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10ME64

Sixth Semester B.E. Degree Examination, June/July 2013

Finite Element Methods

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Write equilibrium equations in elasticity subjected to body and traction forces. **(06 Marks)**

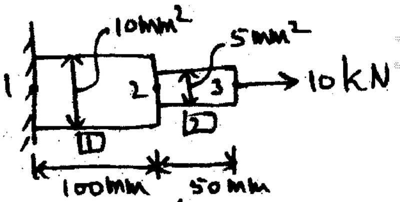
b. Write the stress-strain relationships for both plane stress and plane strain problems. **(06 Marks)**

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

2 a. Explain minimum potential energy principle. **(06 Marks)**

b. Derive the stiffness matrix for a single element bar, using direct stiffness method. **(04 Marks)**

c. A two element two noded bar is shown in Fig.Q2(c). Determine the nodal displacements and the nodal forces. **(10 Marks)**



E = 200 GPa

Fig.Q2(c)

3 a. Write a note on the polynomials involved in linear, quadratic and cubic 1D elements. **(06 Marks)**

b. Derive shape functions for one dimensional two noded bar element. Hence explain the conditions that the shape function has to satisfy. **(06 Marks)**

c. Write the Jacobian matrix for the triangular element shown in Fig.Q3(c). **(08 Marks)**

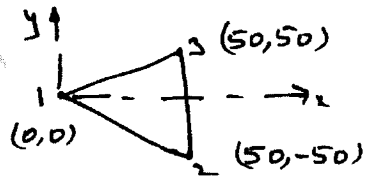


Fig.Q3(c)

4 A stepped bar is shown in Fig.Q4. Determine:

a. The nodal displacements and nodal forces.

b. The stresses in each element.

c. The principal and shear stresses in each element.

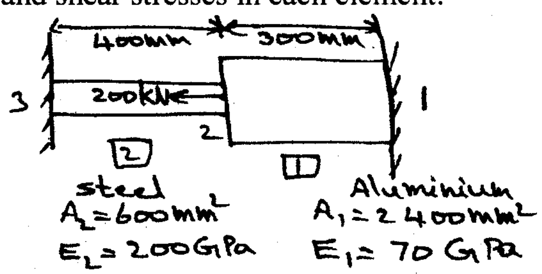


Fig.Q4

Use penalty method to handle the boundary conditions. **(20 Marks)**

PART – B

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

b. Define isoparametric element. What are the advantages? **(04 Marks)**

c. Write a note on 2-point integration rule for 1D and 2D problems. **(08 Marks)**

6 For the two bar truss shown in Fig.Q6, determine the nodal displacements and forces. Assume E = 200 GPa, $A = 6 \times 10^{-4}\ m^2$.

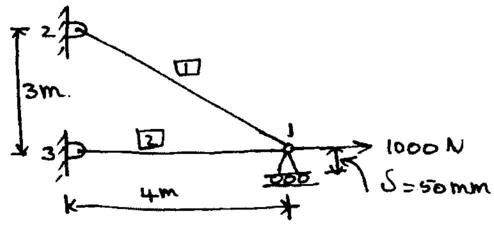


Fig.Q6

(20 Marks)

7 a. Define Hermite shape functions. Derive shape functions for the beam element. **(10 Marks)**

b. Derive stiffness matrix for the beam element using Hermite shape functions. **(10 Marks)**

8 A composite wall shown in Fig.Q8 consists of three materials. The outer temperature T_0 is 20°C. Convective heat transfer takes place on the inner surface of the wall with T_∞ = 800°C. The convective heat transfer coefficient hi is 25 W/m^2°C. Determine the temperature distribution in the wall.

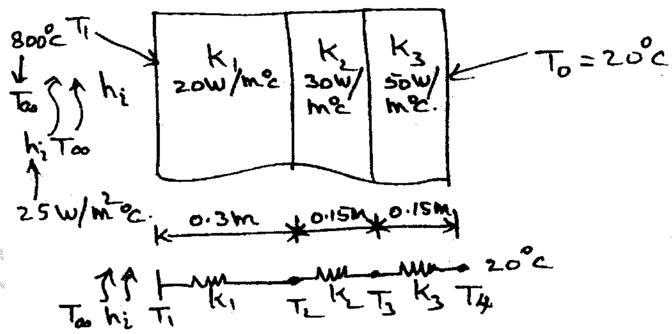


Fig.Q8

(20 Marks)

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