

**BACHELOR OF TECHNOLOGY (C.B.C.S.) (2014 COURSE)**  
**B.Tech.Sem - VIII MECHANICAL :SUMMER- 2022**  
**SUBJECT : FINITE ELEMENT ANALYSIS**

Day : Wednesday  
 Date : 22-06-2022

**S-17937-2022**

Time : 02:30 PM-05:30 PM  
 Max. Marks : 60

**N.B**

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Assume suitable data if **NECESSARY**.

**Q.1** List and explain generalized FEM procedure for solving structural problem. **(10)**

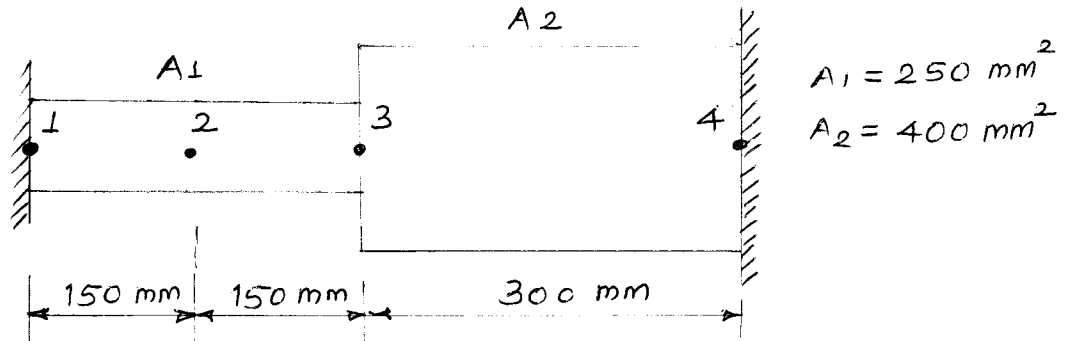
**OR**

Derive equilibrium equations in 3D. **(10)**

**Q.2** Derive shape function in 1D (linear) bar element in global and natural coordinate. **(10)**

**OR**

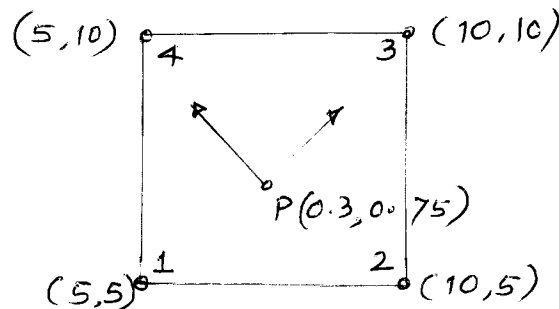
Determine the nodal displacement, elemental stresses and support reaction **(10)** of axially loaded bar as shown in fig. take  $E = 200 \text{ GPa}$ ,  $P = 30 \text{ kN}$ .



**Q.3** Derive the element stiffness matrix and load vector for CST. **(10)**

**OR**

For the element shown in fig having natural coordinates (0.3, 0.75). **(10)** Determine X and Y coordinates of point P.



**Q.4** Explain with sketch concept of axisymmetric problems in solid mechanics. **(10)** How does axisymmetric differ from planner symmetry.

**OR**

State and explain three basic laws on which isoparametric concept is developed. **(10)**

**Q.5** Derive the governing equation for 1D steady state heat conduction. **(10)**

**OR**

Consider a brick wall of thickness 0.6 m,  $K = 0.75 \text{ w/m K}$ . The inner surface is at  $15^\circ\text{C}$  and outer surface is exposed to cold air at  $-15^\circ\text{C}$ . Heat transfer coefficient associated with the outside surface is  $40 \text{ w/m}^2 \text{ K}$ . Determine the steady state temperature distribution within the wall and also the heat flux through the wall. Use two elements and obtain the solution. **(10)**

Q.6 Write down consistent mass and lumped mass matrix for bar element. (10)

OR

Find the nature frequencies of longitudinal vibrations of the same stepped shaft of areas  $A$  and  $2A$  of equal length ( $L$ ) when it is constrained at one end as shown in figure. (10)

