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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2024

(2020 SCHEME)

Course Code : **20CET392**

Course Name: **Finite Element Methods**

Max. Marks : **100** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. What are boundary value problems? What are the physical and mathematical significances of boundary conditions in structural mechanics problems?
2. Explain point collocation method to solve the differential equations.
3. What are the essential features of weighted residual methods to solve partial differential equations?
4. Give the step by step procedure of Rayleigh Ritz method of analysis.
5. What is the role of shape function in finite element method of analysis?
6. How the Lagrange interpolation function is used for the development of shape functions?
7. Differentiate plain stress and plain strain problems with examples.
8. What are the advantages of coordinate mapping?
9. What is the significance of numerical integration in finite element formulation?
10. Write short notes on Gauss Quadrature method for numerical integration.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. Obtain the approximate solution to the given boundary value problem using

    (i) Galerkin Method

    (ii) Method of least squares (14)

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

Boundary Conditions are

$u\ (0) = 0$ and $u\ (1) = 0$

OR

12. Solve the following equation using two parameter trial solution by
    (a) The point collocation method (Rd= 0 at x = 1/3 and x = 2/3)
    (b) The Galerkin method (14)

$$\frac{dy}{dx} + y = 0, \qquad 0 \le x \le 1$$

$$y(0) = 1$$

MODULE II

13. Derive the element stiffness equations for an axial deformation problem, using variational approach (14)

OR

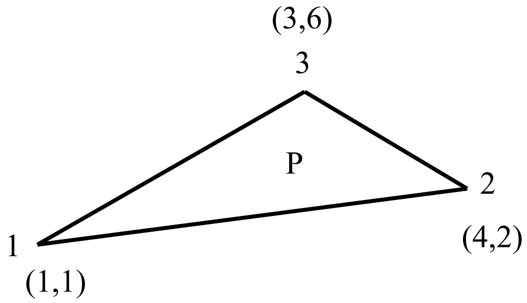
14. A uniform rod fixed at one end and free at other end is subjected to uniform axial load q0/m. Using Rayleigh Ritz method, find the value of stress at any point and compare with exact solution. (14)
Consider two terms of displacement function.

MODULE III

15. a) Give four convergence requirements of shape functions. (10)
    b) What is Melosh Criteria to be satisfied by finite elements? (4)

OR

16. Determine x and y coordinates of point P for the triangular element shown in figure. Shape functions N1 and N2 are 0.2 and 0.3 respectively. (14)



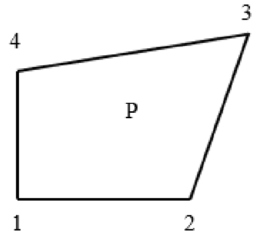
MODULE IV

17. a) Derive the shape functions of one dimensional isoparametric element having 2 nodes. (10)
    b) What is the advantage of using isoparametric elements in FEA? (4)

OR

18. a) For the isoparametric quadrilateral element shown in Figure, determine cartesian coordinates of P which has local coordinates (10)

r=0.5 and s=0.5. The cartesian coordinates of nodes are node1 (1,1), node 2 (5,1), node 3 (6,6) and node 4 (1,4).



b) What are superparametric, subparametric and isoparametric elements? (4)

MODULE V

19. a) Evaluate the given integral using two point gauss quadrature and compare with exact solution. (6)

$$\int_{-1}^{1}\left[3e^{x}+x^{2}+\frac{1}{x+2}\right]dx$$

b) Derive the stiffness matrix of beam element. (8)

OR

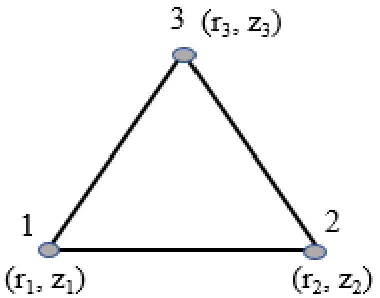
20. The nodal coordinates of axisymmetric triangular element are given as

r_1 = 10 mm, z_1 = 10mm

r_2 = 30 mm, z_2 = 10 mm

r_3 = 30mm, z_3 = 40 mm

a) Evaluate the strain displacement matrix for that element. (10)



b) Evaluate the given integral using three-point gauss quadrature and compare with exact solution. (4)

$$\int_{-1}^{1} cos\frac{x}{2}\, dx$$

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