OFFICIAL SYLLABUS
466 - NUMERICAL LINEAR ALGEBRA WITH APPLICATIONS

Adopted - Spring 2004 (Committee: Drs. C. Lu, G. Pelekanos, E.Sewell)
(Prerequisites changed and course objectives added October 2014 by Department consent; effective Spring 2016.)

Catalog Description. Direct and iterative methods for linear systems, approximation of eigenvalues, solution of nonlinear systems, numerical solution of ODE and PDE boundary value problems, function approximation. Prerequisites: Math 223, Math 250, Math 321, and CS 145 with a grade of C or better.

Textbook. Numerical Analysis, 9th edition by R. Burden and J. Faires, 2010

Course Outline and Topics

Chapter 1: Math Preliminaries
- 1.2 Roundoff Errors and Computer Arithmetic

Chapter 6: Direct Methods for Solving Linear Systems
- 6.1 Linear Systems of Equations
- 6.2 Pivoting Strategies
- 6.3 Linear Algebra and Matrix Inversion (Optional)
- 6.4 The Determinant of a Matrix
- 6.5 Matrix Factorization
- 6.6 Special Types of Matrices

Chapter 7: Iterative Techniques in Matrix Algebra
- 7.1 Norms of Vectors and Matrices
- 7.2 Eigenvalues and Eigenvectors
- 7.3 Iterative Techniques for Solving Linear Systems
- 7.4 Error Bounds and Iterative Refinement

Either

Chapter 8: Approximation Theory
- 8.1 Discrete Least Squares Approximation
- 8.2 Orthogonal Polynomials and Least Squares Approximation
- 8.3 Chebyshev Polynomials and Economization of Power Series
- 8.4 Rational Function Approximation
- 8.5 Trigonometric Polynomial Approximation

Chapter 9: Approximating Eigenvalues
- 9.1 Linear Algebra and Eigenvalues
- 9.2 The Power Method
- 9.3 Householder's Method
- 9.4 The QR Algorithm

or

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Chapter 10: Numerical Solutions of Nonlinear Systems of Equations
- 10.1 Fixed Points for Functions of Several Variables
- 10.2 Newton's Method
- 10.4 Steepest Descent Techniques

Chapter ***11: Boundary-Value Problems for Ordinary Differential Equations***
- 11.3 Finite-Difference Methods for Linear Problems
- 11.4 Finite-Difference Methods for Nonlinear Problems

11.5 The Rayleigh-Ritz Method, **or**
12.1 Elliptic Partial Differential Equations

Course objectives: At the conclusion of this course, students should be able to

1. Solve linear systems using direct methods and iterative methods
2. Solve eigenvalue problems using numerical methods
3. Learn about numerical approximation theory
4. Learn how to obtain numerical solutions to nonlinear systems and boundary value problems for Ordinary Differential Equations and Elliptic Partial Differential Equations.
5. Implement numerical methods that appear in objectives 1-4 above using MATLAB and apply them to solving various real-life applications.