

# CBCS SCHEME

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15AU73

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020

## Finite Element Modeling 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. Define FEM, write the limitations and applications of FEM. (08 Marks)  
b. Differentiate between plane stress and plane strain problems with examples. Write the stress – strain relations for both. Write the assumption for both. (08 Marks)

OR

- 2 a. Write the equilibrium equation of 3-D body. (07 Marks)  
b. A bar of length  $L$ , cross section area  $A$  and modulus of elasticity  $E$ , is subjected to distributed axial load  $q = cx$ , where  $c$  is a constant as shown in Fig Q2(b). Determine the displacement of the bar at the end using Rayleigh – Ritz method.

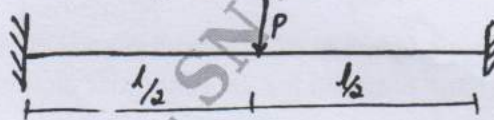


Fig Q2(b)

(09 Marks)

### Module-2

- 3 a. Derive an expression for jacobain matrix for a four noded quadrilateral element. (05 Marks)  
b. Write the basic steps involved in FEM for stress analysis of elastic solid bodies. (04 Marks)  
c. Write the shape function for 1-D linear bar element using natural co-ordinates. (07 Marks)

OR

- 4 a. Explain convergence requirements and compatibility conditions. (05 Marks)  
b. Write the stiffness matrix for 1-D bar element. (06 Marks)  
c. Explain the Pascal triangle with neat sketch. (05 Marks)

### Module-3

- 5 Consider the bar shown in Fig Q5. Using penalty method of handling boundary condition. Determine the nodal displacement, stress in each element and support reactions. Due to applied force  $P = 100\text{kN}$ . Take  $E_{\text{steel}} = 200\text{GPa}$ ,  $E_{\text{cu}} = 100\text{GPa}$ .

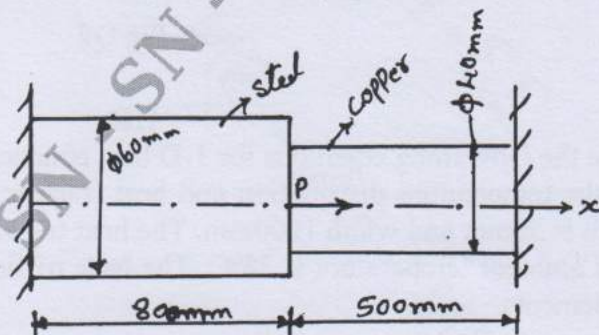


Fig Q5

(16 Marks)

OR

- 6 For the two bar truss shown in Figure Q6, determine the nodal displacement and the stress in each member. Also find the support reaction. Take  $E = 200\text{GPa}$ .

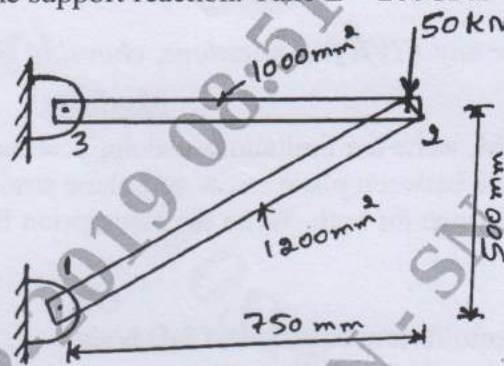


Fig Q6

(16 Marks)

Module-4

- 7 a. Write the shape function of 2D quadrilateral element by using natural coordinates. (08 Marks)  
b. Write the shape function for 2D triangular element by using natural coordinates. (08 Marks)

OR

- 8 Write the Hermit shape function for Beam element. Write the variation diagram also. (16 Marks)

Module-5

- 9 For the beam element shown in Fig Q9. Determine deflection under the given load. Take  $E = 200\text{GPa}$  and  $I = 4 \times 10^6\text{mm}^4$ .

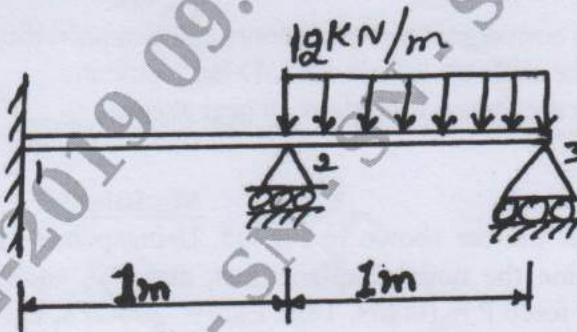


Fig Q9

(16 Marks)

OR

- 10 a. Derive the Governing equations for 1-D heat conduction element with neat sketch. (06 Marks)  
b. Find the temperature distribution and heat transfer through an iron fin of thickness 5mm. Length is 50mm and width 1000mm. The heat transfer coefficient around the fin is  $10\text{W/m}^2$ .  $K$  and ambient temperature is  $28^\circ\text{C}$ . The base of fin is at  $108^\circ\text{C}$ . Take  $K = 50\text{W/m.k}$ . Use two elements. (10 Marks)

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