

LINEAR ALGEBRA

MATH 4050/8056

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1.0 Course Description

- 1.1 Overview of Content and Purpose:** (3 hours) The theory of vectors, vector spaces, inner product spaces, linear transformations, eigenvalues and canonical forms. Unlike MATH 2050, this course emphasizes the theoretical aspects of linear algebra.
- 1.2 For Whom Intended:** This course will be primarily for mathematics majors. However, students from other scientific disciplines may be interested.
- 1.3 Prerequisites:** MATH 2050 or permission of instructor.

2.0 Objectives

- 2.1 Performance Objectives for the Student:** Students should develop their abilities in abstract mathematical thinking, theorem proving, and understanding mathematical systems, as well as mastering the specific content of linear algebra.

3.0 Content and Organization

- 3.1 Topics:**
- I. Vectors and Matrices
 - 1. Introduction to Vectors
 - 2. Lengths and Dot Products
 - 3. Planes
 - 4. Linear Equations by Rows and Columns
 - II. Systems of Linear Equations
 - 1. Idea of Elimination
 - 2. Elimination Using Matrices
 - 3. Rules for Matrix Operations
 - 4. Inverse Matrices
 - 5. Elimination and Factorization
 - 6. Transposes and Permutations
 - III. Vectors and Subspaces
 - 1. Spaces of Vectors
 - 2. The Nullspace of A
 - 3. The Rank of A
 - 4. Independence, Basis, and Dimension
 - 5. Dimensions of the Four Subspaces
 - 6. Orthogonality of the Four Subspaces
 - IV. Determinants
 - 1. Properties of Determinates
 - 2. Cofactors
 - 3. Cramer's Rule, Inverses, and Volumes
 - V. Eigenvalues and Eigenvectors
 - 1. Introduction to Eigenvectors
 - 2. Diagonalizing a Matrix
 - 3. Symmetric Matrices and Orthogonal Eigenvectors
 - 4. Positive Definite Matrices
 - 5. Similar Matrices

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- VI. Linear Transformations
 - 1. Introduction to Linear Transformations
 - 2. Matrix of a Linear Transformations
 - 3. Choice of Basis: Similarity and Diagonalization

4.0 Teaching Methodology

- 4.1 **Methods to be Used:** The course will be presented by lecture, class discussions and questions, and problem assignments. Students will be required to do problems weekly. There will be three contact hours per week.

5.0 Evaluation

- 5.1 **Basis for Evaluating Student Performance:** Students will be evaluated by examinations and assigned problems.

Final	-	25%
In Class Examinations	-	50%
Problem Assignments	-	25%

Graduate students will be expected to cover additional material on Orthogonality and Complex Vectors and Matrices, as independent study. There will be problems assigned from this material and this material will be included on the in class examinations and the final.

Grading Scale

97-100%	A+
90-96%	A
87-89%	B+
80-86%	B
77-79%	C+
70-76%	C
67-69%	D+
60-66%	D
Below 60%	F

6.0 Resource Materials

- 6.1 **Textbook(s) or Other Resource Material:** Friedberg, *Linear Algebra*, 4th edition, Prentice Hall, 2003.
- 6.2 **Current Bibliography of Resources:** Andrilli, S., and D. Hecker, *Elementary Linear Algebra*, PWS Kent, Boston, MA 1993.
Beaumont, R.A., and R.W. Ball, *Introduction to Modern Algebra and Matrix Theory*, Rinehart & Co., New York, 1954.

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Curtis, Charles W., *Linear Algebra, An Introductory Approach*, Allyn & Bacon, Inc., Boston MA, 1963.

Hoffman, D. and R. Kunze, *Linear Algebra*, Prentice-hall, Englewood Cliffs, NJ.

Jaeger, Arno, *Introduction to Analytic Geometry and Linear Algebra*, Holt, Rinegart & Winston, New York, 1960.

Lowen, Kenneth, *Linear Algebra Workbook*

Nearing, Evar D. *Linear Algebra and Matrix Theory*, Wiley, New York 1963.

Paige, L.J. and J.D. Swift, *Elements of Linear Algebra*, Ginn & Co., N.Y., 1961.

Smirov, V.I. (Edited by R.A. Silverman), *Linear Algebra and Group Theory*, McGraw-Hill Book Co., New York, 1961.

Stoll, R.R., *Linear Algebra and Matrix Theory*, McGraw-Hill Book Co. New York, 1952.