MATH 212: INTRODUCTION TO LINEAR ALGEBRA

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2025
Credits:	4
Total Contact Hours:	72
Lecture Hours :	72
Lab Hours:	0
Hours Arranged:	0
Outside of Class Hours:	144
Prerequisite:	MATH 191.
District General Education:	A3. Mathematics
Transferable to CSU:	Yes
Transferable to UC:	Yes - Approved
Grading Method:	Standard Letter

Catalog Course Description

This course develops the techniques and theory needed to solve and classify systems of linear equations. Solution techniques include row operations, Gaussian elimination, and matrix algebra. The course investigates the properties of vectors in two and three dimensions, leading to the notion of an abstract vector space. Vector space and matrix theory are presented including topics such as inner products, norms, orthogonality, eigenvalues, eigenspaces, and linear transformations. Selected applications of linear algebra are included. This introduction to linear algebra course complements coursework in calculus. 72 lecture hours.

Course Objectives

- Critically analyze and develop an understanding of linear independence, basis, and dimension.
- Critically examine and demonstrate an understanding of how to use the characteristic polynomial
- Demonstrate an application of the Gram-Schmidt process.
- Demonstrate the use of Cramer's rule and properties of determinants.
- Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.
- Apply the techniques of Gauss-Jordan elimination to transform matrices to reduced row echelon form.
- Use elementary row operations, elementary matrices and matrix algebra to solve systems of linear equations.
- Perform matrix operations, find inverses for matrices (where possible), use matrix algebra, find the transpose of a matrix and use matrices to solve systems of equations.
- Find determinants and use properties of determinants to determine if a matrix is nonsingular.
- Perform vector operations, use properties of vector operations, and determine vector subspaces, spanning sets and bases of vector spaces.
- Show that a set of vectors forms a basis for a set and find the dimension of a subspace.
- Find the standard matrix for a given linear transformation and use this matrix to find the image of a given vector.
- Find real eigenvalues and eigenvectors of 3 x 3 real matrices with at least one rational eigenvalue

Major Course Content

1. Systems of Linear Equations
   a. Gaussian Elimination
   b. Gauss-Jordan Elimination
2. Matrices
   a. Operations with Matrices
   b. Properties of Matrix Operations, including invertibility and transpose
   c. The Inverse of a Matrix
   d. Special Matrices: diagonal, triangular, and symmetric
3. Determinants
   a. The Determinant of a Matrix
   b. Evaluation of a Determinant Using Elementary Operations
   c. Properties of Determinants
4. Vector Spaces
   a. Vector Algebra for R^n
   b. Vector Spaces
   c. Subspaces of Vector Spaces
   d. Spanning Sets and Linear Dependence and Independence
   e. Basis and Dimension
   f. Matrix-generated spaces: row space, column space, null space, rank, nullity
   g. Coordinates and Change of Basis
5. Inner Product spaces
   a. Angle Between Vectors, Ortogonality of Two Vectors in R^n
   b. Norm and Dot Product in R^n
   c. Inner Product Spaces
   d. Orthogonal, Orthonormal Bases, Gram-Schmidt Process
6. Linear Transformations
   a. Introduction to Linear Transformations
   b. The Kernel and Range of a Linear Transformation
   c. Matrices for Linear Transformations
7. Eigenvalues and Eigenvectors
   a. Eigenvalues, Eigenvectors, and Eigenspaces
   b. Diagonalization
   c. Symmetric Matrices and Orthogonal Diagonalization

Suggested Reading Other Than Required Textbook

Students will read the required text.

Examples of Required Writing Assignments

Students will need to have sufficient writing skills to complete outside homework assignments which will mainly consist of math homework.

Examples of Outside Assignments

1. Students will apply the techniques of Gauss-Jordan elimination to transform matrices to reduced row echelon form.
2. A student will apply the Gram-Schmidt process in order to produce orthogonal or orthonormal basis for any nonzero subspace of an n-dimensional space.

Instruction Type(s)

Lecture, Online Education Lecture

IGETC Area 2: Mathematical Concepts and Quantitative Reasoning

Yes