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10ME64

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

Finite Element Method

Time: 3 hrs.

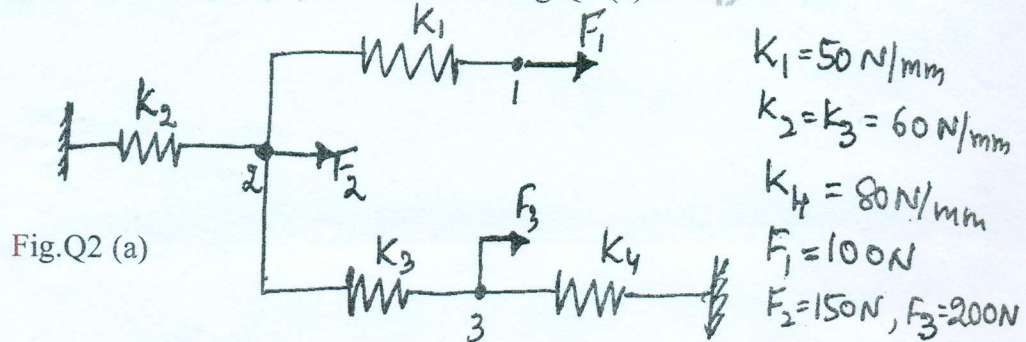
Max. Marks: 100

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)

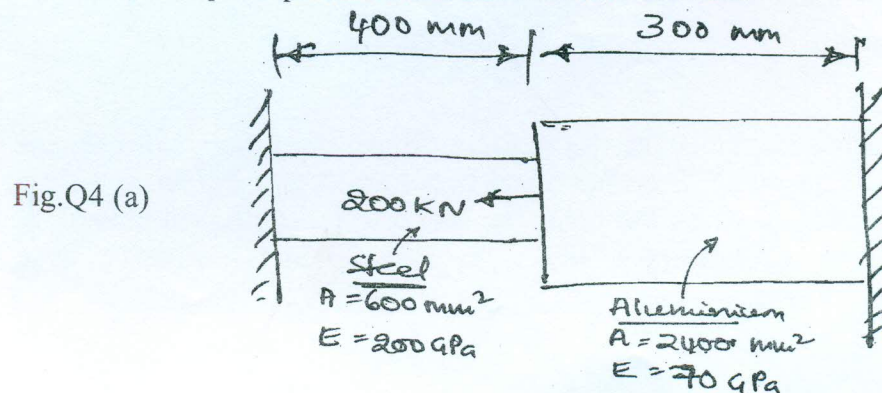
2. a. State the principle of minimum potential energy and apply the same to determine nodal displacement of a spring system shown in Fig Q.2(a) (10 Marks)



- 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)



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



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.

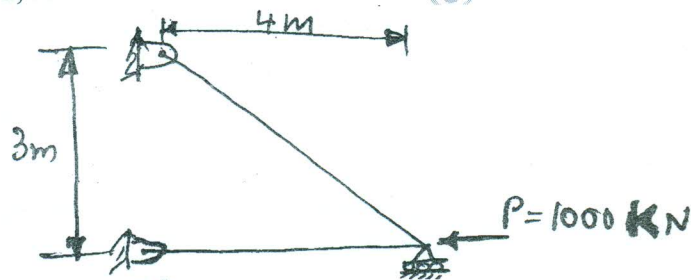
(10 Marks)

b. For the two bar truss shown in Fig.6 (b), determine the nodal displacements.

Assume $E = 200\text{GPa}$, $A = 6 \times 10^{-4}\text{m}^2$

(10 Marks)

Fig.Q6 (b)



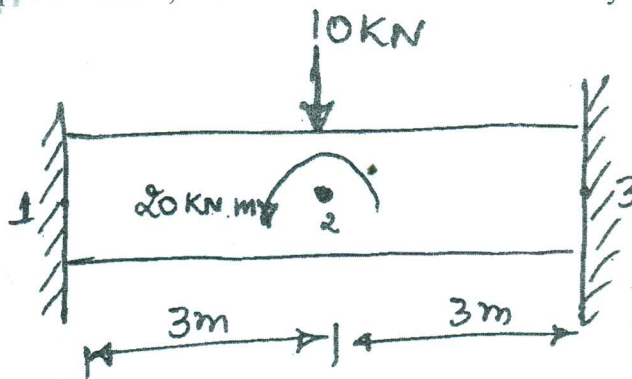
7 a. Derive the Hermite shape functions for a beam element.

(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 $10\text{W/m}^2\text{K}$ and ambient temperature is 28°C . The base of fin is at 108°C . Take $K = 50\text{W/m K}$. Use two elements. (10 Marks)
