OFFICIAL SYLLABUS

462- ENGINEERING NUMERICAL ANALYSIS

Adopted - Fall 2006 (Committee: Drs. Leem, Lu, Pelekanos)

Catalog Description. Polynomial interpolation and approximations, numerical integration, differentiation, direct and iterative methods for linear systems. Introduction to numerical solutions for ODEs and PDEs. Matlab programming required. Prerequisite: MATH 250, 305, CS 140 or 141 or consent of instructor. **NOT FOR MATH MAJORS.**

Textbook Required: **Friendly Introduction to Numerical Analysis, by Brian Bradie**

Course Outline and Topics

i) *Getting Started*
- Floating Point Arithmetic

ii) *Systems of Equations*
- Linear Algebra Review
- Gaussian Elimination
- Pivoting Strategies
- Vector and Matrix Norms
- Error Estimates and Condition Number
- *LU* Decomposition
- Direct Factorization
- Special Matrices
- Iterative Techniques for Linear Systems: Basic Concepts and Methods

iii) *Interpolation (and Curve Fitting)*
- Lagrange Form of the Interpolating Polynomial
- The Newton Form of the Interpolating Polynomial
- Piecewise Linear Interpolation
- Cubic Spline Interpolation
- Hermite and Hermite Cubic Interpolation

iv) *Differentiation and Integration*
- Numerical Differentiation, Part I
- Numerical Differentiation, Part II
- Numerical Integration – The Basics and Newton–Cotes Quadrature
- Composite Newton-Cotes Quadrature
- Gaussian Quadrature

v) *Initial Value Problems of Ordinary Differential Equations*
- Key Numerical Concepts and Elements of Continuous Theory
- Euler's Method
- Higher-Order One-Step Methods: Taylor Methods
- Runge-Kutta Methods
- Convergence and Stability Analysis **(optional)**

vi) *Two-Point Boundary Value Problems*
- Finite Difference Method, Part I: The Linear Problem with Dirichlet Boundary Conditions

vii) *Elliptic Partial Differential Equations*
- The Poisson Equation on a Rectangular Domain, I: Dirichlet Boundary Conditions
- The Poisson Equations on a Rectangular Domain, II: Non-Dirichlet Boundary Conditions **(optional)**