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

Question Paper Code: 1016104

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV / DEC 2024
Sixth Semester
Aeronautical Engineering
U20AE601 – FINITE ELEMENT METHODS
(Regulation 2020)
(Common to Aerospace Engineering)

Time: Three Hours | Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Classify the various weighted residual methods.

2. What is meant by discretization and assemblage?

3. State the properties of stiffness matrix.

4. State the assumptions made while finding the forces in a truss.

5. Describe the plane stress analysis?

6. Explain the LST element?

7. Discuss the shape functions for bi-linear 4 noded rectangular element.

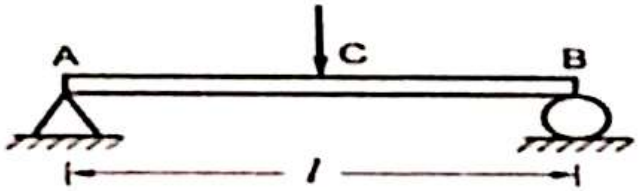
8. Interpret the stiffness matrix equation for four noded isoparametric element.

9. Write down the expression of shape function N and temperature function T for one dimensional heat conduction element.

10. Write down the finite element equation for torsional bar element.

PART – B (5 x 16 = 80 Marks)

11. (a) A beam AB of span "l" simply supported at ends carrying a concentrated load W at the center C as shown in fig. Compute the deflection at mid span by using Rayleigh Ritz method and compare with exact solution. (16)



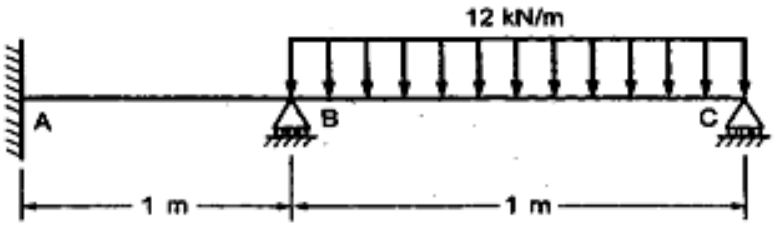
(OR)

(b) The following differential equation is available for a physical phenomenon: $\frac{d^2y}{dx^2} - 10x^2 = 5; 0 \leq x \leq 1$ The boundary conditions are: y(0)=0 and y(1)=0. By using Galerkin's method of weighted residuals to find an approximate solution of the above differential equation and also compare with exact solution. (16)

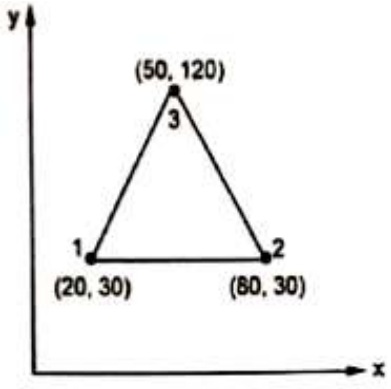
12. (a) Estimate the displacement function, shape function and the stiffness matrix for a one dimensional bar element of length L. (16)

(OR)

(b) For the beam and loading shown in fig. predict the rotations at B and C. Take E = 210GPa; I = $6x10^6$ mm^4. (16)

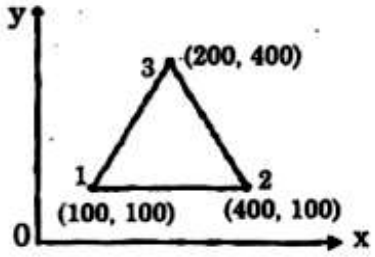


13. (a) Estimate the element stiffness matrix for the CST element as shown in fig. The coordinates are given in mm. Assume plain strain conditions. (16)
E = 210 GPa, μ=0.25 and t = 10mm.

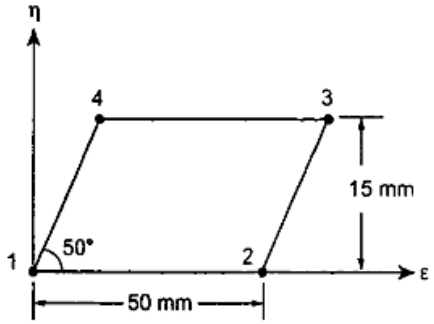


(OR)

(b) For a plane stress element shown in fig. The nodal displacements [(u_1,v_1), (u_2,v_2), (u_3,v_3)] are [(2,1), (1,1.5), and (2.5,0.5)] respectively. Estimate the element stresses. Assume E = 200 GN/m^2; μ = 0.3 and t = 10mm. All co-ordinates are in mm. (16)



14. (a) Estimate the Jacobian Matrix for isoparametric quadrilateral element as shown in fig. The local coordinates are ε = 0.5 & η = 0.5. (16)



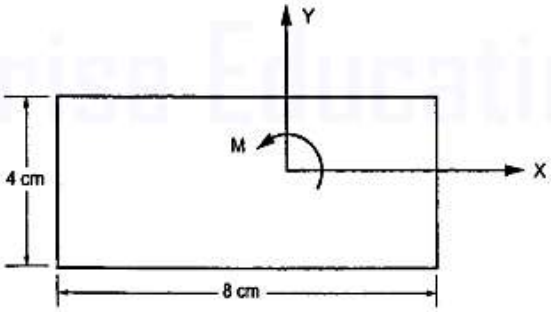
(OR)

(b) Evaluate the integration $I = \int_{-1}^{1} \left[x^2 + \cos\left(\frac{x}{2}\right)\right] dx$ using 3point Gaussian Quadrature and compare it with the exact solution. (16)

15. (a) A Wall of 0.6m thickness having thermal conductivity of 1.2W/mK. The wall is to be insulated with a material of thickness 0.06m having an average thermal conductivity of 0.3W/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^{2}K. Estimate the nodal temperatures. (16)

(OR)

(b) Figure shows a shaft having rectangular cross section with 8cm x 4cm sides. The material has shear modulus 80x10^5 N/cm^2. Shaft length is 100cm. The shaft is fixed at one end and subjected to torque T at the other end. Determine the total angle of twist if the applied torque is 10x10^3 Ncm. (16)



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