

MATH-351: Numerical Methods

Credit Hours: 3-0

Pre-requisites: MATH-121 Linear Algebra and ODEs

Course objectives

- To introduce with numerical techniques to handle any mathematical problem having not an exact solution will be handled with numerical techniques
- Simulation techniques will enable to solve the problems arising in advance courses
- To familiarize with the numerical methods programming in MATLAB

Course Contents

- i. (Non) Linear Algebraic Equation(s):
 - a. Bisection method, fixed point method, Newton's method,
 - b. Newton Raphson method, Newton method for the system of nonlinear equations.
 - c. Gauss Elimination, Gauss Jordan with pivoting strategies
 - d. LU-factorization, Crout's, Doolittle's & Cholesky methods
 - e. Jacobi & Gauss Seidel methods.
- ii. Interpolation:
 - a. Lagrange, Divided difference
 - b. Cubic spline & Extrapolation
- iii. Numerical differentiation:
 - a. Forward/backward
 - b. Three- and five-point formulas.
- iv. Numerical integration:
 - a. (Composite) Trapezoidal
 - b. Simpsons 1/3rd & Simpsons 3/8th rules
 - c. Gaussian Quadrature.
- v. Differential equations (DE):
 - a. Euler, Modified Euler, Taylor,
 - b. Runge-Kutta, Multistep methods for one variable & system of ODEs.

vi. Boundary Value Problems DE:

- a. Shooting method, Finite difference methods for ODE & PDE,
- b. Finite Element technique (Glerkin' Method).

vii. Implementation of MATLAB

- a. Introduction, loops, plots, the system of equations
- b. differentiation, integration, and differential equations.

Course Outcomes

After taking this course, student should know the utilization of simulation techniques and MATLAB.

Suggested Books

- Constantinides, Alkis, and Mostoufi, Navid. (1999). Numerical Methods for Chemical Engineers with MATLAB Applications. Prentice Hall PTR.
 - Loney, Norman W. (2006). Applied Mathematical Methods for Chemical Engineers. CRC Press.
 - Schiff, Daniel, and D'Agostino, Ralph B. (1996). Practical Engineering Statistics. Wiley Interscience.
- Montgomery, Douglas C., Runger, George C., and Hubele, Norma Faris. (2007). Engineering Statistics. Johan Wiley & Sons.