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10ME64

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Finite Element Method

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What is Finite Element Method (FEM)? Explain the steps involved in FEM. **(10 Marks)**

b. Differentiate between plane stress and plane strain problems. Also state the stress strain relations for both. **(10 Marks)**

2 a. State the principle of minimum potential energy and apply the same to determine nodal displacement of a spring system shown in Fig Q.2(a) **(10 Marks)**

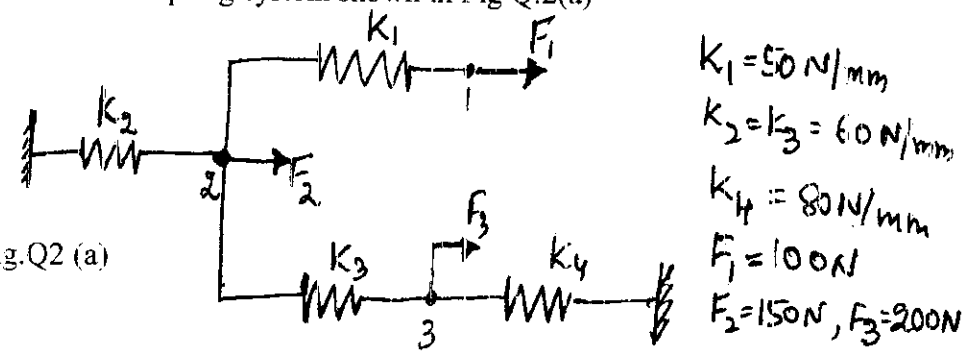

Fig.Q2 (a)

b. Using Rayleigh's – Ritz method, derive an expression for maximum deflection of the simply supported beam with point load 'p' at centre. **(10 Marks)**

3 a. Derive the shape function for triangular element (CST Element) in natural co-ordinate system. **(10 Marks)**

b. Derive an expression for Jacobean matrix for a four noded quadrilateral element. **(10 Marks)**

4 a. A stepped bar is shown in Fig. 4(a).
Determine i) The nodal displacement and nodal forces
ii) The stresses in each element
iii) The principal and shear stress in each element. **(10 Marks)**

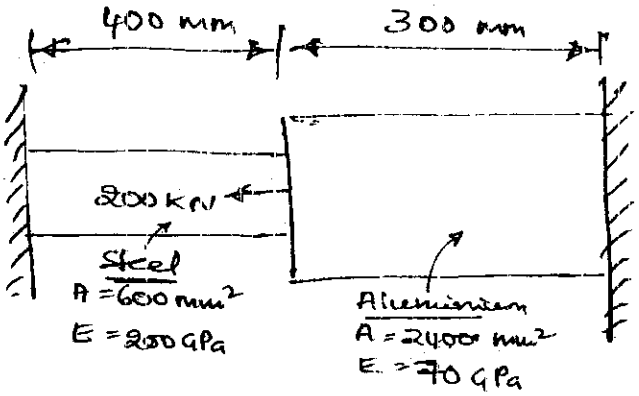

Fig.Q4 (a)

b. Solve the following system of equations by Gauss Elimination method.

$x_1 + x_2 + x_3 = 6$

$x_1 - x_2 + 2x_3 = 5$

$x_1 + 2x_2 - x_3 = 2$ **(10 Marks)**

PART – B

5 a. Derive the shape function for a quadratic bar element using Lagrange's interpolation. **(10 Marks)**

b. Evaluate $\int_{-1}^{+1}\left[3e^x + x^2 + \frac{1}{(x+2)}\right]dx$

Using one – point and two – point Gauss quadrature. **(10 Marks)**

6 a. Derive the stiffness matrix for truss element. **(10 Marks)**

b. For the two bar truss shown in Fig.6 (b), determine the nodal displacements. Assume E = 200GPa, A = $6 \times 10^{-4}m^2$ **(10 Marks)**

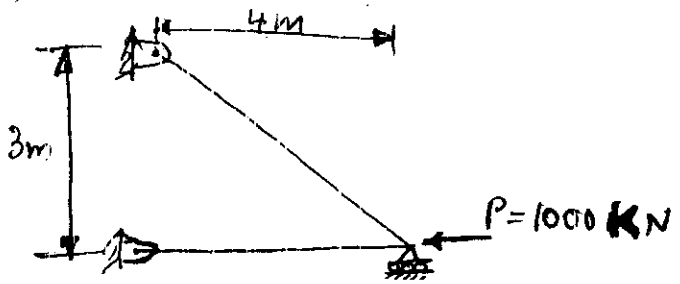

Fig.Q6 (b)

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

b. For the beam fixed at both ends and loaded as shown in Fig.Q7(b). Determine the displacement and shapes at node 2, and reaction forces at node 1 only. **(10 Marks)**

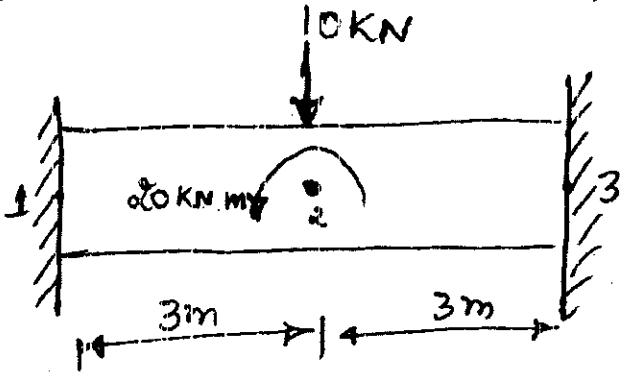

Fig.Q7 (b)

8 a Derive element conductivity matrix for one dimensional heat flow element. **(10 Marks)**

b. Find the temperature distribution and heat transfer through an iron fin of thickness 5mm, height 50mm and width 1000mm. The heat transfer coefficient around the fin is $10W/m^2$ K and ambient temperature is 28°C. The base of fin is at 108°C. Take K = 50W/m K. Use two elements. **(10 Marks)**

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