Reg. No.												

Question Paper Code	12583

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Seventh Semester

Mechanical Engineering

20MEPC701 - FINITE ELEMENT ANALYSIS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A ($10 \times 2 = 20$ Marks)

Answer ALL Questions

	Question	Marks	K – Level	CO
1.	Why polynomial type interpolation functions are mostly used in FEM?	2	K2	CO1
2.	What is meant by discretization?	2	K1	CO1
3.	Define shape function.	2	K1	CO2
4.	Express the element stiffness matrix of a truss element.	2	K2	CO2
5.	Define CST element.	2	K1	CO3
6.	What are the required conditions for a problem assumed to be axisymmetric?	2	K1	CO3
7.	Define Super parametric element.	2	K1	CO5
8.	Give the shape functions for a four-noded linear quadrilateral element in natural coordinates.	2	K2	CO5
9.	What is meant by Longitudinal vibration?	2	K1	CO6
10.	Define Heat Transfer.	2	K1	CO6

PART - B ($5 \times 13 = 65$ Marks)

Answer ALL Questions

11. a) Describe the step by step procedure of solving FEA. *13 K2 CO1*

OR

b) Solve the differential equation for a physical problem expressed as *13 K2 CO1*

$$\mathbf{d^2y/dx^2 + 50 = 0, \; 0 \leq x \leq 10}$$

with boundary conditions as y(0)=0 and y(10)=0 using (i) Point collocation method (ii) Sub domain collocation method (iii) Least square method and (iv) Galerkin method

12. a) For a tapered bar of uniform thickness t = 10mm as shown in figure-1. Predict the displacements at the nodes by forming into two element model. The bar has a mass density ρ = 7800 kg/m^3, the young's modulus E = 2x10^5 MN/m^2. In addition to self-weight, the bar is subjected to a point load P = 1 kN at its Centre. Also determine the *13 K3 CO2*

reaction forces at the support.

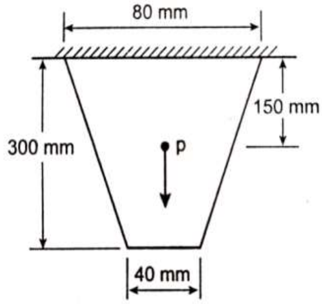


Figure-1

OR

b) Derive the displacement function u and shape function N for one dimensional Linear bar element based on global co-ordinate approach *13 K3 CO2*

13. a) Derive the shape function for CST elements. *13 K3 CO3*

OR

b) Calculate the element stiffness matrix for the axisymmetric triangular element shown in fig-2. The coordinate are in mm. Take E=2x10^5 N/mm^2, v = 0.25. *13 K3 CO3*

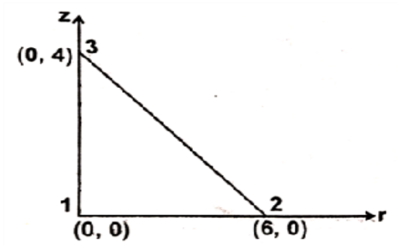


Figure-2.

14. a) For a four noded rectangular element shown in fig-3. Estimate the following (i). Jacobian matrix (ii). Strain-Displacement matrix *13 K3 CO5*

