

# LINEAR ALGEBRA

## MATH 4050/8056

### Course Description:

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. **3 credits**

### Prerequisites:

MATH 2050; MATH 2030 or MATH 2230 or equivalent; or permission.

### Overview of Content and Purpose of the Course:

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.

### Anticipated Audience/Demand:

This course will be primarily for mathematics majors. However, students from other scientific disciplines may be interested.

### Major Topics:

#### **1) Vectors and Matrices**

- a. Introduction to Vectors
- b. Lengths and Dot Products
- c. Planes
- d. Linear Equations by Rows and Columns

#### **2) Systems of Linear Equations**

- a. Idea of Elimination
- b. Elimination Using Matrices
- c. Rules for Matrix Operations
- d. Inverse Matrices
- e. Elimination and Factorization
- f. Transposes and Permutations

#### **3) Vectors and Subspaces**

- a. Spaces of Vectors
- b. The Nullspace of A
- c. The Rank of A
- d. Independence, Basis, and Dimension
- e. Dimensions of the Four Subspaces
- f. Orthogonality of the Four Subspaces

#### **4) Determinants**

- a. Properties of Determinates
- b. Cofactors
- c. Cramer's Rule, Inverses, and Volumes

#### **5) Eigenvalues and Eigenvectors**

- a. Introduction to Eigenvectors
- b. Diagonalizing a Matrix
- c. Symmetric Matrices and Orthogonal Eigenvectors
- d. Positive Definite Matrices
- e. Similar Matrices

#### **6) Linear Transformations**

- a. Introduction to Linear Transformations
- b. Matrix of a Linear Transformations
- c. Choice of Basis: Similarity and Diagonalization

#### **Methods:**

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.

#### **Textbook:**

Axler, Sheldon. *Linear Algebra Done Right, 3rd ed.* New York: Springer, 2014.

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