CE 521: NUMERICAL ANALYSIS (3-0-0: 3)

Errors and Accuracy

Approximate numbers and significant figures, absolute error, relative error and percentage error, error in determinants, accuracy and precision

Systems of Linear Algebraic Equations

Direct elimination method, LU factorization, tridiagonal systems of equations, pitfalls of elimination method, Jacobi iteration, Gauss-Seidel iteration, successive-over-relaxation method, conjugate gradient method, characteristics of Eigen problem, power method, direct method, Eigenvectors

Polynomial Approximation and Interpolation

Weierstrass approximation theorem, Chebyshev's polynomials, Newton's forward and backward interpolation, divided difference, Newton's general interpolation formula, Lagrange's interpolation formula, accuracy of Newton's and Lagrange's interpolation, multivariate approximation, least squares approximation

Numerical Solution of Transcendental Equation

Approximate value of the root, regular falsi method, Newton-Raphson method, error and geometric significant of Newton-Raphson method, method of iteration, convergence of Newton-Raphson and iteration methods, Newton-Raphson method for simultaneous equations

Numerical Differentiation and Difference Formulas

Taylor series approach, difference formulas, general quadrature formula, Simpson's rule, trapezoidal rule, Gauss's quadrature formula, Euler's quadrature

Numerical Solution to Ordinary Differential Equation

Euler's method, stability analysis of Euler's method, Picard's method of successive approximation, Runge-Kutta method

Finite Difference Method

Introduction tofinite difference, difference equation, initial and boundary conditions, forward difference, backward difference, central difference, explicit and implicit approach, no uniform grids, errors and stability analysis, Courant number, Lax equivalence theorem, coordinate transformation of governing equations

Introduction to Finite Element Method

Introduction to variational approach, Euler–Lagrange equation, Rayleigh-Ritz method, Weighted Residual Method, Galerkin methods, finite element formulation for boundary value problems

Text Books and References:

1. Scarborough, J. B., "*Numerical Mathematical Analysis*", Oxford & IBH Publishing Co Pvt., 6th edition 2015.
2. Hoffmanm, J. D., Frankel,S., "*Numerical Methods for Engineers and Scientists, Second Edition*", CRC Press, 2001.
3. Anderson Jr, J. D., "*Computational Fluid Dynamics*", McGraw-Hill Higher Education, 1st edition 1995.
4. Zienkiewicz, O. C., Taylor, R. L., Zhu, J. Z., "*The Finite Element Method: Its Basis and Fundamentals*", Elsevier India Pvt. Ltd, 6th edition 2005.
5. Huebner, K. H., Dewhirst,D. L., Smith, D. E., Byrom, T. G.,"*The Finite Element Method for Engineers*", John Wiley & Sons, 1982.

6. Kincaid, D., Cheney, W., "*Numerical Analysis: Mathematics of Scientific Computing*", American Mathematical Society, 2nd edition 2002.