National University of Computer & Emerging Sciences

Course Outline: MT207-Numerical Methods

Program: BS (CS) **Semester:** Spring 2020 **Credit Hours:** 03
Instructor: Mr. Osama Sohrab **Email:** osama.sohrab@nu.edu.pk **Office No:** 34

Course Objectives:

The main objective of this is to obtain a working knowledge of how to apply numerical methods to real-world problems and a basic understanding of the mathematics and properties of these methods.

Recommended Books:

1. Numerical Analysis by Richard L. Burden and J. Douglas Faires, 9th Edition, Publisher: Cengage Learning, 2010.
2. Computer-Oriented Numerical Methods by P. Thangaraj.

Reference Book:

Numerical Methods Using MATLAB by John H. Mathews and Kurtis D. Fink, Fourth Edition, Publisher: Pearson 2004.

Course Contents:

Introduction

Definition of Error, Types of Errors including Absolute Error, Relative Error, Percentage, Local, Global and Truncation Errors.
Round off Error and Computer Arithmetic, Algorithms and Convergence, Numerical software.

Solutions of Nonlinear Equations

The Bisection Method, Regula Falsi Method, Secant Method, Newton –Raphson Method, Fixed Point Iteration, Error analysis for Iterative Methods.

Methods for Solving Linear Systems

Direct Methods

Gaussian Elimination Method. Pivoting Strategies. LU Decomposition, Doolittle's Method, Crout's Method, Cholesky's Method.

Indirect Methods

Iterative Techniques: Jacobi Method and Gauss-Seidel Method.

Interpolation with Equally Spaced Data

The difference table, Newton Forward-Difference and Backward-Difference formulas, Gauss forward and backward formulae, Stirling's Interpolation formula, Bessel's interpolation formula, Laplace-Everett's formula.

Interpolation with Unequally Spaced Data

Divided differences, Newton's Divided difference formula, Lagrange formula, Inverse Interpolation.

Numerical Differentiation

Numerical differentiation based on forward and backward differences etc.

Numerical Integration

The Trapezoidal Rule, Simpson's Rule, Romberg's Method.

Numerical Solution of Ordinary Differential Equations

Taylor's series method for single ODE and for system of ODEs, Picard Method, Euler's method, Improved Euler's method. Modified Euler method, Runge-Kutta Methods.

Multistep Methods

Predictor-Corrector Schemes including Adams-Bashforth Technique, Adams-Moulton Technique, Milan's technique for the solution of ODE. Higher Order ODEs and Systems of Differential Equations. Finite Difference Method for Boundary Value Problems, Stability, Convergence and Consistency of the methods.

Assessment Plan:

Exams	Marks
Final	**50**
Sessional I & II	**15+15=30**
Quizzes	**10**
Assignments	**10**
Total	**100**