

Course Title: Numerical Analysis

Course Code: MATH-403

Course Type: Major Math

Prerequisites: Single Variable Calculus & Linear Algebra

Credit Hours: 3 (3 + 0)

Course Objectives: After the completion of the course, students will be able to:

- Understand numerical methods for solving mathematical problems.
- Analyze and estimate errors in numerical computations.
- Solve non-linear equations and systems of linear equations.
- Explore various interpolation techniques and polynomial approximations.
- Apply computational tools for the solution of numerical methods.

Course Contents:

Number Systems and Error Analysis: Computer arithmetic, Floating point arithmetic, Sources of numerical error: Round-off Error, Truncation Error. Absolute, Relative and Percentage errors.

Methods for the Solution of Nonlinear Equations: Iterative methods and convergence, Bisection method, Fixed point iterative method, Regula falsi, Secant and Newton's method.

Numerical Solution of a System of Linear Equations: Direct methods: Gaussian elimination method, Gauss-Jordan method, Matrix inversion, LU-factorization, Doolittles, Crouts and Choleskys methods. Iterative methods: Gauss-Jacobi method and Gauss-Seidel method. Ill-condition system and condition number, Eigenvalues and eigenvectors, Power and Rayleigh quotient methods.

Interpolation and Polynomial Approximation: Difference operators, Interpolation with unequal intervals, Lagrange's interpolation formula, Newton's divided difference formula, Error in polynomial interpolation, Interpolation with equal intervals, Gregory Newton forward/backward interpolation formula, Error in polynomial interpolation, Central difference interpolation formulae Gauss's forward/backward interpolation formula, Stirling's formula, Laplace Everett's formula, Bessel's formula.

Recommended Books:

1. Burden, R. L. and Faires, J. D., *Numerical Analysis*, Cengage Learning, 10th edition, 2015.
2. Chapra, S. C. and Canale, R. P., *Numerical Methods for Engineers*, McGraw Hill, 7th edition, 2014.
3. Gerald, C. F. and Wheatley, P. O., *Applied Numerical Analysis*, Pearson College Div., 7th edition, 2003.
4. Mathews, J. H., *Numerical Methods for Mathematics*, Pearson College Div., 1992.

5. Vedamurthy, V. N. and Iyenger, N. Ch. S. N., *Numerical Methods*, Vikas Publishing House Pvt. Ltd, 2002.
