Total No. of Questions : 10]

SEAT No. : ____

P4540

[Total No. of Pages : 4

[4959] - 1048

B.E. (Mechanical)

FINITE ELEMENT ANALYSIS

(2012 Course) (Elective - IV(b))

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) Write down the basic steps of FEA and list down methods adopted for Finite Element Formulations. **[6]**

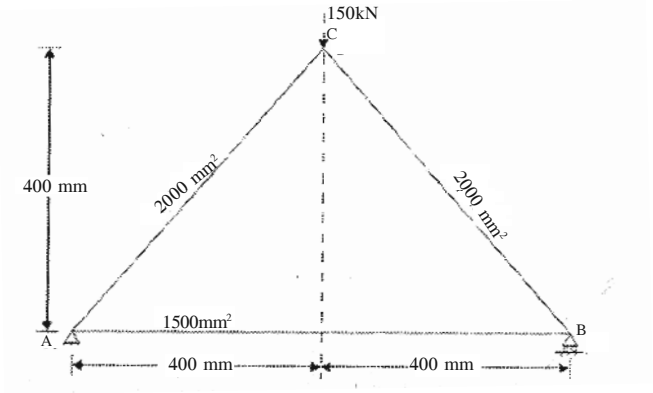
b) Write a note on Plane Stress Formulations and explain its applications. **[4]**

OR

Q2) a) Explain step by step procedure for Weighted Residual Method. **[6]**

b) Explain CST element. **[4]**

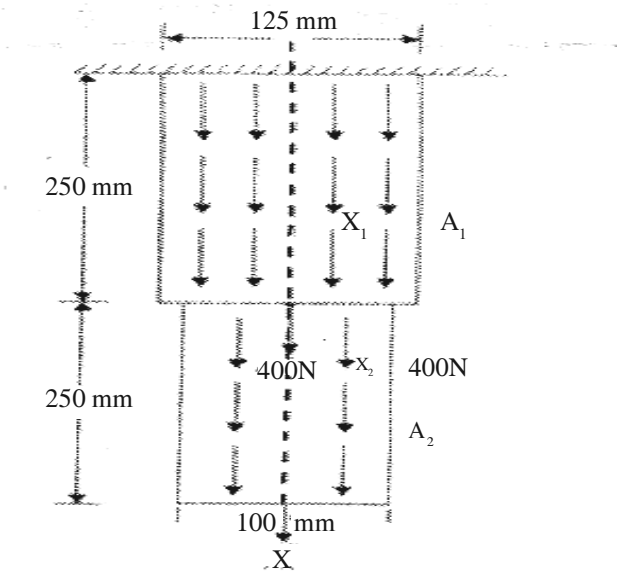
Q3) Determine stresses and reaction forces in Truss structure shown below. Take E = 200GPa. **[10]**



P.T.O.

OR

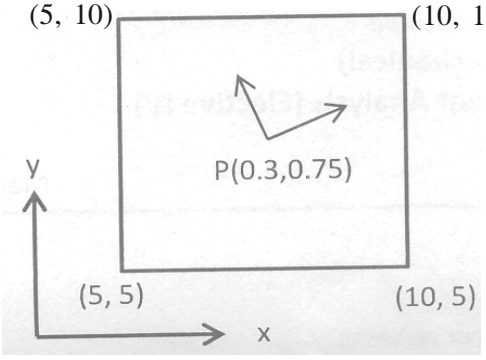
Q4) a) The thin uniform thickness 20 mm is shown in figure. In addtion to the self weight, the plate is subjected to point load of 400 N at mid-depth. The Youngs Modulus E = 200 GPa and unit weight $\rho = 0.8 \times 10^{-4}$N/mm. Analyse the plate after modeling it with two elements and find deformations in nodes. **[6]**



b) What is meant by Pascal's Triangle and how it is used in decision of interpolation function in element formulations. **[4]**

Q5) a) Explain what is Isoparametric formulations and what is meant by Iso, Super and Sub Parametric Formulation. **[6]**

b) Point P is located in rectangular element having natural coordinates (0.3,0.75) as shown in figure below, determine X and Y coordinates of point P. **[6]**



c) Explain step by step procedure of Gauss 2-point and 3-point Numerical integration method and how it is applied in isoparametric formulations? **[6]**

OR

Q6) a) Explain concept of rigid body modes and constant strain rates and how it is ensured in isoparametric formulations. Write down rules of isoparametric formulations. **[8]**

b) Determine integration of following function by using Gauss 2-point and 3-point method and compare with exact solution. **[10]**

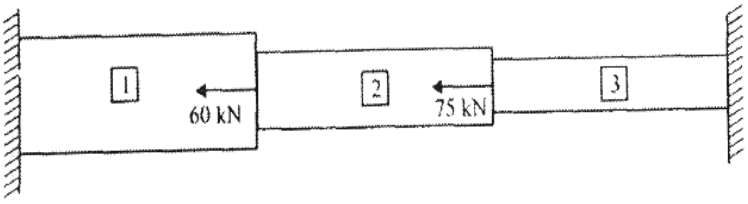
$$\int_5^{10} \left(1 + x + x^2\right) dx$$

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

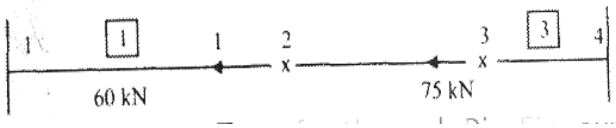
b) A metallic fin, with thermal conductivity 70 W/m °K, 1 cm radius and 5 cm long extends from a plane wall whose temperature is 140°C. Determine the temperature distribution along the fin if heat is transferred to ambient air at 20°C with heat transfer coefficient of 5 W/m^2 °K. Take two elements along the fin. **[10]**

OR

Q8) a) A composite bar of 3 different materials, rigidly fixed at both the ends, is subjected to a uniform temperature rise of 80°C. In addition, axial loads, are applied at two points on the bar as shown. Determine the displacements stress and support reactions. **[10]**



	Section-1	Section-2	Section-3
Material	Bronze	Aluminium	Steel
Area of cross section (mm^2)	2400	1200	600
Length (mm)	800	600	400
Modulus of elasticity(GPa)	83	70	200
Coefficient of thermal expansion (/°C)	18.9×10^{-6}	23×10^{-6}	11.7×10^{-6}



b) Write a note on Heat Transfer through Pin-Fin, explain with appropriate governing equations. **[6]**

Q9) a) Write down a dynamic equation and explain each term. Convert this into a Eigen value problem and explain its significance. **[6]**

b) Consider the Three element model of fixed free bar as shown in figure undergoing axial vibrations. **[10]**

Let L = 1m. A = 30×10^{-6} m^2, E = 2×10^{-5} $\frac{N}{mm^2}$, ρ = 7800 kg/m^3, using lumped mass matrix determine natural frequencies of bar.

OR

Q10)a) Write down cosistent and lumped mass matrices for following elements. **[6]**

i) Bar Element

ii) Plane Stress Element

iii) Triangular Element

b) Find the natural frequencies of longitudinal vibrations of the same stepped shaft of areas A and 2A and of equal lengths (L), when it is constrained at one end, as shown below. **[10]**