Reg. No.												

Question Paper Code	12239

B.E. / B.Tech - DEGREE EXAMINATIONS, NOV / DEC 2023

Seventh Semester

Mechanical Engineering

(Common to Production Engineering)

20MEPC701 - FINITE ELEMENT ANALYSIS

(Regulations 2020)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level,CO
1.	Compare the Ritz technique with the nodal approximation method.	*2,K2,CO1*
2.	State the three phases of the finite element method.	*2,K1,CO1*
3.	Differentiate global and local coordinates.	*2,K2,CO2*
4.	List out the stiffness matrix properties.	*2,K1,CO2*
5.	Define plane strain analysis.	*2,K1,CO3*
6.	Write down the stress strain relationship matrix for plane stress condition.	*2,K2,CO3*
7.	What is meant by Transverse vibration?	*2,K1,CO4*
8.	Illustrate the expression of longitudinal vibration of bar element.	*2,K2,CO4*
9.	Differentiate between Isoparametric, super parametric and sub- parametric elements.	*2,K2,CO5*
10.	Give the shape functions for a four-noded linear quadrilateral element in natural coordinates.	*2,K2,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

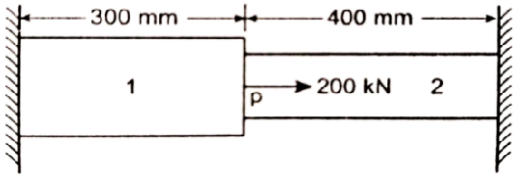
11. a) Using Rayleigh-Ritz method obtain an approximate solution for the differential equation given below with boundary conditions y(0) = 0 and y(l) = 0. *13,K2,CO1*

$$\frac{d^2y}{dx^2} - 10x^2 = 5 \; ; \; 0 \leq x \leq 1$$

OR

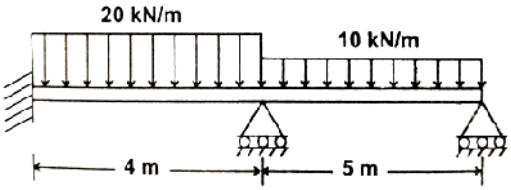
b) Solve the differential equation for a physical problem expressed as $d^2y/dx^2 + 100 = 0$, $0 \leq x \leq 10$ with boundary conditions as y (0) = 0 and y(10) = 0 using the trial function $y = a_1x (x-10)$ find the value of the parameters a_1 by the following methods listed below. *13,K2,CO1*
(i) Point collocation method (ii) Sub domain collocation method (iii) Least squares method and (iv) Galerkin method.

12. a) Consider a bar as shown in figure an axial load of 200 kN is applied at a point P. Take $A_1 = 2400$ mm^2, $E_1 = 70x10^9$ N/mm^2, $A_2 = 600$ mm^2 and $E_2 = 200x10^9$ N/mm^2. Calculate the following (i) the nodal displacement at point P (ii) Stress in each element (iii) Reaction force. *13,K3,CO2*

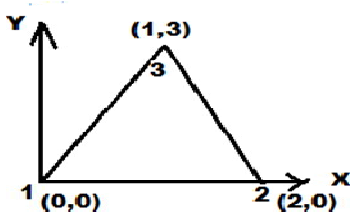


OR

b) For the beam as shown in the fig. compute slope at the hinged support points, E = 200 GPa and I = 4x10-6 m4. Use two beam elements. *13,K3,CO2*



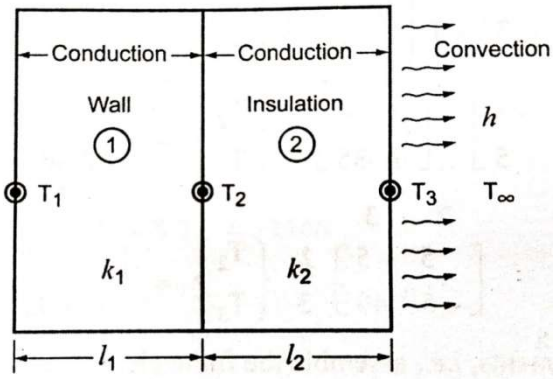
13. a) Calculate the strain displacement matrix for the CST element shown in the figure given below. *13,K3,CO3*



OR

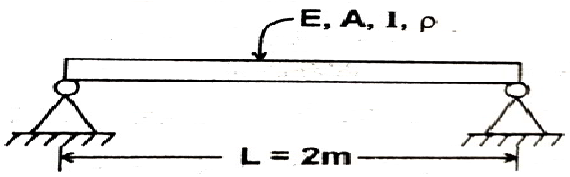
b) Develop shape function for axisymmetric triangular elements. *13,K3,CO3*

14. 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^{2}K. Calculate the nodal temperatures. *13,K4,CO4*

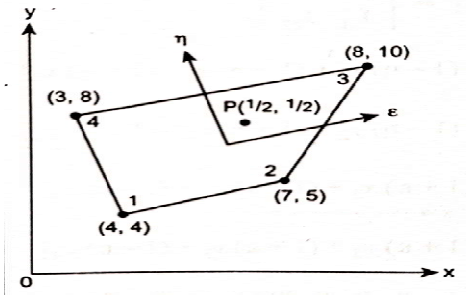


OR

b) 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,K4,CO4*



15. a) For the four noded quadrilateral element shown in the figure. Calculate the Jacobian matrix and evaluate its value at the point ε = 0.5, η = 0.5 *13,K4,CO5*



OR

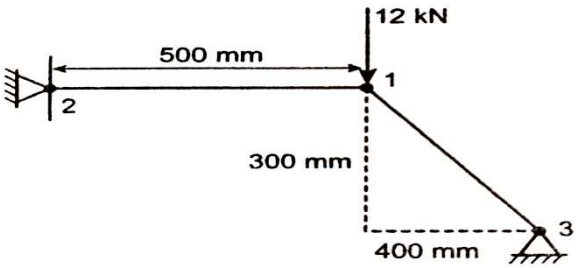
b) Evaluate the integral, *13,K4,CO5*

$$I = \int_{-1}^{1} Cos\ \frac{\pi x}{2} dx$$

by applying 3 point Gaussian quadrature and compare with exact solution.

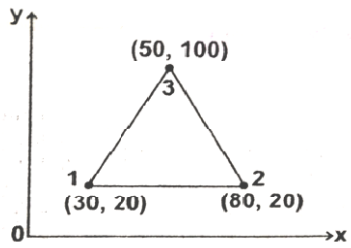
PART - C (1 × 15 = 15 Marks)

16. a) For the two bar truss shown in the fig, Estimate the displacements of node 1 and the stress in element 1-3.Take E = 70 GPa, A = 200 mm^2 *15,K3,CO6*



OR

b) For the plane stress CST element as shown in the fig. Calculate element stiffness matrix. Assume E= 210 x 10^3 N/mm^2. v=0.25, t=10mm. The co-ordinates are given in mm. *15,K3,CO6*


y
(50, 100)
3
1
2
(30, 20)
(80, 20)
0
x