Reg. No. : | | | | | | | | | | |

Question Paper Code: 97702

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2024

Seventh Semester

Mechanical Engineering

19UME702 – FINITE ELEMENT ANALYSIS

(Regulation 2019)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. __________ is a Numerical method for solving problems of Engineering and mathematical physics. CO1- U

   (a) Finite Element Analysis (b) Finite Element Method

   (c) Both (a) & (b) (d) none of the above

2. The art of subdividing a structure into a convenient number of smaller element is known as………. CO1- U

   (a) Non – Structural Problems (b) Structural Problems

   (c) Discretization of structure (d) None of the above

3. ______ is a force acting at a particular point which causes displacement. CO1- U

   (a) Traction force (b) Body force (c) Point load (d) None of the above

4. Assemblage of bars is called______ CO1- U

   (a) Truss (b) Beams (c) Spring (d) None of the above

5. Linear Strain Triangular Element has _____ number of nodes. CO1- U

   (a) 3 (b)6 (c)12 (d) 24

6. In plane strain analysis CO1- U

   (a) $\rho_z = 0$ (b) $\gamma_{xz} = 0$ (c) $\gamma_{yz} = 0$ (d) All of the above

7 A motion which repeats itself after equal interval of time is called CO1- U

   (a) Cycle (b) Frequency (c) Counter flow (d) Damping

8 The causes of vibration is/are CO1- U

(a) Winds (b) Earthquakes (c) Elastic Nature (d) All of the above

9 In non-structural problems _________ at each nodal point is obtained CO1- U

(a) Displacement (b) Temperature (c) Stress (d) Strain

10 ___________ is imaginary line that connects a series of points CO1- U

(a) Path Line (b) Stream Line (c) Inviscid Flow (d) None of the above

PART – B (5 x 2= 10Marks)

11 Explain the Aspect Ratio. CO1- U

12 Explain Degrees of freedom. CO1- U

13 Write down the stress-strain relationship matrix for plane strain condition. CO1- U

14 State difference between Direct and Iterative methods for solving system of equations. CO1- U

15 Write down the expression for stiffness matrix in 2D fluid mechanics. CO1- U

PART – C (5 x 16= 80 Marks)

16 (a) The following differential equation is available for a physical phenomenon CO2- App (16)

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

with boundary conditions as y(0) = 0 and y(1)= 0

By using Galerkins method of weighted residuals to find an approximate solution of the above different equation and also compare with exact solution.

Or

(b) A simply supported beam subjected to Uniformly Distributed Load over entire span. Analyze the bending moment and deflection at mid-span by using Rayleigh Ritz method and compare with exact solution. CO4- Ana (16)

17 (a) Consider a bar as shown in figure. Cross-sectional area of the bar is **750mm^2** and Young's Modulus is **2 X 10^5 N/mm^2.** If **u_1=0.5mm and u_2 = 0.625mm**, calculate the following: CO2- App (16)

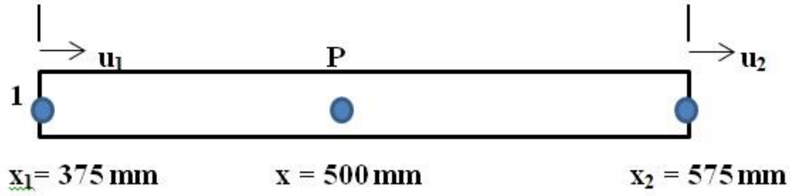
(i) Displacement at point, P

(ii) Strain, Ɛ

(iii) Stress, σ

(iv) Strain Energy, U

(v) Element Stiffness Matrix [K]



Or

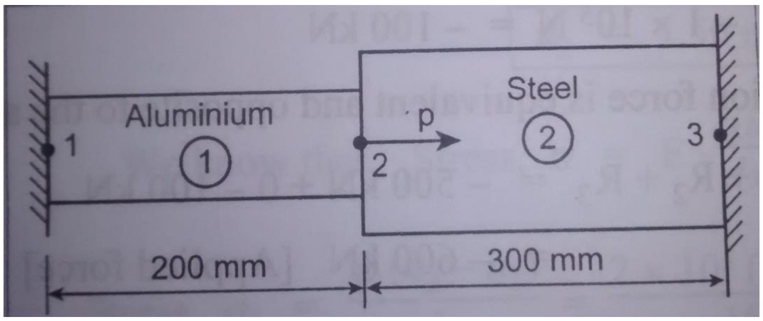
(b) An axial load **of 4x10^5 N** is applied at **30°C** to the rod as shown in the figure. The temperature is then raised to **60°C**. Calculate the following: CO2- App (16)

