

12. (a) Derive shape functions for a 2D rectangular element.

Or

- (b) Evaluate $\int_{-1}^1 (x^4 + x^2) dx$ by applying 3 point Gaussian quadrature.

13. (a) Derive shape functions and stiffness matrix for a 2D rectangular element.

Or

- (b) Explain with an example of each of the following : (4+4+5)
(i) Sub parametric element
(ii) Iso parametric element
(iii) Super parametric element.

14. (a) Explain the Kirchhoff's plate bending theory. What are the assumptions made?

Or

- (b) What do we need to change in the program when using 3-node elements (6 global DOF per node) compared with 4-node elements (6 global DOF per node)?

15. (a) Comment on discretization error with an example.

Or

- (b) What is adoptive meshing? Explain any one algorithm for auto meshing.

PART C — (1 × 15 = 15 marks)

16. (a) A cantilever beam of length 3.4 m has an elastic spring support of stiffness 230 kN/m at its free end where a point load of 13 kN acts. Take young's modulus as 200 GPa and area. Moment of inertia of the cross-section as $1 \times 10^{-4} \text{m}^4$. Evaluate the displacement and slope at the node and reactions.

Or

- (b) Differentiate Thin Plate theory and thick plate theory with a case study.