A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 97702

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

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. __________ is developed by rotating a triangle or quadrilateral about fixed axis located in the plane of the element through 360 degree CO1 - U

   (a)Tetrahedral Element (b) Axisymmertric Element

   (c) Both A&D (d) Rectangular Element

3. _______ can resist only axial loads. CO1 - U

   (a) Bar (b) Beam (c) Both (a) & (b) (d) None of the above

4. Assemblage of bars is called______ CO1 - U

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

5. The sum of all the shape functions in a CST element is equal to CO1 - U

   (a) 0 (b) -1 (c) 1 (d) 2

6. Constant Strain Triangular Element has _____ number of nodes. CO1 - U

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

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

(a) Cycle (b) Frequency (c) Periodic Motion (d) Damping

8. Actual damping coefficient to critical damping coefficient is CO1 - U

(a) Frequency (b) Time Period (c) Damping Ratio (d) Density

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

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

10. Generally, matter exists in ________ state(s). CO1 - U

(a) Solid (b)Liquid (c) Gas (d) All the above

PART – B (5 x 2= 10Marks)

11. Define Aspect Ratio. CO1 - U

12. State the principle of minimum potential energy. CO1 - U

13. Write strain-displacement matrix for CST element. CO1 - U

14. List out the causes of Vibrations CO1 - U

15. Compare Path Line and Stream Line. CO1 - U

PART – C (5 x 16= 80Marks)

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

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

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

$$\frac{d^2y}{dx^2} + 500x^2 = 0 \quad , 0 \le x \le 1$$

and the trial function is $y = a_1(x-x^4)$

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

Find the value of the parameter a_1 by the following methods

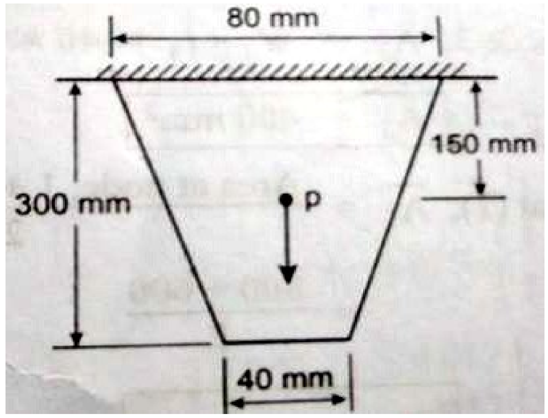
(i) Point Collocation Method

(ii) Sub-domain Collocation Method

(iii) Least Squares Method

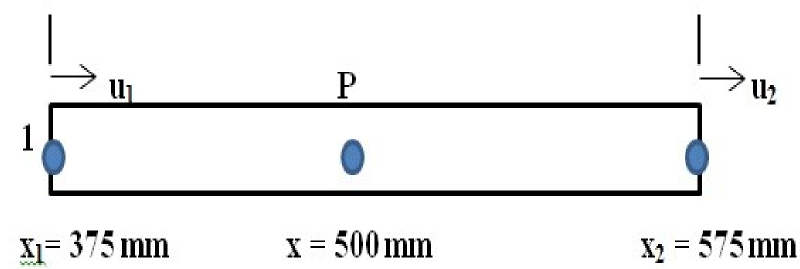
Galerkin's Method

17.	(a)	For a tapered plate of uniform thickness t=10mm as shown in the figure, find the displacements at the nodes by forming into two element model. The bar has mass density, ρ = 7800kg/m^3, Young's Modulus, E= 2x10^{5}MN/m^2. In addition to self-weight, the plate is subjected to a point load, p=10kN at its centre. Also determine the reaction force at the support.	CO2- App	(16)

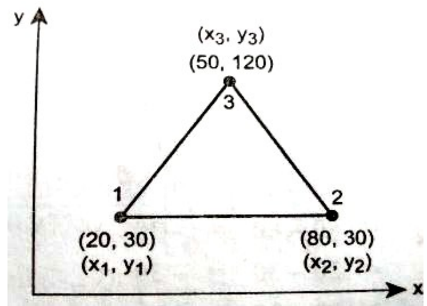


Or

	(b)	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: (i) Displacement at point, P (ii) Strain, Ɛ (iii) Stress, σ (iv) Strain Energy, U (v) Element Stiffness Matrix [K]	CO2- App	(16)

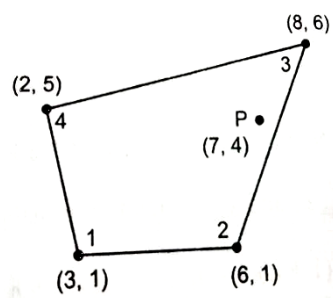


18. (a) Determine the stiffness matrix for the CST element shown in figure. The co-ordinates are given in units of millimeters. Assume plane stress conditions. Take E=210GPa, v=0.25 and t=10 mm. CO2- App (16)

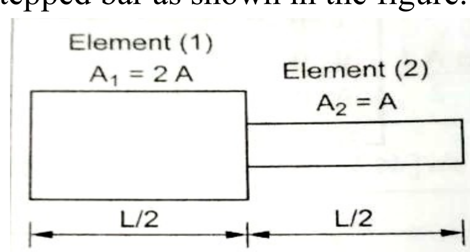


Or

(b) 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)



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



Or

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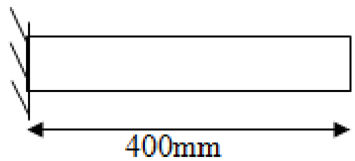
(b)	For the One dimensional bar having Area, A = $600mm^2$, Length L= 400m, Young's modulus E = 2 $x10^5$ N/mm^2, Density ρ = 0.8 x 10^{-4} N/mm^3, Compare the natural frequencies of longitudinal vibration using two elements of equal length.	CO4 Ana	(16)



20.	(a)	An aluminium alloy fin of 7mm thick and 50mm long protrudes form a wall, which is maintained at 120°C. The ambient air temperature is 22°C. The heat transfer coefficient and thermal conductivity of the fin material are $140W/m^2K$ and 55W/mK respectively. Evaluate the temperature distribution of fin.	CO5- Eva	(16)
		Or		
	(b)	A wall of 0.6m 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°C and outside of the insulation is exposed to atmospheric air at 30°C with heat transfer coefficient of 35 W/m^2K. Evaluate the nodal temperature.	CO5- Eva	(16)