

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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