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

Question Paper Code: U6703

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

Sixth Semester

Mechanical Engineering

21UME603 FINITE ELEMENT ANALYSIS

(Regulations 2021)

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 number of element to be selected for discretization depends upon the following factor is/are…… CO1 U

   (a) Accuracy desired (b) Size of the elements.

   (c) Number of degrees of freedom involved (d) All the above.

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

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

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. Direct Method has _____ value.

(a) approximate (b)Exact (c)Zero (d) All the above

9. Heat transfer between two solid mediums is called CO1- U

(a) Conduction (b) Convection (c) Radiation (d) None of the above

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

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

PART – B (5 x 2= 10 Marks)

11. Differentiate structural and non-structural problems. CO1- U

12. Define degrees of freedom. CO1- U

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

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

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

PART – C (5 x 16= 80 Marks)

16. (a) The following differential equation is available for a physical phenomenon CO4 Ana (16)

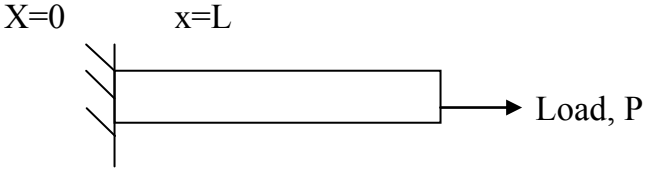
$\frac{d^2y}{dx^2} - 10x^2 = 5; \quad 0 \leq x \leq 1$

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 bar of uniform cross section is clamped at one end and left free at the other end and it is subjected to a uniform axial load P as shown in Fig. Analyze the displacement and stress in a bar by using two terms polynomial and three terms polynomial, compare with exact solutions. CO4 - Ana (16)



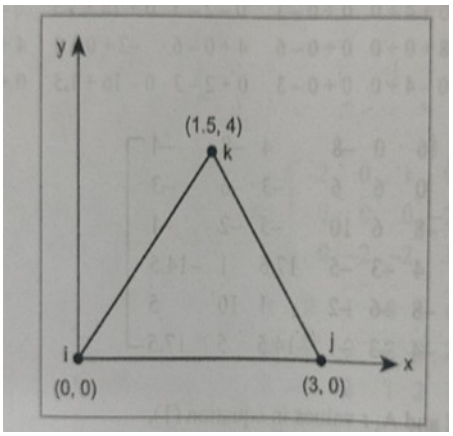
17. (a) Using two finite elements, find the stress distribution in a uniformly tapering bar of circular cross- sectional area 3 cm^2 and 2 cm^2at their ends, length 100 mm, subjected to an axial tensile load of 50 N at smaller end and fixed at larger end. Take the value of Young's modulus E= $2x10^5$ N/mm^2. CO2- App (16)

Or

(b) Derive the stiffness matrix for One dimensional Linear Bar Element. And also list out the properties of stiffness matrix. CO2- App (16)

18. (a) Determine the stiffness matrix for the CST element shown in figure. CO2 - App (16)

The co-ordinates are given in units of millimeters. Assume plane stress conditions. Take E=2.1 x 10^5 N/mm^2, v=0.25 and t=10 mm.



Or

(b) A fournoded Rectangular element as shown in figure. Determine the following: CO2 - App (16)

(i) Jacobian Matrix

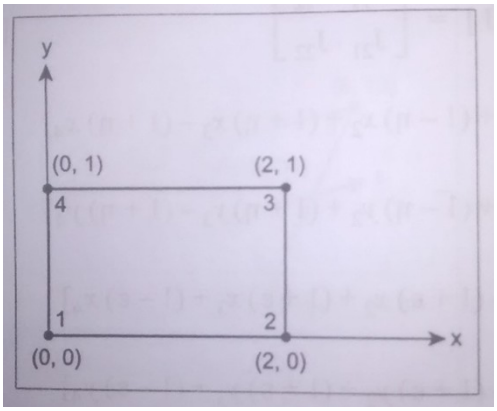
(ii) Strain-Displacement Matrix.

(iii) Element Stresses

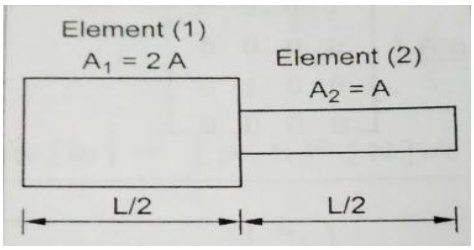
Take E = $2x10^5$ N/mm^2, v = 0.25,

u = $[0, 0, 0.003, 0.004, 0.006, 0.004, 0, 0]^T$, $\varepsilon = 0, \eta = 0$

Assume plane stress condition.



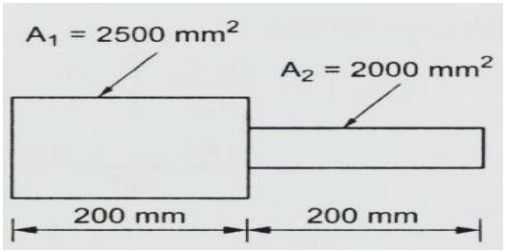
19. (a) Compare the natural frequencies of longitudinal vibration of the unconstrained stepped bar as shown in the figure. CO4- Ana (16)



Or

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

Take,Young's modulus $E = 2 \times 10^5$ N/mm^2,
Unit weight Density $\rho = 0.8 \times 10^{-4}$ N/mm^3



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^{2}K and 55W/mK respectively. Evaluate the temperature distribution of fin. 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)