

CE 333: COMPUTATIONAL METHODS IN ENGINEERING (3-1-0: 4)

Errors and Accuracy

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

Polynomial Approximation and Interpolation

Relation between difference and derivatives, 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, Gauss's central-difference formula, multivariate approximation, least squares approximation

Numerical Solution of Transcendental Equation

Approximate value of the root, regula 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, Milne's method, Runge-Kutta method

Finite Difference Method

Introduction to Finite Difference, Difference equation, initial and boundary conditions, forward difference, backward difference, central difference, explicit and implicate approach, no uniform grids, errors and stability analysis, Courant number, Lax equivalence theorem, Crank-Nicolson method, Lax-Wendroff technique, MacCormack's technique, ADI technique, coordinate transformation of equations, transformation of governing equation to suitable coordinate axes

Introduction to Finite Element Method

Rayleigh-Ritz and Galerkin methods, finite element method for boundary value problems, finite element method for Laplace (Poisson) and diffusion equations

Text Books:

1. J. B. Scarborough, "Numerical Mathematical Analysis", Oxford & IBH Publishing Co Pvt.
2. [K. H. Huebner](#), [D. L. Dewhurst](#), [D. E. Smith](#) and [T. G. Byrom](#), "The Finite Element Method for Engineers", John Wiley & Sons.
3. J. D. Anderson Jr, "Computational Fluid Dynamics", McGraw-Hill Higher Education.

References:

1. J. D. Hoffman and S. Frankel, "Numerical Methods for Engineers and Scientists", CRC Press.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press.