Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

M.E DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Second Semester

Product Design and Development

ED4251 - Finite Element Methods in Mechanical Design

Regulations - 2021

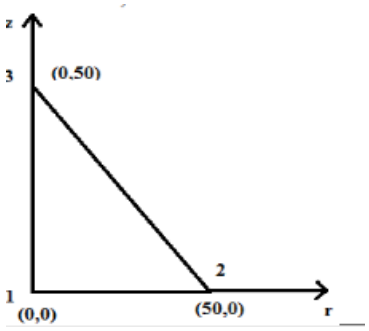
Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

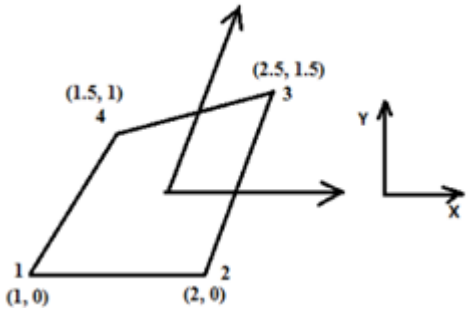
Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	List any four advantages of finite element method.	RE	1	2
2.	Compare error with residual.	UN	1	2
3.	How will you modify a three-dimensional problem to a two-dimensional problem?	RE	2	2
4.	Illustrate the shape function of a CST element.	UN	2	2
5.	Illustrate the purpose of isoparametric element.	UN	3	2
6.	List out the significance of jacobian transformation.	RE	3	2
7.	State Newton's second law in the context of equations of motion.	RE	4	2
8.	How does a transient problem differ from a steady-state problem?	RE	4	2
9.	Why are non-linear analyses often more complex than linear ones?	RE	5	2
10.	Name one factor that affects mesh quality.	RE	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

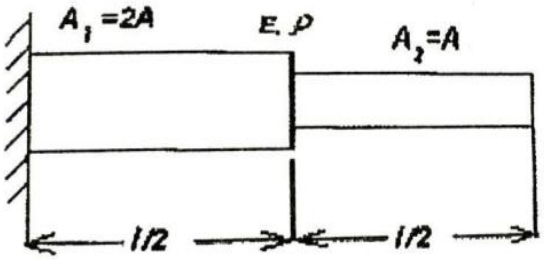
Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	A tapered bar made of steel is suspended vertically with the larger end rigidly clamped and the smaller end acted on by a pull of 10 N. The areas at the larger and smaller ends are 80 cm^2 and 20 cm^2 respectively. The length of the bar is 3 m. The bar weighs 0.075 N/cm^3. Young's modulus of the bar material is E=2 x 10^7 N/cm^2. Obtain an approximate expression for the deformation of the rod using Ritz technique. Determine the maximum displacement at the tip of the bar.	AP	1	13
		Or			
	b	Axial load of 500N is applied to a stepped shaft, at the interface of two bars. The ends are fixed. Calculate the nodal displacement and stress when the element is subjected to all in temperature of 100°C. Take $E_1=30\times10^3$ N/mm^2 & $E_2=200\times10^3$ N/mm^2, $A_1=900$ mm^2 & $A_2=900$ mm^2, $\alpha_1=23\times10^{-6}/°C$ & $\alpha_2=11.7\times10^{-6}/°C$, $L_1=200$ mm & $L_2=300$ mm.	AP	1	13
12.	a	Estimate the stiffness matrix for the triangular element with the (x,y) coordinates of the nodes are (0,-4), (8,0) and (0,4) at nodes i, j, k. assume plane stress condition E=200GPa. Poisson's ratio = 0.35.	AN	2	13
		Or			
	b	Determine the stiffness matrix for the axisymmetric element shown in figure. Take E=2.1 x 10^5 N/mm^2, v=0.25. the coordinates are in mm.	AN	2	13



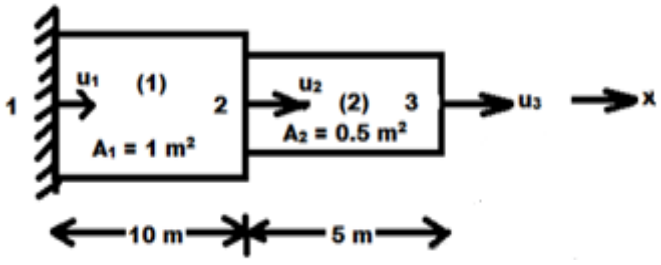
13.	a	Explain the element characteristics of a four-node quadrilateral element.	EV	3	13
		Or			
	b	Evaluate the Jacobian matrix for the isoparametric quadrilateral element shown in figure.	EV	3	13



14.	a	Determine the first two natural frequencies of longitudinal vibration of the stepped steel bar shown in figure and plot the mode shapes. All the dimensions are in mm E=200 GPa. and ρ=0.78 kg/cm^3. A=4cm^2, length l=500mm.	AN	4	13



		Or			
	b	Determine the Eigen values for the stepped bar shown in figure.	AN	4	13



15.	a	Explain the solution techniques for non-linear problems with simple examples.	UN	5	13
		Or			
	b	Discuss error estimation techniques in non-linear finite element analysis.	UN	5	13

*PART – C (Marks 1*15 = 15)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
16.	a	Discover the step-by-step procedure of solving FEA.	AN	1	15
		Or			
	b	Examine the integral by two-point Gaussian Quadrature, $I = \int_{-1}^{1}\int (2x^2 + 3xy + 4y^2)dxdy$. Gauss points are +0.57735 and -0.57735 each of weight 1.0000.	AN	1	15