Total No. of Questions : 10]

SEAT No. :

P2993

[Total No. of Pages : 3

[5154]-558

B.E. (Mechanical)

FINITE ELEMENT ANALYSIS

(2012 Course) (402050B) (Elective - IV) (Semester - II)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Draw suitable neat diagrams, wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***Use of electronic pocket calculator is allowed.***
4) ***Assume suitable data, if required.***

Q1) a) Explain importance of Boundary conditions and further explain: **[6]**

i) Essential Boundary Conditions.

ii) Natural Boundary Conditions.

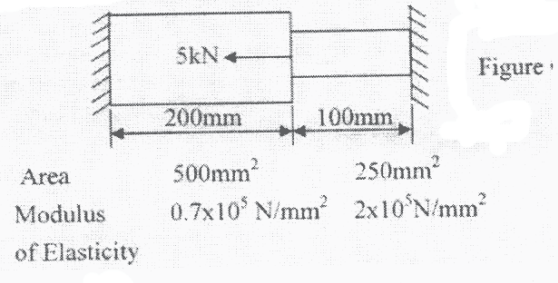
b) Why quality of meshing is important in FEA and how it is ensured and how the convergence of element in FEA formulation is achieved? **[4]**

OR

Q2) a) Explain the principle of Galerkin's Weighted Residual Method. **[6]**

b) Write a step by step procedure for Weak Formulation in elemental formulations. **[4]**

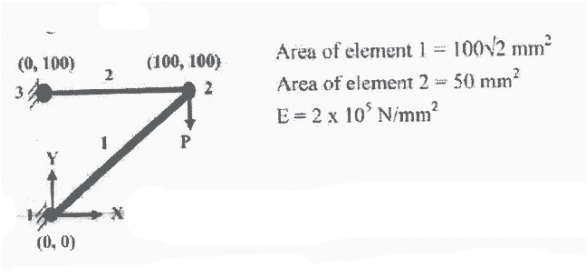
Q3) Determine the nodal displacements and element stresses by finite element formulation for the following figure. **[10]**



OR

P.T.O.

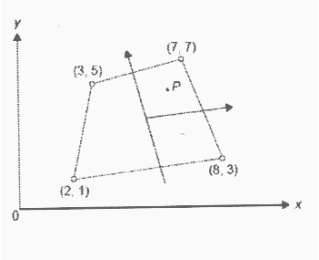
Q4) a) For the truss shown in figure acted by a force P. the displacements of node 2 is found to be Ux = 0.01 mm and Uy = –.02 mm, Determine the Force P. **[6]**



b) Explain method of Penalty for solution of equation [K] {X} = {F} where, [K] is a stiffness matrix, {X} is displacement vector and {F} is load vector. **[4]**

Q5) a) What is meant by ISO, SUPER and SUB parametric element and for structural analysis which is mostly preferred? **[6]**

b) Determine the Cartesian coordinate of the point $P(\zeta = 0.5, \eta = 0.5)$ shown in Fig. **[6]**



c) State and explain the three basic laws on which isoparametric concept is developed. **[6]**

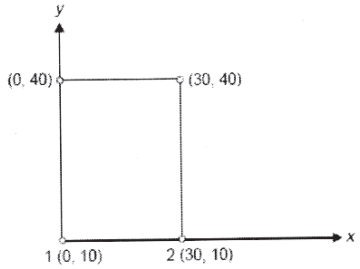
OR

Q6) a) Write short notes on: **[8]**

i) Uniqueness of mapping of isoparametric elements.

ii) Jacobian matrix.

b) For the element shown in Fig. assemble Jacobian matrix and strain displacement matrix for the Gaussian point (0.7, 0.5). **[10]**



Q7) a) Write down governing equation of steady state Heat Transfer and also write down elemental stiffness matrix and compare with Bar element. **[6]**

b) Consider a brick wall of thickness 0.6m, k = 0.75 W/m°K. The inner surface is at 15°C and the outer surface is exposed to cold air at –15°C. The heat transfer coefficient associated with the outside surface is 40 W/m^2 °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]**

OR

Q8) a) Heat is generated in a large plate (K = 0.5 W/m °C) at the rate of 2000W/m^3. The plate is 10 cm thick. Outside surface of the plate is exposed to ambient air at 30°C with a convective heat transfer coefficient of 40 W/m^2 °C. Determine the temperature distribution in the wall. **[10]**

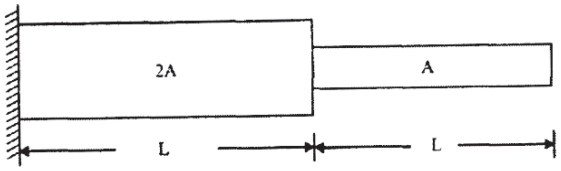
b) Derive FEA stiffness matrix for Pin Fin Heat Transfer Problem. **[6]**

Q9) a) Write down Consistent Mass and Lumped Mass Matrix for **[6]**

i) Bar Element

ii) Plane Stress Element

b) Find the natural frequencies of longitudinal vibrations of the same stepped shaft of areas A = 12000 mm^2 and 2A = 2500 mm^2 and of equal lengths (L = 1m), when it is constrained at one end, as shown below: **[10]**



OR

Q10)a) Explain difference between consistent and lumped mass matrix technique for modal analysis of structure. **[6]**

b) Find the natural frequencies of longitudinal vibrations of the unconstrained stepped shaft of areas A and 2A and of equal lengths (L), as shown below: **[10]**