

## **Philosophy Statement for Math 315: Linear Algebra**

### Catalog Description

Matrices, linear systems, vector spaces, vector geometry, linear transformations, and appropriate applications are covered.

*3 credit hours. Prerequisite: MATH 300. Offered spring.*

### General Purpose

To introduce the basic techniques and results (via calculations and proofs) associated with linear systems and linear operations and to continue to provide more experience with the process of abstraction in mathematics.

### Major Topics

Systems of linear equations, matrix algebra, abstract vector spaces, linear transformations and their relationship to matrices, determinants, eigenvalues and eigenvectors.

### Clientele

Mostly junior and sophomore mathematics majors with some science majors and math minors. This is a required course in the math major, in both the liberal arts and teacher education programs.

### Prerequisite

Mathematics 300.

### Approach

The course should include both technique and theory. Students who successfully complete this course should master all basic calculations involved with each topic and should be able to show understanding of the theory relating topics to one another. Students should be expected to write proofs throughout the course. Simple proofs and verifications like “Is this a vector space?” “Is this a linear transformation?” “Is this set linearly independent?” are very important. The process of defining terminology and structure and applying them to obtain useful results should be conveyed to the student. Examples other than Euclidean  $n$ -space and matrices should be used often. The pace must be fairly fast to cover all the appropriate topics. Be sure that definitions and their use are carefully covered, as students do struggle at this level of abstraction.

### Technology

All students are required to have a graphing calculator, the type of which is recommended yearly by the CCC. This is a nice tool since this allows us to spend more time on the meatier topics and less time on the arithmetic such as Gauss-Jordan elimination.

The use of computer software capable of performing symbolic manipulation has been mandated by the department. At least two evaluated assignments using this software are

to be given. Maple is available in the college labs, although the instructor may choose to use other available software packages.

### **Course Outline for Mathematics 315: Linear Algebra**

This outline should be textbook independent, but is loosely based on the following textbook:

Larson & Edwards, Elementary Linear Algebra, Houghton Mifflin Company, 5<sup>th</sup> edition.

#### **Systems of Linear Equations:** 1 week

Do fast review of systems of linear equations, covering Gaussian Elimination, and Gauss-Jordan Elimination.

#### **Matrices:** 2 weeks

Cover all basic operations with matrices, including properties of matrix operations, and inverses of matrices.

#### **Determinants:** 1.5 weeks

Cover the definition of the determinant, properties of determinants, finding eigenvalues and eigenvectors of a matrix, and if time, a couple of applications of the determinant.

#### **Vector Spaces:** 4.5 weeks

Many different vector spaces (e.g. Polynomial spaces, set of  $m \times n$  Matrices,  $\mathbb{R}^n$ , etc.) should be used throughout this chapter (and the rest of the course) in all of the following topics: Definition of a Vector Space, Subspaces of Vector Spaces, Spanning Sets and Linear Independence, Basis and Dimension, Rank of a matrix and systems of linear equations.

#### **Linear Transformations:** 3 weeks

The Definition of Linear Transformations, The Kernel and Range of a Linear Transformation, Representing a linear transformation as a matrix, Isomorphisms and Isomorphic Vector Spaces.

#### **Choose from the following topics:** 1 week

Inner Product Spaces and Orthonormal Bases (Gram-Schmidt Process)

or

More on Eigenvalues and Eigenvectors, and Diagonalization.

#### **Testing:** 1 week.

Total weeks: 14

Model Assessment Statement to be included in syllabus:

MODEL STATEMENT #1

**Departmental Outcomes and Professional Standards**

Students in a teacher education program who successfully complete this course will know and be able to meet the following Department outcomes and professional standards:

Math/CS Department outcomes: 1.1, 2.1, 2.2, 3.1.

NCTM Standards grades 5-8: 1.5.1, 1.5.2, 1.5.7, 1.5.11.

NCTM Standards grades 9-12: 1.5.1, 1.5.2, 1.5.8, 1.5.12, 1.5.13

Rhode Island Beginning Teacher Standards: 2.1, 2.5, 2.6, 2.7

MODEL STATEMENT #2

**Relation to Teacher Education Programs**

Successful completion of this course will contribute to the mathematical content knowledge of students. In addition, students in a teacher education program will be able to relate this knowledge to the following Department outcomes and professional standards:

Math/CS Department outcomes: 1.1, 2.1, 2.2, 3.1.

NCTM Standards grades 5-8: 1.5.1, 1.5.2, 1.5.7, 1.5.11.

NCTM Standards grades 9-12: 1.5.1, 1.5.2, 1.5.8, 1.5.12, 1.5.13

Rhode Island Beginning Teacher Standards: 2.1, 2.5, 2.6, 2.7