

Course Objective: The main objective of this course is to motivate the students to understand and learn various numerical techniques to solve mathematical problems representing various engineering, physical and real life problems.

Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.

Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.

Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss--Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.

Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.

Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss--Legendre quadrature formulae.

Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.

Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical techniques using MATLAB..

Course learning outcomes: Upon completion of this course, the students will be able to:

- 1) understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
- 2) learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.
- 3) solve system of linear equations numerically using direct and iterative methods.
- 4) understand how to approximate the functions using interpolating polynomials.
- 5) learn how to solve definite integrals and initial value problems numerically.

Texts Books:

- 1) Curtis F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Pearson, (2003) 7th Edition,
- 2) M. K. Jain, S .R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6th edition.
- 3) Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7 edition (1 March 2014)

References Books:

- 1) J. H. Mathew, Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2nd edition,
- 2) Richard L. Burden and J. Douglas Faires, Numerical Analysis, Brooks Cole (2004), 8th edition.
- 3) K. Atkinson and W. Han, Elementary Numerical Analysis, John Willey & Sons (2004), 3rd Edition.

Evaluation Scheme:

Sr.No.	Evaluation Elements	Weight age (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include assignments/quizzes)	15
4	Laboratory evaluation	20