MATHEMATICS 310/COMPUTER SCIENCE 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 CSCI 310. *Prerequisites: MATH 280, 290, and CSCI 161 or equivalent.* Offered every other year; offered Spring 2007.

B. Objectives

This course is concerned with solving mathematical problems numerically using digital computers. The main objectives are to give students 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. This course should cover the topics in the Numerical Analysis Component of the Actuarial Exams.

C. Prerequisites

MATH 280, 290, and CSCI 161 or equivalent. A grade of C- or better is required in both 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
4. Ill-conditioned problems

B. Numerical Methods for solving Equations in One Variable

1. Fixed-point method and other iterative algorithms
2. Error analysis and rate of convergence
3. Zeroes of polynomials
4. Complex roots and Müller's Method.

C. Numerical Differentiation and Integration

1. Numerical Differentiation
2. Numerical Quadrature
3. Newton-Cotes Formulas
4. Rhomberg Integration

II. Required Topics (continued)

D. Interpolation and Curve Fitting

1. Polynomial Interpolation
2. Piecewise Polynomial Interpolation
3. Divided Differences
4. Parametric Curves

E. Numerical Linera Algebra

1. Linear Equations and Matrices
2. Triangular Systems and the LU Decomposition
3. Norms of Vector and Matrices; Condition Numbers
3. Iteration Techniques
4. Eigenvalues and Eigenvectors
5. Error Estimates and Iterative Refinement

F. Approximation Theory

1. Least Squares Approximation
2. Orthogonal Polynomial Approximation
3. Trigonometric Polynomial Approximation
4. Rational Function Approximation

III. Optional Topics

A. Numerical Solutions of Differential Equations

B. Numerical Solutions of Partial Differential Equations

C. The QR Algorithm and Approximation of Eigenvalues

IV. Bibliography

Richard L. Burden & J. Douglas Faires, Numerical Analysis

Gene H. Hostetter, Mohammed S. Santian, Paul D'Carpio-Montalvo, Analytical, Numerical, and Computational Methods for Science and Engineering

Curtis F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis

John Gregory and Don Redmond,Introduction to 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