Reg. No.															

Question Paper Code	13721

M.E. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Second Semester

M.E. - CAD/CAM

24PCDPC202 - ADVANCED FINITE ELEMENT ANALYSIS

Regulations - 2024

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

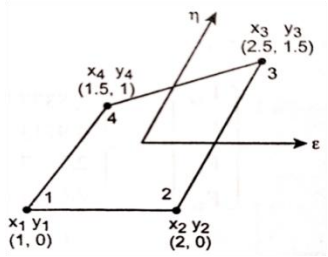
Answer ALL Questions

		Marks	K – Level	CO
1.	Illustrate the methods generally associated with finite element analysis.	2	K2	CO1
2.	What do you mean by Boundary conditions?	2	K1	CO1
3.	Write the strain displacement equation for CST element.	2	K1	CO1
4.	Assess the required conditions for a problem assumed to be Axisymmetric.	2	K2	CO1
5.	What is meant by Transverse vibration?	2	K1	CO1
6.	Define Resonance.	2	K1	CO1
7.	Write down the Stiffness Matrix for 1D Heat conduction element with free end Heat convection.	2	K1	CO1
8.	Differentiate Conduction, Convection and Radiation.	2	K2	CO1
9.	What is the purpose of linearization in nonlinear analysis?	2	K1	CO1
10.	What is the role of Newton-Raphson method in nonlinear finite element analysis?	2	K1	CO1

PART - B (5 × 13 = 65 Marks)

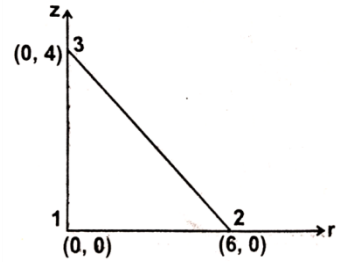
Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Discuss the various applications of Finite Element Analysis in engineering. How does FEA enhance the design and analysis processes in different fields?	13	K3	CO1
		OR			
	b)	Solve the differential equation for a physical problem expressed as $d^2y/dx^2 + 50 = 0, 0 \leq x \leq 10$ with boundary conditions as y(0)=0 and y(10)=0 using (i) Least square method and (ii) Galerkin method.	13	K3	CO1
12.	a)	Evaluate the Jacobian matrix for the isoparametric quadrilateral element shown in the figure.	13	K3	CO1

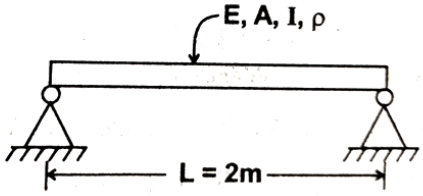


OR

b) Calculate the element stiffness matrix for the axisymmetric triangular element shown in fig. The coordinate are in mm. Take E=2x10^5 N/mm^2 , v = 0.25. *13 K3 CO1*

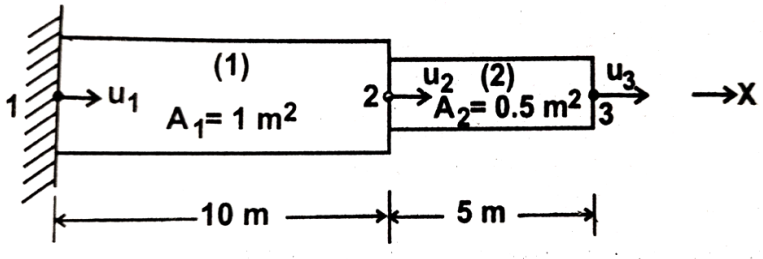


13. a) Find the Natural frequencies in the vibration of two elements simply supported beam having the parameters as length L = 2m, area of cross-section A = 30 x 10^{-4} m^2 and moment of inertia I = 4 x 10^{-10} m^4, density ρ = 7800 kg/m^3 and Young's modulus E = 200 GPa. *13 K3 CO1*

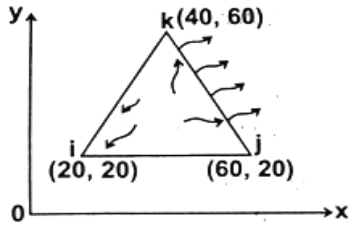


OR

b) Determine the first two natural frequencies of longitudinal vibration of the stepped steel bar shown in fig. All the dimensions are in m E=30x10^{10} N/m^2. and ρ = 8500 kg/m^3. *13 K3 CO1*



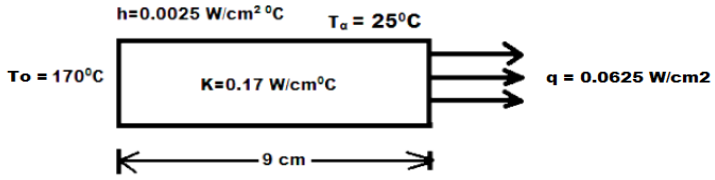
14. a) Calculate the element equations for the element shown in figure, which experiences convection on the side jk and its upper face. *13 K3 CO1*



$k = 7.5\ W/mm°C$
$h = 0.15\ W/mm^2°C$
$T_\infty = 20°C$
$t = 1\ mm$

OR

b) Calculate the temperature distribution in the stainless steel fin of circular cross section shown in the figure. The cross section of the fin is circular with diameter of 2 cm. The region can be discretized in 3 elements of equal sizes. *13 K3 CO1*



15. a) Derive the governing differential equation for a nonlinear bar under axial loading. Explain how material nonlinearity is incorporated. *13 K2 CO1*

OR

b) Explain how geometric nonlinearity is modeled in truss and beam elements. Provide relevant equations. *13 K2 CO1*

PART - C (1 × 15 = 15 Marks)

16. a) Trace the historical development of Finite Element Analysis. Discuss key milestones and contributions that led to its current state in engineering analysis. *15 K3 CO1*

OR

b) Find the deflection at the centre of a simply supported beam of span length 'L' subjected to uniformly distributed load throughout its length, using (i) Point collocation method (ii) Galerkin method. *15 K3 CO1*