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06ME63

Sixth Semester B.E. Degree Examination, December 2012
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. Using Rayleigh-Ritz method, derive an expression for maximum deflection of the simply supported beam with point load P at centre. Use trigonometric function. **(08 Marks)**

b. Solve the following system of simultaneous equations by Gauss elimination method.

$$x + y + z = 9$$
$$x - 2y + 3z = 8$$
$$2x + y - z = 3$$

(08 Marks)

c. Explain the principle of minimum potential energy and principle of virtual work. **(04 Marks)**

2 a. Explain the basic steps involved is FEM. **(10 Marks)**

b. Explain the concepts of iso, sub and super parametric elements. **(05 Marks)**

c. Define a shape function. What are the properties that the shape functions should satisfy? **(05 Marks)**

3 a. What are the convergence requirements? Discuss three conditions of convergence requirements. **(05 Marks)**

b. What are the considerations for choosing the order of the polynomial functions? **(05 Marks)**

c. Derive the shape functions for CST element. **(10 Marks)**

4 a. Derive the Hermite shape function for a 2-noded beam element. **(10 Marks)**

b. Derive the shape functions for a four noded quadrilateral element in natural coordinates. **(10 Marks)**

PART – B

5 a. Derive an expression for stiffness matrix for a 2-D truss element. **(10 Marks)**

b. Derive the strain displacement matrix for 1-D linear element and show that $\sigma = E[B]\{u\}$ **(10 Marks)**

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

b. Derive the element matrices, using Galerkin for heat conduction in one dimensional element with heat generation Q. **(10 Marks)**

7 a. A bar is having uniform cross sectional area of 300 mm^2 and is subjected to a load P = 600kN as shown in Fig.Q7(a). Determine the displacement field, stress and support reaction in the bar. Consider two element and rise elimination method to handle boundary conditions. Take E = 200 GPa. **(10 Marks)**

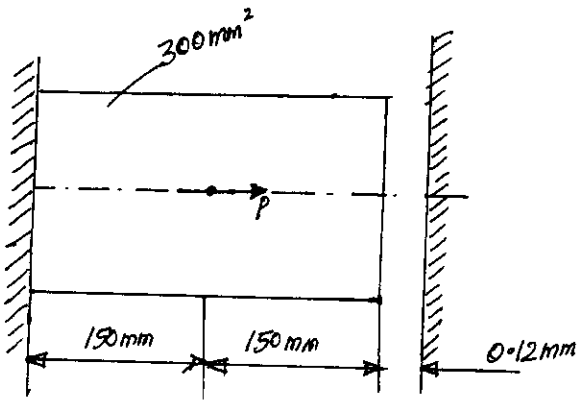

Fig.Q7(a)

b. For the two bar truss shown in Fig.Q7(b), determine the nodal displacements and stress in each number. Also find the support reaction. Take E = 200 GPa. **(10 Marks)**

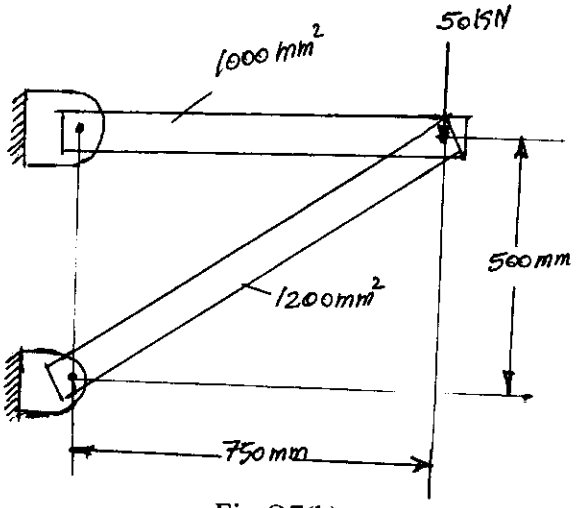

Fig.Q7(b)

8 a. For the beam shown in Fig.Q8(a), determine the end reaction and deflection at mid span. Take E = 200 GPa, I = 4×10^6 mm^4. **(10 Marks)**

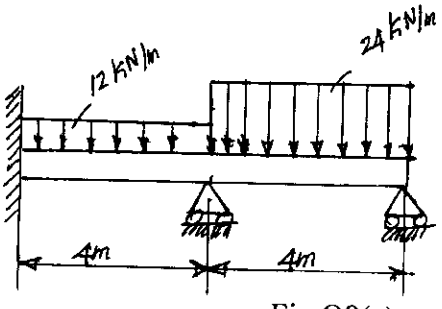

Fig.Q8(a)

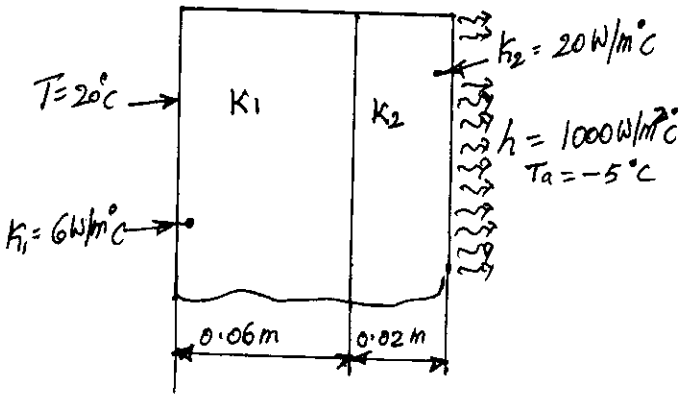

Fig.Q8(b)

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convection heat transfer coefficient shown in Fig.Q8(b). The ambient temperature is –5°C. **(10 Marks)**

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