

(3 Hours)

Total Marks 80

- NB**
1. Question No. 1 is Compulsory.
 2. Attempt any three questions out of remaining 5 questions.
 3. Figures to the right indicates full marks.
 4. Assume suitable data wherever necessary but justify the same.

Q.1. Attempt any Four. (20)

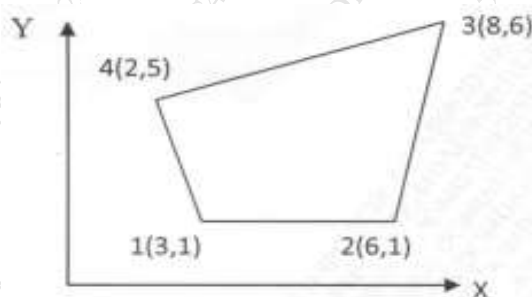
- a) Explain the stages in FEA.
- b) Write element matrix equation in the following fields explaining each term: i) 1D steady state, heat transfer by conduction ii) Torsion Analysis.
- c) Explain types of elements with sketches.
- d) Derive the shape function for 1D linear element in the natural coordinate system.
- e) Explain plane stress and plane strain condition with examples.

Q.2. (10) a) A constant strain triangle element has the nodal coordinates (10, 10), (40, 20) and (30, 50) mm for 1, 2, & 3 nodes respectively. Find the coordinates of point P inside the triangle, if the shape functions are $N_1=0.15$ and $N_2=0.25$. Also find the temperature at point P if temperature at node 1, 2, and 3 are 20°C , 30°C and 50°C respectively.

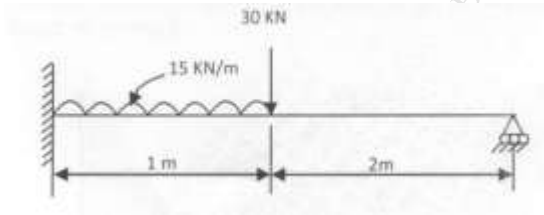
b) For a uniform cross section bar of Length $L=1$ m. made up of a material having $E=2 \times 10^{11} \text{ N/m}^2$ & $\rho = 7800 \text{ kg/m}^3$. Estimate the natural frequencies of axial vibration of the bar using lumped mass matrix method. Use a two element mesh. Assume $A=30 \times 10^{-6} \text{ m}^2$ **(10)**

Q.3. (10) a) Derive the shape functions of rectangular element in the local coordinate system.

b) For the is-parametric quadrilateral element as shown in figure determine **(10)** Cartesian coordinates of the point 'P' which has local coordinates ($\xi=0.9125$, $\eta=0.2106$).



- Q.4.** a) Find using FEA the deflection and slope at nodes and reaction at supports for the beam as shown in figure. Take $EI = 5000 \text{ KN-m}^2$. (10)



- b) i) Obtain the strain nodal displacement relationship for one dimensional linear element. (10)
 ii) Explain Weak & Non-weak form method used in FEA.

- Q.5.** a) i) Explain sources of errors in FEA. (10)
 ii) Explain pre-processing and post processing in FEA

- Q.6. Attempt any four.** (20)
 a) Explain Global, Local & Natural Co-ordinate System.
 b) Draw Lower order & Higher order 1D, 2D and 3D elements.
 c) Prove that the strain in three node triangular element is constant.
 d) What is significance of shape function?
 e) Obtain the strain nodal displacement relationship for one dimensional linear element.