

Introduction to Linear Algebra (One Semester Course)

Overview

Introduction to Linear Algebra is one of several college-level courses designed for students who have successfully completed the Calculus I/II/III sequence. Introduction to Linear Algebra presents a study of systems of linear equations and properties of matrices and forms a part of the mathematical foundation in social sciences, natural sciences, and engineering. Introduction to Linear Algebra sits outside the Alabama state course of study; topics and standards below are from UAB, through which this course is offered as a dual enrollment course.

Topics in Introduction to Linear Algebra include, but are not limited to:

- linear equations and systems of linear equations
- Gaussian and Gauss-Jordan elimination
- matrices, including matrix operations, properties, invertibility, inverse matrices, and matrix transformations
- determinants, including through cofactor expansion and row reduction
- Cramer's Rule to solve systems of linear equations by using determinants
- Euclidean vector spaces, including vectors, norms, dot products, distance, and orthogonality
- general vector spaces, including real vector spaces, subspaces, linear independence, bases, and dimension
- eigenvalues and eigenvectors
- diagonalization, including symmetric matrices and orthogonal diagonalization

Upon successful completion of the course, a student will be able to:

- solve systems of linear equations using a variety of methods, including elimination, substitution, Cramer's Rule, inverse matrices, Gaussian elimination, and Gauss-Jordan elimination
- understand the fundamental structure of the algebra of matrices
- find, characterize, and use invertible matrices
- describe Euclidean vector spaces, including orthogonality
- describe general vector space structure
- find bases for n -space and write points in n -space with respect to other bases
- find eigenvalues and eigenvectors of matrices and use them in complex computation of matrices

Introduction to Linear Algebra Content Units

Unit 1 – Systems of Linear Equations and Matrices

- Solving Systems of Linear Equations
- Gaussian Elimination
- Matrices and Their Operations and Properties
- Inverses of Matrices
- Elementary Matrices
- Diagonal, Triangular, and Symmetric Matrices
- Matrix Transformations

Unit 2 – Determinants

- Determinants by Cofactor Expansion
- Determinants by Row Reduction
- Properties of Determinants
- Cramer's Rule

Unit 3 – Euclidean Vector Spaces

- Vectors in n -Space
- Norms, Dot Products, and Distance
- Orthogonality

Unit 4 – General Vector Spaces

- Real Vector Spaces
- Subspaces
- Linear Independence
- Coordinates and Bases
- Change of Basis
- Dimension
- Row, Column, and Null Space
- Rank and Nullity

Unit 5 – Eigenvalues, Eigenvectors, and Diagonalization

- Eigenvalues of Matrices
- Eigenvectors Associated with Eigenvalues
- Diagonalization of Matrices
- Orthogonal Diagonalization