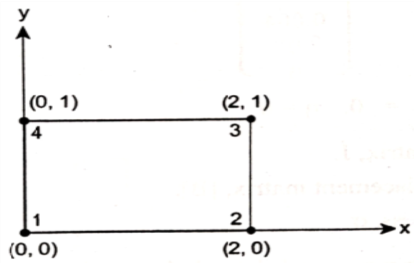


Figure-3

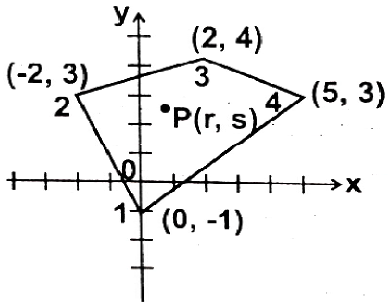
OR

b) i) Evaluate the integral by applying 3-point Gaussian quadrature *6 K3 CO5*

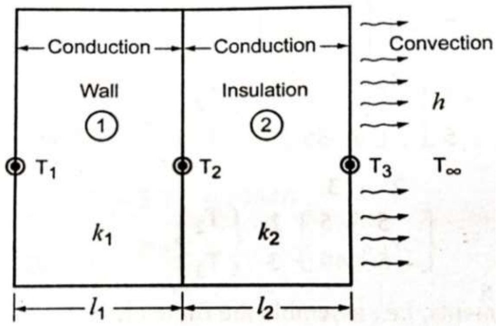
$$\int_{-1}^{1} (x^4 + x^2)dx$$

ii) The cartesian coordinates of the corner nodes of a quadrilateral elements are given by (0,-1), (-2,3), (2,4) and (5,3). Find the coordinates transformation between global and local co-ordinates. *7 K3 CO5*

Using this, determine the cartesian co-ordinates of the point defined by (r,s) = (0.5, 0.5) in the local co-ordinate system.



15. a) A wall of 0.6 m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface temperature is 1000^{o} C and outside of the insulation is exposed to atmospheric air at 30^{o}C with Heat transfer coefficient of 35 W/m^2K. Calculate the nodal temperatures. *13 K3 CO6*



OR

b) Determine the first two natural frequencies of longitudinal vibration of the stepped steel bar shown in fig-4. All the dimensions are in m $E=30x10^{10}$ N/m^2. and ρ = 8500 kg/m^3. *13 K3 CO6*

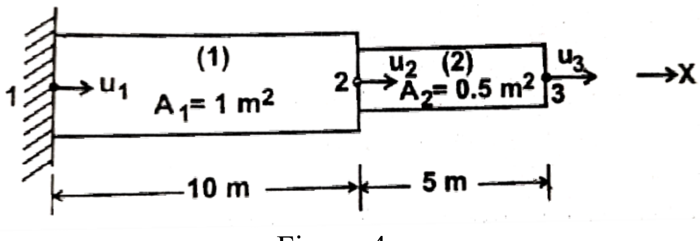


Figure-4

PART - C (1 × 15 = 15 Marks)

16. a) Determine the deflection at the centre of a simply supported beam subjected to uniformly distributed load over the entire span of length 'l' as shown in figure-5. Use Rayleigh Ritz method. *15 K3 CO4*

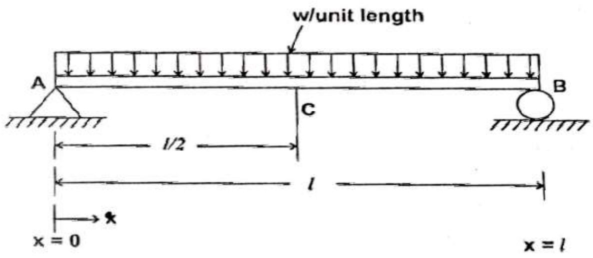


Figure-5.

OR

b) For the tapered bar shown in figure-6 subjected to its own self weight, determine the deflection at the free end using Ritz Technique. Assume Youngs Modulus E = 200 GPa and density ρ = 77 KN/m^3. *15 K3 CO4*

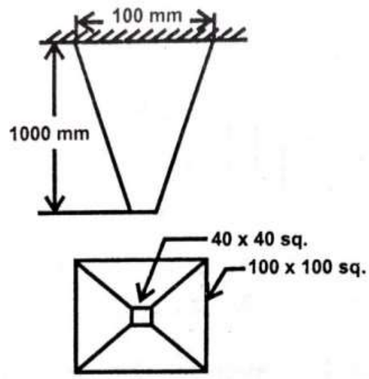


Figure-6.