OFFICIAL SYLLABUS

Math 421: Linear Algebra II

(Adopted - Fall 2005; Committee: Drs. U. Ledzewicz, K. Leem, C. Lu, J. Parish, G. Pelekanos)

Catalog Description: [Dist.NSM] Advanced study of vector spaces: Cayley-Hamilton Theorem, minimal and characteristic polynomials, eigenspaces, canonical forms, Lagrange-Sylvester Theorem, applications. Prerequisites: 223, 250, 321 or consent of instructor.

Textbook: *Linear Algebra, 4th edition by S. Friedberg, A. Insel, and L. Spence.*

The purpose of the course is to provide students rigorous theories of the principal topics of linear algebra.

Course Outline and Topics
Chapter 1-4 need to be reviewed carefully during the first 4 weeks (maximum).

Chapter 1, Vector Spaces (3 classes)
- 1.1 Introduction
- 1.2 Vector Spaces
- 1.3 Subspaces
- 1.4 Linear Combinations and Systems of Linear Equations
- 1.5 Linear Dependence and Linear Independence
- 1.6 Bases and Dimension
- 1.7 Maximal Linearly Independent Subsets

Chapter 2, Linear Transformations and Matrices (3 classes)
- 2.1 Linear Transformations, Null Spaces, and Ranges
- 2.2 The Matrix Representation of a Linear Transformation
- 2.3 Composition of Linear Transformations and Matrix Multiplication
- 2.4 Invertibility and Isomorphism
- 2.5 The Change of Coordinate Matrix

Chapter 3, Elementary Matrix Operations and Systems of Equations (1-2 classes)
- 3.1 Elementary Matrix Operations and Elementary Matrices
- 3.2 The Rank of a Matrix and Matrix Inverses
- 3.3 Systems of Linear Systems - Theoretical Aspects
- 3.4 Systems of Linear Systems - Computational Aspects

Chapter 4, Determinants (1/2 class)
- 4.1 Determinants of Order 2
- 4.2 Determinants of Order n
- 4.3 Properties of Determinants
- 4.4 Summary

Chapter 5, Diagonalization
- 5.1 Eigenvalues and Eigenvectors
- 5.2 Diagonalizability
- 5.4 Invariant Subspaces and the Cayley-Hamilton Theorem

Chapter 6, Inner Product Spaces
- 6.1 Inner Products and Norms
- 6.2 The Gram-Schmidt Orthogonalization Process and Orthogonal Complements
- 6.3 The Adjoint of a Linear Operator
- 6.4 Normal and Self-Adjoint Operators
- 6.5 Unitary and Orthogonal Operators and Their Matrices
- 6.6 Orthogonal Projections and the Spectral Theorem
- 6.7 The Singular Value Decomposition and Pseudoinverse
- 6.8 Bilinear and Quadratic Forms (Optional)

Chapter 7, Canonical Forms
- 7.1 The Jordan Canonical Form I
- 7.2 The Jordan Canonical Form II
- 7.3 The Minimal Polynomial
- 7.4 The Rational Canonical Form

Any instructor should cover all of the material specified; additional sections are optional.