COMPUTER SCIENCE 310/MATHEMATICS 310

NUMERICAL ANALYSIS

I. Introduction

   A. Catalog Description

      Students learn about numerical solutions to linear systems; numerical linear algebra; polynomial approximations (interpolation and quadrature); numerical differentiation and integration. Students also learn about error analysis and how to select appropriate algorithms for specific problems. Crosslisted as MATH 310. *Prerequisites: MATH 280, 290, and CSCI 161 or equivalent.* Offered every other year; offered Spring 2007.

   B. Objectives

      This course is concerned with students learning how to solve mathematical problems using digital computers. The main objectives are for students to gain a clear understanding of how to select a suitable method for a given problem and to determine from computer output whether the desired accuracy was achieved.

   C. Prerequisites

      MATH 280, 290, and CSCI 161 or equivalent. A grade of C- or better is required in prerequisite courses.

II. Required Topics

   A. Algorithms, Errors, and Digital Devices

      1. Representation of numeric data

      2. Loss of Significance and Error Propagation

      3. Strategies for Minimizing Roundoff Error

   B. Numerical Methods for solving Equations in One Variable

      1. Rates of Convergence

      2. Iterative Algorithms

      3. Numerical Methods for Solving $f(x) = 0$

      4. Approximations of Polynomials

   C. Methods for Solving Linear Systems

      1. Basic Properties of Matrices

      2. Gaussian Elimination

      3. Triangular Systems

II. Required Topics   (continued)

    D. Differentiation and Integration

        1. Lagrange Polynomials

        2. Richardson's Formula

        3. Composite Rules and Romberg Integration

    E. Differential Equations and Boundary Value Problems

        1. Taylor Series

        2. Runge-Kutta Methods

        3. Predictor-Corrector Methods

        4. Finite Difference Methods

III. Optional Topics

    A. Eigenvalues

    B. Random Number Generation

IV. Bibliography

Burden & Faires   Numerical Analysis

W. Cheney & D. Kincaid   Numerical Mathematics & Computing

M. J. Maron   Numerical Analysis: A Practical Approach

S. D. Conte & C. de Boor   Elementary Numerical Analysis: An Algorithmic Approach

G. Forsythe, M. Malcolm, & C. B. Moler   Computer Methods for Mathematical Computation

CD ROM   Dr. Dobb's Numerics and Numerical Programming