Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), MAY 2023

STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT

(2021 Scheme)

Course Code: 21SC201

Course Name: Finite Element Analysis

Max. Marks: 60 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Demonstrate mathematical modelling in FEA with an example.
2. Explain principle of minimum potential energy with an example.
3. Discuss guidelines to be considered while choosing appropriate functions in FEA.
4. Differentiate plane stress and plane strain element.
5. Differentiate Lagrangian and Serendipity elements.
6. Explain the concept of static condensation.
7. Explain shear locking in Mindlin's element.
8. What are spurious modes?

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Explain different approaches of getting the finite element equations and Explain the natural and geometric boundary conditions. (6)

OR

10. Explain the procedure involved in finite element analysis using displacement approach. (6)

MODULE II

11. Using different weighted residual methods solve a cantilever bar problem subjected to a uniformly varying load q(x) = cx, where c is a constant. (6)

OR

12. Using Rayleigh Ritz method, determine the central deflection of a simply supported beam carrying a point load at the midpoint. Use y= C1 Sin (π x/L). Compare it with theoretical solution. (6)

MODULE III

13. Derive shape function for bilinear plane rectangular element using Lagrangian interpolation function. (6)

OR

14. Derive shape function for a two noded beam element. (6)

MODULE IV

15. (a) Derive the element stiffness matrix for a bar element with a single degree of freedom at each node using variational formulation. Assume that the bar lies parallel to X axis and its cross sectional area varies linearly from A_1 to A_2 from one end to theother. (4)

    (b) Compute the element stiffness matrix for a bar element with cross sectional area varying linearly from 10 mm^2 to 20 mm^2 from one end to the other. Assume that the bar is parallel to X axis. Length of the element is 300 mm and modulus of elasticity of the material is 2 x 10^5 N/mm^2. (2)

OR

16. Derive element stiffness matrix for a plane strain CST element. (6)

MODULE V

17. Explain convergence criteria. What is its significance in FEA? (6)

OR

18. Evaluate the following integral using two-point Gauss quadrature and compare with exact solution.

$$I = \int_{-1}^{+1} \{ 3e^x + x^2 + (\frac{1}{x+2}) \} dx$$ (6)

MODULE VI

19. Compare Kirchhoff's and Mindlin's plate theories. Comment on suitability of the theories in plate bending. (6)

OR

20. Discuss finite element formulation of Kirchhoff's plate element. (6)

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