Course Goals: Math 341, Linear Algebra

Students should be able to demonstrate:

- An understanding the concepts of Linear Algebra, being aware of the influence of mathematicians such as Gauss, Jordan, and Cauchy, performing computations, using technology as a tool when appropriate, understanding the nature of proof, creating original proofs, and applying the concepts and computational methods to solve real world problems are each important in the course.
- Specific content, computations, applications, etc. are outlined below.
- Additional topics should be added as time permits.

I. Systems of Linear Equations, Matrices, Determinants

Students should be able to demonstrate the ability to:

- Recognize and use elementary operations to solve a system of equations
- Use Gaussian elimination and Gauss-Jordan elimination to write a system of equations in row-echelon form or reduced row-echelon form
- Write a solution in parametric form when appropriate
- Know and apply the basic properties of matrix operations, find and use matrix inverses, understand the relation between elementary matrices and elementary row operations
- Know and use equivalent conditions for n x n matrices (invertible, determinant not zero, etc.)
- Understand and apply the basic properties of determinants
- Compute determinants by the cofactor expansion
- Know how to use technology as a problem-solving tool in problems involving linear systems
- Create proofs using concepts learned
- Apply the concepts to real world problems; e.g., polynomial curve fitting, network analysis, and least squares regression analysis and to be able to solve problems in these areas

II. Vectors and Vector Spaces

Students should be able to demonstrate the ability to:

- Do basic vector arithmetic, and understand the relation between linear systems and vector equations
- Compute the length of a vector, the dot product and angle between two vectors, and the orthogonal projection of a vector along another vector
- Understand and apply the concepts of vector space, subspace, dependence and independence, span, basis, dimension, etc.
- Compute the coordinate vector with respect to a given basis and to find and use the transition matrix

- Know how to find bases for the null, row, and column spaces of a matrix
- Know and apply the basic properties of inner products
- Understand and use orthogonal and orthonormal sets and matrices and to use the Gram-Schmidt process
- Create proofs using concepts learned
- Apply the concepts to real world problems; e.g., to solve least squares problems in modeling world population

III. Linear Transformations

Students should be able to demonstrate the ability to:

- Know what a linear transformation is, to be able to test for it, and to understand and use the relation between transformations and matrices
- Compute the kernel and range of a linear transformation
- Understand the concepts of one-to-one, onto, and isomorphism
- Know how to compute the matrix of a linear transformation with respect to a new basis
- Understand and use similarity transformations
- Create proofs using concepts learned
- Understand and apply linear transformation in the plane: reflections, expansions, shears

IV. Eigenvalues and Eigenvectors

Students should be able to demonstrate the ability to:

- Know how to compute eigenvalues and eigenvectors
- Know which matrices and transformations can be diagonalized and how to diagonalize them
- Create proofs using concepts learned
- Use eigenvalues and eigenvectors in mathematical modeling; e.g., population growth

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