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15AU73

## Seventh Semester B.E. Degree Examination, June/July 2019 Finite Element Modelling and Analysis

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

### Module-1

- 1 a. Derive the equilibrium equation in elasticity of 3D elastic body subjected to body force and traction force. (08 Marks)
- b. Solve the following system of simultaneous equation by gauss elimination method  

$$x + y + z = 9$$

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

$$2x + y - z = 3$$
(08 Marks)

OR

- 2 a. Explain with neat sketch plane stress and plane strain. (08 Marks)
- b. For the spring system shown in Fig Q2(b) using principle of minimum potential energy, determine the nodal displacements Take  $F_1 = 75\text{N}$  and  $F_2 = 100\text{N}$

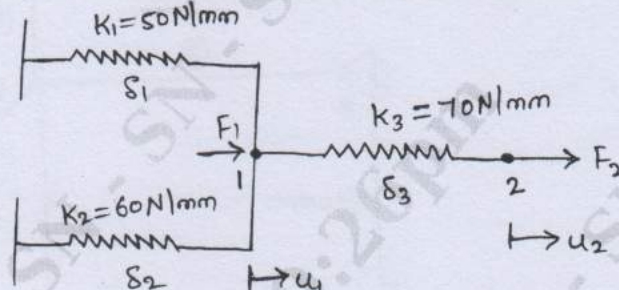


Fig Q2(b)

(08 Marks)

### Module-2

- 3 a. What is FEA? Explain the basic steps involved in FEM? (08 Marks)
- b. What is shape function? Derive the shape function for bar element in global co-ordination. (08 Marks)

OR

- 4 a. Derive the stiffness matrix for the bar subjected to axial load P using direct method. (08 Marks)
- b. What are the convergence requirements? Discuss three conditions of convergence requirements? (08 Marks)

### Module-3

- 5 a. Determine the nodal displacement, stress in each elements and support reaction in the bar shown in Fig Q5(a) due to applied force  $P = 100\text{kN}$ . Take  $E_{\text{steel}} = 200\text{GPa}$ ,  $E_{\text{cu}} = 100\text{GPa}$ .

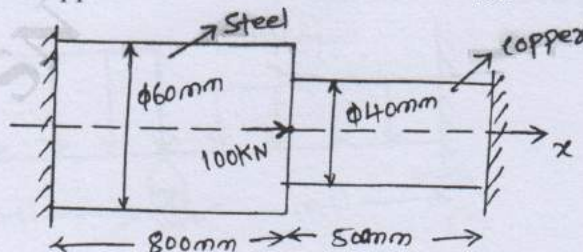


Fig Q5(a)

(08 Marks)

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.

- b. Consider the bar as shown in Fig Q5(b). An axial load  $P = 60 \times 10^3 \text{ N}$  is applied at its mid point. Using elimination method of handling boundary conditions. Determine nodal displacement and support reaction?

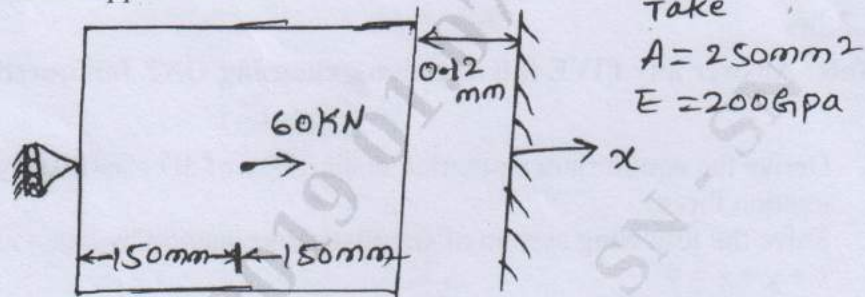


Fig Q5(b)

(08 Marks)

OR

- 6 a. Derive the element stiffness matrix for truss elements. (08 Marks)  
 b. For the two bar truss shown in Fig Q6(b), determine the nodal displacement, stress in each element and reaction at the support. Take  $E = 2 \times 10^5 \text{ MPa}$ ,  $A_e = 200 \text{ mm}^2$ .

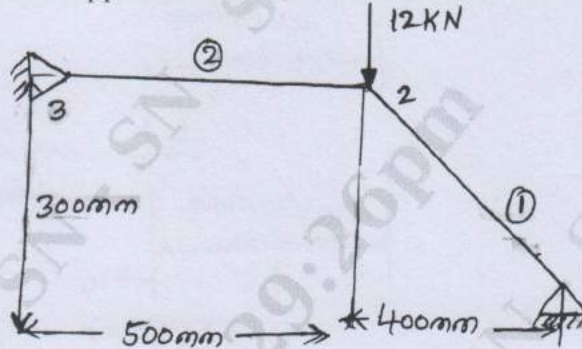


Fig Q6(b)

(08 Marks)

**Module-4**

- 7 Derive the Hermite shape function for beam element. Sketch the variation. (16 Marks)

OR

- 8 a. Derive the shape functions for a three noded quadratic bar element. (10 Marks)  
 b. Explain serendipity elements. (06 Marks)

**Module-5**

- 9 For the beam shown in Fig Q9, determine the end reaction and deflection at mid span. Take  $E = 200 \text{ GPa}$ ,  $I = 4 \times 10^6 \text{ mm}^4$

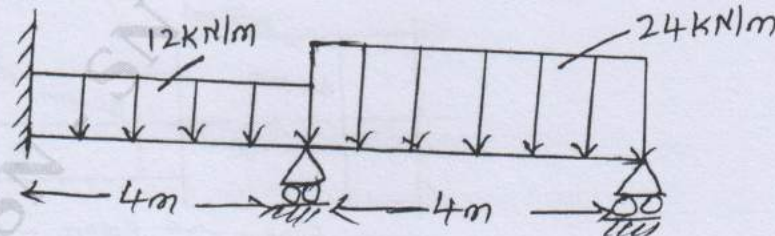


Fig Q9

2 of 3

(16 Marks)

OR

- 10 a. Derive the expression for stiffness matrix for 1D – heat conduction. (06 Marks)  
 b. Solve the temperature distribution in the composite wall as shown in Fig Q10(b). Using 1-D heat elements use penalty approach of handling boundary conditions.

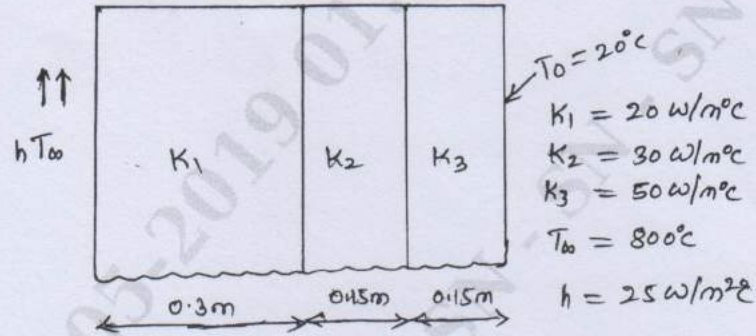


Fig Q10 (b)

(10 Marks)

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