Total No. of Questions : 10]

SEAT No. :

**P3067**

[Total No. of Pages :4

# [5059]-548

## B.E.(Mechanical)

## FINITE ELEMENT ANALYSIS

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

*Time :2½Hours]* *[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 step by step procedure for FEA and comment on convergence based on elemental size. **[6]**

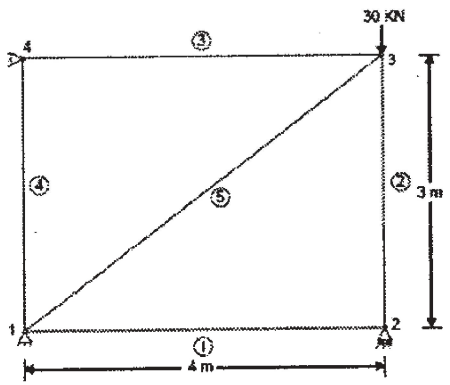
b) Explain concept of Plane Stress with appropriate example. **[4]**

OR

***Q2)*** a) Write down the difference between Weighted Residual Method and Weak Formulations. **[6]**

b) Explain LST (Linear Strain Triangle Element) Element. **[4]**

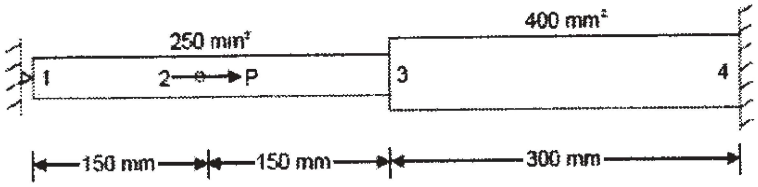
***Q3)*** Determine the forces in the members of the truss shown in Fig.Take E= 200GPa. A=2000mm$^2$. **[10]**




OR

***P.T.O.***

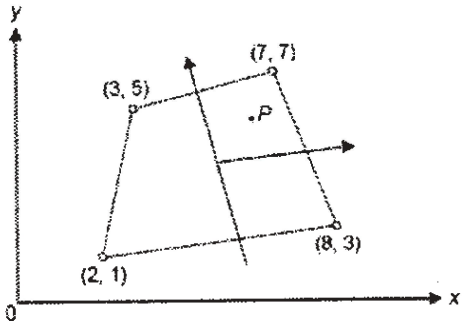
***Q4)*** a) Determine the nodal displacement, element stresses and support reactions of the axially loaded bar as shown in Fig.Take E=200GPa and P=30kN **[6]**




b) Write a note on Lagrendge interpolation functions used in FEA formulations. **[4]**

***Q5)*** a) Write a note on isoparametric formulations and how the geometric as well as field variable variation is taken into account? **[6]**

b) Determine the Cartesian coordinate of the point P (ζ ? 0.5,η ? 0.6) shown in Fig. **[4]**




c) Write short notes on **[4]**

i) Uniqueness of mapping of isoparametric elements.

ii) Jacobian matrix

d) State and explain the three basic laws on which isoparametric concept is developed. **[4]**

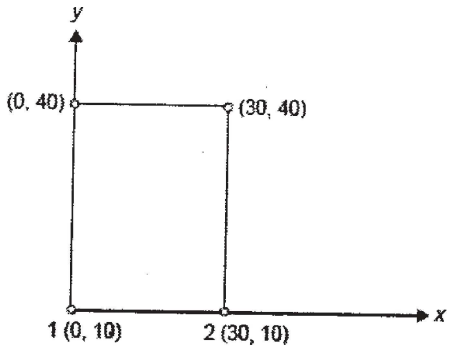
OR

***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 40W/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=0.5W/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 40W/m$^2$ °C. Determine the temperature distribution in the wall. **[10]**

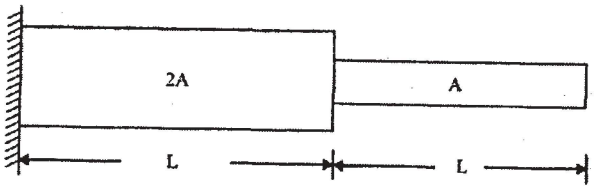
b) Derive FEA stiffness matrix for Pin Fin Heat Transfer problem. **[6]**

***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=1200 mm$^2$ and 2A=2500mm$^2$ 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]**