Explain the general description of finite element method. **(06 Marks)**

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

b. Using Raleigh's Ritz method find a deflection of a simply supported beam of length L subjected to a uniformly distributed load of P_0 N/m. **(12 Marks)**

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

b. Obtain an expression for a strain displacement matrix of a rectangular element. **(14 Marks)**

4 a. Determine the nodal displacements, reactions and stresses for the Fig. Q4 (a) using penalty approach. Take E = 210 GPa, Area = 250 mm^2. **(12 Marks)**

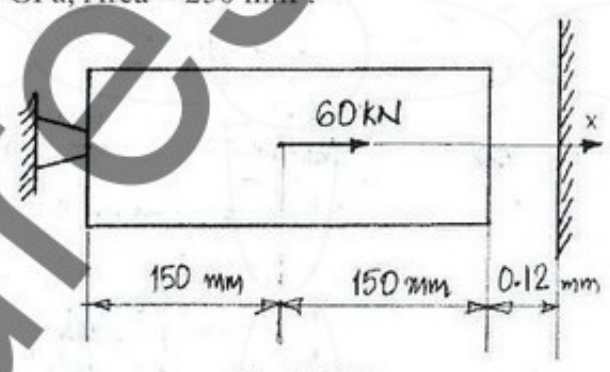

Fig. Q4 (a)

b. Find the nodal displacement, stress and strain of the system shown in Fig. Q4 (b). Take E = 70 GPa, Area = 1 m^2. **(08 Marks)**

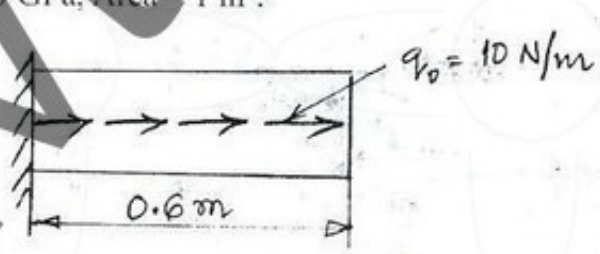

Fig. Q4 (b)

PART – B

5 a. Find the shape functions of a 2-D quadrilateral quadratic (9 noded) element. **(14 Marks)**

b. With a sketch define Iso, Sub and Super parametric elements. **(06 Marks)**

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

b. Find the nodal displacement, stress and reaction of truss element shown in Fig. Q6 (b). Take E = 70 GPa, Area = 200 mm^2. **(12 Marks)**

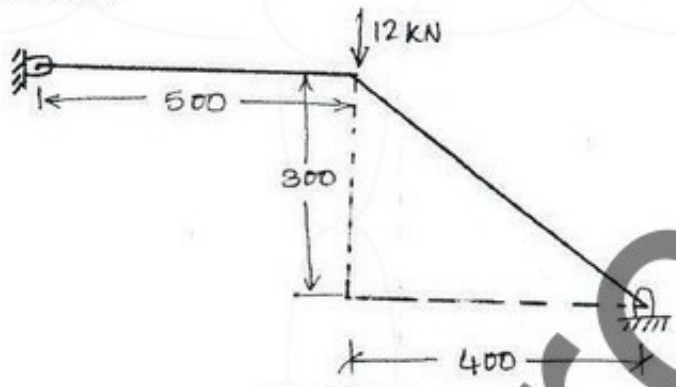

Fig. Q6 (b)

7 a. Derive the Hermite shape functions of a beam element. **(08 Marks)**

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

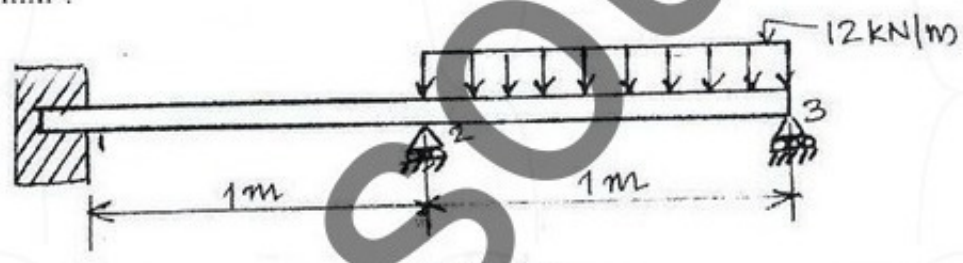

Fig. Q7 (b)

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

b. A composite wall consists of 3 materials shown in Fig. Q8 (b). The outer temperature is $T_0 = 20^0 C$, determine the temperature distribution in the wall. Convection heat transfer takes place at inner surface with $T_\infty = 800^0 C$. Take h = 25 $w/m^{2o}C$, Area = 1 m^2 **(12 Marks)**

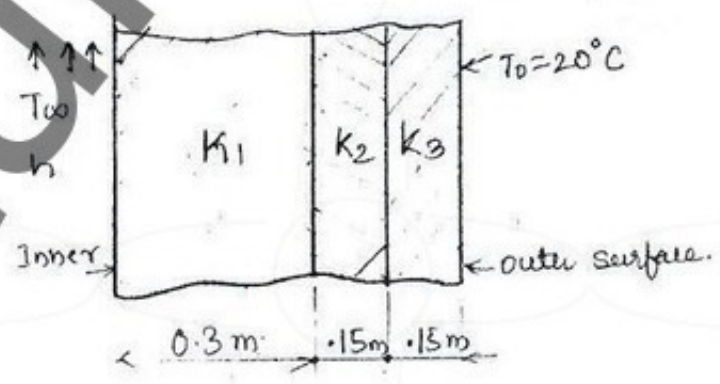

Fig. Q8 (b)

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