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10ME64

Sixth Semester B.E. Degree Examination, June/July 2017
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. Explain with neat sketch, plain stress and plain strain. **(06 Marks)**

b. Sketch the different types of 1D, 2D and 3D elements used in the finite element analysis. **(06 Marks)**

c. Derive the equilibrium equation in elasticity of 3D elastic body subjected to a body force and traction force. **(08 Marks)**

2 a. Write the properties of stiffness matrix and derive the element stiffness matrix for a 1D bar element. **(10 Marks)**

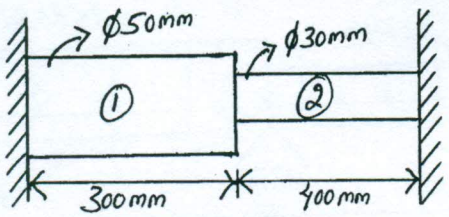
b. A cantilever beam of span 'L' is subjected to a point at free end. Derive an equation for the deflection at free end by using Rayleigh Ritz method. Assume polynomial displacement function. **(10 Marks)**

3 a. Define interpolation polynomial, simplex, complex and multiplex element. **(04 Marks)**

b. Explain two Dimensional Pascal's triangle. **(06 Marks)**

c. Derive the shape function for C.S.T element. **(10 Marks)**

4 a. Determine the nodal displacements, elemental stresses and support reactions for the Fig Q4(a). Use elimination approach to handle the Boundary conditions. **(10 Marks)**

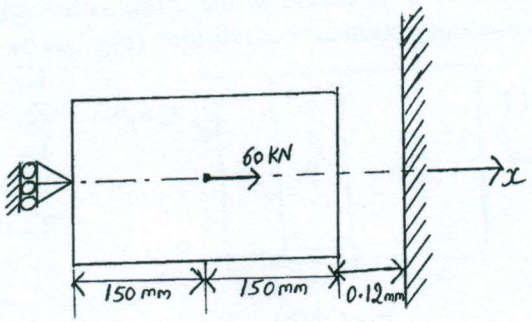


(1) Aluminium
$E_1 = 0.7 \times 10^5$ MPa

(2) Steel
$E_2 = 2 \times 10^5$ MPa

Fig Q4(a)

b. Consider the bar shown Fig Q4 (b). An axial load $P = 60 \times 10^3$N is applied at its mid point. Using penalty method of handling Boundary conditions. Determine the nodal displacement and support reactions. **(10 Marks)**



$A = 250mm^2$

$B = 200$ GPa

Fig Q4(b)

PART – B

5 a. Derive the shape function for a quadratic bar element using Lagrange's interpolation. **(05 Marks)**

b. With a neat sketch explain iso, sub and super parametric elements. **(06 Marks)**

c. Derive Lagrange quadratic quadrilateral element (9 noded quadrilateral element). **(09 Marks)**

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

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

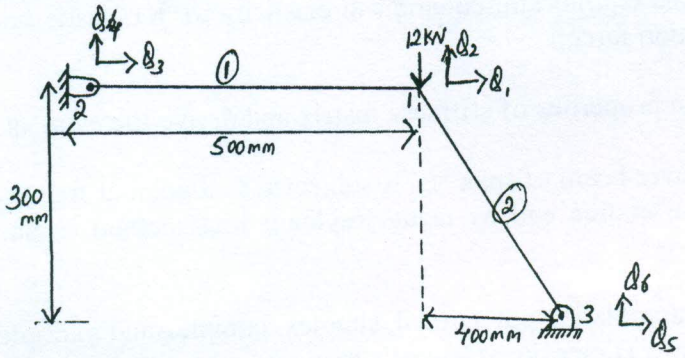


Fig Q6(b)

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

b. For the beam and loading shown in the Fig Q7(b). Determine the end reaction and deflection at midspan. Take E = 200 GPa, I = 4 × 10^6 mm^4. **(12 Marks)**

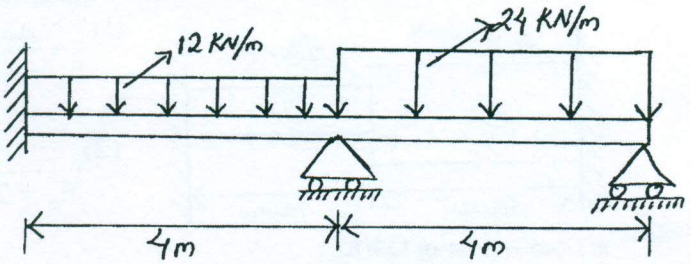
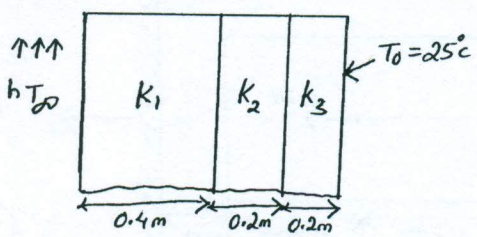


Fig Q7(b)

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

b. Determine the temperature distribution in the composite wall using 1D heat elements, use penalty approach of handling boundary conditions (Fig Q8(b). **(12 Marks)**



K_1 = 25 W/m °C
K_2 = 35 W/m °C
K_3 = 55 W/m °C
h = 30 W/m^2 °C
T_∞ = 900°C
A = Unit area

Fig Q8(b)

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