

MATH-2410: INTRODUCTION TO LINEAR ALGEBRA

Cuyahoga Community College

Viewing: MATH-2410 : Introduction to Linear Algebra

Board of Trustees:

March 2021

Academic Term:

Fall 2021

Subject Code

MATH - Mathematics

Course Number:

2410

Title:

Introduction to Linear Algebra

Catalog Description:

Includes study of vector spaces, linear transformations and matrices, determinants, invariant subspaces, eigenvalues and eigenvectors, and applications.

Credit Hour(s):

3

Lecture Hour(s):

3

Lab Hour(s):

0

Other Hour(s):

0

Requisites

Prerequisite and Corequisite

MATH-1620 Calculus II, or departmental approval: equivalent coursework.

Outcomes

Course Outcome(s):

Perform basic operations and simplification of matrices.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Demonstrate scalar multiplication, addition and multiplication of matrices.
2. Apply elementary row operations to reduce a matrix to echelon form.
3. Define and determine the inverse of a matrix.
4. Solve systems of linear equations using matrices.

Course Outcome(s):

Evaluate and apply the determinant of a matrix.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Calculate the determinant using the formula for a 2x2 matrix, the triangular form of a matrix, and cofactor expansion.
2. Solve systems of equations using Cramer's Rule
3. Determine the inverse of a matrix using the adjoint method.

Course Outcome(s):

Analyze and operate within a vector space.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Determine the basis and dimension of a vector space.
2. Identify and interpret the rank of a matrix.
3. Calculate inner products.
4. Define and determine the orthogonality of vectors.
5. Apply inner products to illustrate orthonormal bases.
6. Construct an orthogonal or orthonormal basis for a subspace using the Gram-Schmidt process.
7. Determine coordinate vectors relative to different bases.
8. Define and demonstrate the properties of a vector space.
9. Define and calculate null spaces, column spaces and row spaces.

Course Outcome(s):

Perform and analyze linear transformations.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Define and demonstrate the properties of linear transformations.
2. Determine the kernel and range of a linear transformation.
3. Construct matrices of linear transformations relative to different bases.
4. Define and utilize similar matrices.

Course Outcome(s):

Calculate and apply eigenvalues and eigenvectors.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Determine the characteristic polynomial.
2. Solve the characteristic equation to find the eigenvalues and determine the eigenvectors.
3. Diagonalize a matrix using eigenvalues and eigenvectors.
4. State and apply the Cayley-Hamilton Theorem.

Methods of Evaluation:

1. A minimum of three periodic exams
2. Quizzes
3. Homework
4. In class collaborative work
5. Computer / calculator application problems
6. Comprehensive final exam

Course Content Outline:

1. Matrices
 - a. Gaussian elimination
 - b. Matrix operations
 - c. Elementary matrices
 - d. Invertibility of a matrix
 - e. Applications
2. Determinants
 - a. The determinant function
 - b. Evaluation of determinants
 - c. Properties
 - d. Cofactor expansion: Cramer's Rule
 - e. Adjoint and inverses
 - f. Applications
3. Vector spaces
 - a. General vector spaces
 - b. Subspaces
 - c. Linear independence
 - d. Basis and dimension
 - e. Row and column space of a matrix: rank
 - f. Inner product spaces
 - g. Euclidean n- space
 - h. Orthonormal bases: Gram-Schmidt process
 - i. Coordinates: change of bases
4. Linear transformations
 - a. Definition and properties of linear transformations
 - b. Kernel and range; rank and nullity
 - c. Matrices of linear transformations
 - d. Similarity
5. Eigenvalues, eigenvectors
 - a. Eigenvalues and Eigenvectors
 - b. Characteristic polynomials
 - c. Diagonalization
 - d. Orthogonal diagonalization
 - e. Cayley-Hamilton theorem
 - f. Applications

Resources

Lay, David C, Lay, Steven R, McDonald, Judi J. *Linear Algebra and Its Applications*. 5th ed. Pearson, 2015.

Poole, David. *Linear Algebra: A Modern Introduction*. 4th ed. Cengage Learning, 2015.

Friedberg, Stephen H., Arnold J. Insel, Lawrence E. Spence. *Linear Algebra*. 5th ed. Pearson, 2018.

Anton, Howard, Chris Rorres, and Anton Kaul. *Elementary Linear Algebra: Applications Version*. 12th ed. Wiley, 2019.

Larson, ron. *Elementary Linear Algebra*. 8th ed. Cengage, 2016.

Instructional Services**OAN Number:**

Ohio Transfer 36 TMM019 and Transfer Assurance Guide OMT019

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