Mathematics 3301 - Linear Algebra

Student Learning Outcomes

1. **The students will demonstrate factual knowledge including the mathematical notation and terminology used in this course.** Students will read, interpret, and use the vocabulary, symbolism and basic definitions used in linear algebra, including vectors, matrices, vector spaces, subspaces, linear independence, span, basis, dimension, linear transformation, inner product, eigenvalue and eigenvector.

2. **The students will describe the fundamental principles including the laws and theorems arising from the concepts covered in this course.** Students will identify and apply the theorems about and the characteristics of linear spaces and linear transformations, determine bases, compute dimensions, evaluate linear transformations, solve systems of linear equations and find determinants.

3. **The students will apply course material along with techniques and procedures covered in this course to solve problems.** Students will apply properties and theorems about linear spaces to specific mathematical structures that satisfy the linear space axioms.

4. **The students will develop specific skills, competencies and thought processes sufficient to support further study or work in this or related fields.** Students will acquire a level of proficiency in the fundamental concepts and applications necessary for further study in academic areas requiring linear algebra as a prerequisite or for work in occupational fields requiring a background in linear algebra. These fields might include the physical sciences and engineering as well as mathematics.

Course Content

Textbook: *Linear Algebra and Its Applications,* Third Edition, by David Lay.

1. **Linear Equations in Linear Algebra:** Systems of Linear Equations; Row Reduction and Echelon Forms; Vector Equations; The Matrix Equation Ax = b; Solution Sets of Linear Systems; Linear Independence; Introduction to Linear Transformations; The Matrix of a Linear Transformation.

2. **Matrix Algebra:** Matrix Operations; The Inverse of a Matrix; Characterizations of Invertible Matrices.

3. **Determinants:** Introduction to Determinants.

4. **Vector Spaces:** Vector Spaces and Subspaces; Null Spaces, Column Spaces, and Linear Transformations; Linearly Independent Sets, Bases; Coordinate Systems; The Dimension of a Vector Space; Rank.

5. **Eigenvalues and Eigenvectors:** Eigenvectors and Eigenvalues; The Characteristic Equation; Diagonalization.

6. **Orthogonality and Least Squares:** Inner Product, Length, and Orthogonality; Orthogonal Sets; Orthogonal Projections; the Gram-Schmidt Process; Least-Squares Problems.

Additional topics include partitioned matrices, matrix factorizations, change of basis, topics from Chapter 7 (Symmetric Matrices and Quadratic Forms), and applications.