

**UNIT I: Nonlinear Equations and Simultaneous Linear Equations:**

Roots of nonlinear equation, Methods of solution, Order of convergence of iterative methods, Simple roots: Bisection, False position, Secant, Newton-Raphson, Chebyshev, Iteration and multi point iteration methods, Multiple roots: Newton-Raphson and Chebyshev, Complex roots: Newton-Raphson and Muller's method, a system of nonlinear equations: Newton-Raphson and Iteration methods, Polynomial equations: Bairstow's method, convergence analysis of above methods.

Linear systems: Introduction, Direct methods, Operation count, Pivoting, Ill conditioned linear systems & condition number, Iteration methods: Jacobi, Gauss-Seidel, SOR methods, convergence conditions. Special system of equations: Thomas algorithm. Eigen value problems: Given's and Power methods.

**UNIT II: Interpolation, Differentiation and Integration:**

Curve fitting: Polynomial interpolation, error, Existence and Uniqueness, Truncation error bounds, difference operators, Newton forward and backward difference interpolations, Lagrange, Newton divided difference and Iterated interpolations, Stirling and Bessel's interpolations, Spline interpolation, Least squares and Chebyshev approximations.

Numerical Differentiation: Methods based on interpolation, Error analysis.

Numerical Integration: Methods based on interpolations (Trapezoidal, Simpson's  $1/3$  , Simpson's  $3/8$  rule), Gauss quadrature methods, Romberg integration, Error bounds and estimates.

**UNIT III: Numerical Solution of Ordinary Differential Equations:**

Initial-value problems, Single step methods: Taylor's, Picard's, Euler's, Modified Euler's method and Runge -Kutta method (Fourth Order), Error estimates, Multi-step methods: Adam's-Bashforth and Milne's methods, convergence and stability analysis, Simultaneous and Higher order equations: RK Fourth order method.

**UNIT IV: Boundary value- and Initial Boundary value Problems:**

BVP: Finite difference method, Shooting method, Solution of Laplace & Poisson equations: Standard 5 – point and diagonal 5-point formulae, Jacobi method, Gauss Seidel method (Liebmann's iterative method) Relaxation method. Solution of heat equation: Crank-Nicolson method, Solution of wave equation.

**UNIT V: Finite Element Method:**

Basic concepts, Variational formulation and functionals, base functions, approximations by Ritz method, Galerkin method, Least squares method, collocation method, time dependent problems, Finite element solution of simple problems.

**Books Recommended:**

1. M.K.Jain, S.R.K. Iyengar & R.K.Jain, Numerical methods for Scientific and Engineering Computation, New age International Publication.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Eastern Economy Edition.
3. S. Rajasekaran, Numerical Method in Science and Engineering, Wheeler Publishing House.
4. B.S. Grewal, Numerical Method in Engineering & Science, Khanna Publishers.