

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]

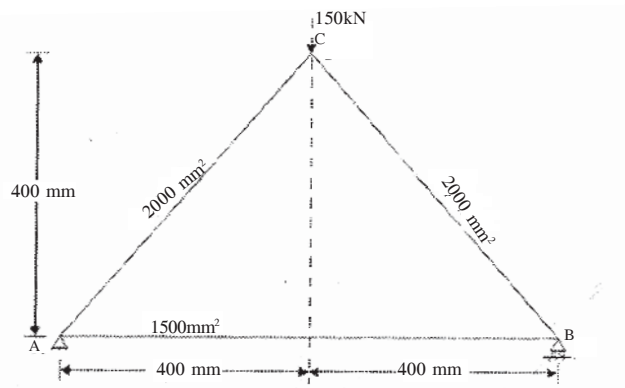
b) Write a note on Plane Stress Formulations and explain its applications. [4]

OR

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

b) Explain CST element. [4]

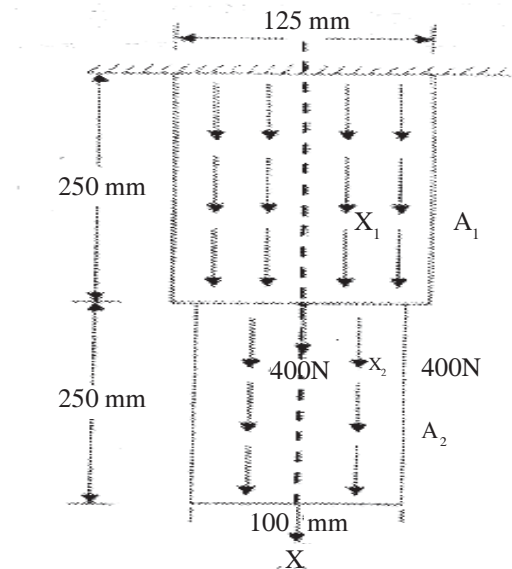
Q3) Determine stresses and reaction forces in Truss structure shown below. Take $E = 200\text{GPa}$. [10]



P.T.O.

OR

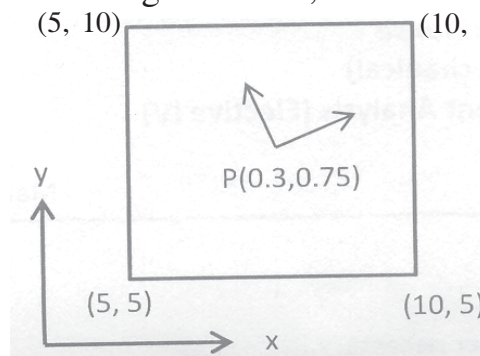
- Q4) a)** The thin uniform thickness 20 mm is shown in figure. In addition to the self weight, the plate is subjected to point load of 400 N at mid-depth. The Youngs Modulus $E = 200 \text{ GPa}$ and unit weight $\rho = 0.8 \times 10^{-4} \text{ N/mm}$. Analyse the plate after modeling it with two elements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

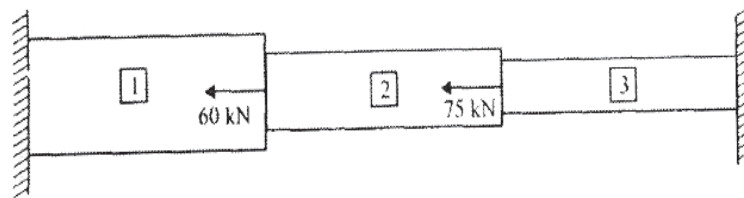
$$\int_5^{10} (1 + x + x^2) dx$$

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

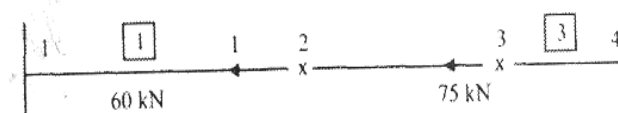
b) A metallic fin, with thermal conductivity 70 W/m °K, 1 cm radius and 5 cm long extends from a plane wall whose temperature is 140°C. Determine the temperature distribution along the fin if heat is transferred to ambient air at 20°C with heat transfer coefficient of 5 W/m² °K. Take two elements along 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 (1/°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 $L = 1\text{m}$. $A = 30 \times 10^{-6}\text{ m}^2$, $E = 2 \times 10^5 \frac{\text{N}}{\text{mm}^2}$, $\rho = 7800\text{ kg/m}^3$, using lumped mass matrix determine natural frequencies of bar.

OR

- Q10)a)** Write down consistent and lumped mass matrices for following elements. [6]
- Bar Element
 - Plane Stress Element
 - 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]

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