(i) Assemble the **K** and **F** matrices

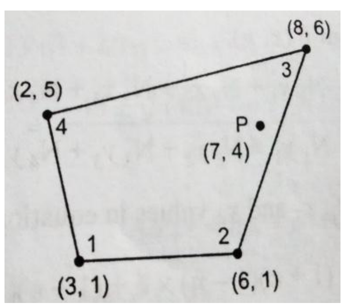
(ii) Nodal Displacements

(iii) Stresses in each material

(iv) Reactions at each nodal point



18 (a) For the Isoparametric quadrilateral element shown in figure, determine the local co-ordinates of the point P which has **Cartesian co-ordinates (7,4).** CO2- App (16)

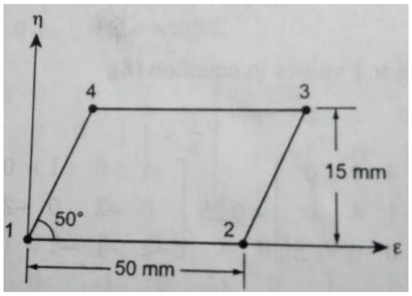


Or

(b) Consider a quadrilateral element as shown in figure. The co-ordinates are **ε=0.5 and η=0.5**. Evaluate CO2- App (16)

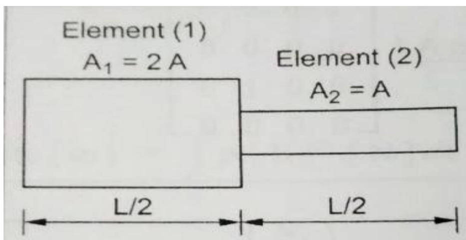
(i) Jacobian Matrix

(ii) Strain-Displacement Matrix.



Or

19 (a) Compare the **natural frequencies** of longitudinal vibration of the unconstrained stepped bar as shown in the figure. CO4- Ana (16)

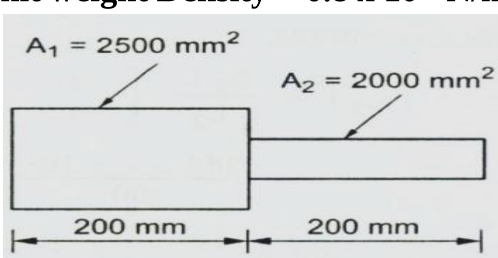


Or

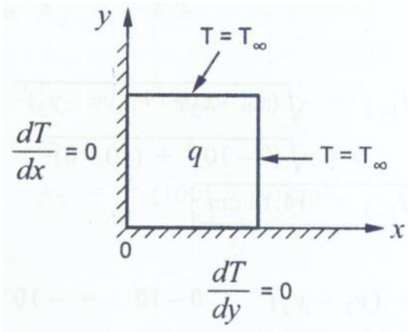
(b) Compare the eigen values and frequencies for the stepped bar as shown in the figure. CO4- Ana (16)

Take,**Young's modulus E = 2 x10^5 N/mm^2,**

Unit weight Density = 0.8 x 10^{-4} N/mm^3



20	(a)	Evaluate the temperature distribution in a square region with uniform energy generation as shown in figure. Assume that there is no temperature variation in the z-direction. Take k=30W/cm°C, l=10cm, T_∞=50°C, q=100W/cm^3.	CO6- Eva	(16)



Or

	(b)	A steel rod of diameter **d= 2 cm, Length L=5 cm** and thermal conductivity **k = 50W/m°C** is exposed at one end to a constant temperature of **320°C**. The other end is in ambient air of temperature **20°C** with a convection coefficient of **h = 100 W/m^2°C**. Evaluate the temperature at the midpoint of the rod.	CO6- Eva	(16)