

MATH-220: LINEAR ALGEBRA

Effective Term

Fall 2026

CC Approval

12/05/2025

AS Approval

12/11/2025

BOT Approval

12/18/2025

SECTION A - Course Data Elements

CB04 Credit Status

Credit - Degree Applicable

Discipline

Minimum Qualifications	And/Or
Mathematics (Master's Degree)	

Subject Code

MATH - Mathematics

Course Number

220

Department

Mathematics

Division

Mathematics (MATH)

Full Course Title

Linear Algebra

Short Title

Linear Algebra

CB03 TOP Code

1701.00 - Mathematics, General

CB08 Basic Skills Status

NBS - Not Basic Skills

CB09 SAM Code

E - Non-Occupational

Rationale

Updated due to CCN changes.

SECTION B - Course Description

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. Properties of vectors are investigated 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.

SECTION C - Conditions on Enrollment

Open Entry/Open Exit

No

Repeatability

Not Repeatable

Grading Options

Letter Grade Only

Allow Audit

Yes

Requisites

Prerequisite(s)

Completion of MATH-C2220 or equivalent with a minimum grade of C.

Advisory Prerequisite(s)

Completion of MATH-221 with a minimum grade of C.

Requisite Justification

Requisite Description

Course Not in a Sequence

Subject

MATH

Course

C2220

Level of Scrutiny

Content Review

Upon entering this course, students should be able to:

1. Ability to use a graphical calculator
2. Ability to graph, evaluate, and analyze planes and lines in space
3. Ability to use vectors and derivatives
4. Ability to read and understand formal proofs
5. Ability to solve application problems in the physical sciences

SECTION D - Course Standards

Is this course variable unit?

No

Units

3.00

Lecture Hours

54.00

Outside of Class Hours

108

Total Contact Hours

54

Total Student Hours

162

Distance Education Approval

Is this course offered through Distance Education?

Yes

Online Delivery Methods

DE Modalities	Permanent or Emergency Only?
Hybrid	Permanent
Online with Proctored Exams	Permanent
Entirely Online	Emergency Only

SECTION E - Course Content

Student Learning Outcomes

Upon satisfactory completion of the course, students will be able to:	
1.	Analyze linear systems using matrix methods.
2.	Apply basic vector space concepts.
3.	Find eigensystems for linear transformations.
4.	Write mathematical proofs.

Course Objectives

Upon satisfactory completion of the course, students will be able to:	
1.	Find solutions of systems of equations using various methods appropriate to lower division linear algebra;
2.	Use bases and orthonormal bases to solve problems in linear algebra;
3.	Find the dimension of spaces such as those associated with matrices and linear transformations;
4.	Find eigenvalues and eigenvectors and use them in applications; and
5.	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.

Course Content

1. Techniques for solving systems of linear equations including Gaussian and Gauss-Jordan elimination and inverse matrices;
2. Matrix algebra, invertibility, and the transpose;
3. Relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices;
4. Special matrices: diagonal, triangular, and symmetric;
5. Determinants and their properties;
6. Vector algebra for \mathbb{R}^n ;
7. Real vector space and subspaces;
8. Linear independence and dependence;
9. Basis and dimension of a vector space;
10. Matrix-generated spaces: row space, column space, null space, rank, nullity;
11. Change of basis;
12. Linear transformations, kernel and range, and inverse linear transformations;
13. Matrices of general linear transformations;
14. Eigenvalues, eigenvectors, eigenspace;
15. Diagonalization including orthogonal diagonalization of symmetric matrices;
16. Inner products on a real vector space;
17. Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in \mathbb{R}^n ;
18. Angle and orthogonality in inner product spaces; and
19. Orthogonal and orthonormal bases: Gram-Schmidt process.

Methods of Instruction

Methods of Instruction

Types	Examples of learning activities
Lecture	Lecture Examples: Lecture on the Gram-Schmidt process. Lecture on using Gauss-Jordan elimination.
Discussion	Discussion Examples: Meet with your group to discuss special matrices; diagonal, triangular and symmetric. Meet with your group to discuss matrix generated spaces.
Activity	Activity Examples: Find the inverse matrix for given matrices. Find the dot product and angle between two vectors. Determine if they are orthogonal.

Online Adaptation

Types	Examples of learning activities
Lecture	View pre-recorded lectures or attend synchronous lectures on course content. For example: Lecture on the Gram-Schmidt process. Lecture on using Gauss-Jordan elimination.
Discussion	Discussion Examples: In your your group, discuss special matrices; diagonal, triangular and symmetric. In your group discuss matrix generated spaces.
Activity	Activity Examples: Find the inverse matrix for given matrices. Find the dot product and angle between two vectors. Determine if they are orthogonal.

Instructor-Initiated Online Contact Types

Announcements/Bulletin Boards
Chat Rooms
Discussion Boards
E-mail Communication
Video or Teleconferencing

Student-Initiated Online Contact Types

Chat Rooms
Discussions
Group Work

Course design is accessible

Yes

Methods of Evaluation

Methods of Evaluation

Types	Examples of classroom assessments
Exams/Tests	<p>Traditional exams including a final exam. Except in the event of an emergency, exams should be proctored in person.</p> <p>Exams could include finding eigenvalues and eigenvectors.</p> <p>Exams could include determining linear independence or dependence.</p>
Quizzes	Quizzes on class material
Projects	Group or individual vector space projects.
Homework	Homework problems from textbook.
Other	<p>The Mathematics Department maintains a commitment to diverse teaching methods in courses emphasizing vital quantitative skills and qualitative reasoning ability. To that end, it is expected that sufficient formative assessments will be given to students that in frequency, length and rigor adequately assess both quantitative skills and qualitative reasoning.</p> <p>1) An exam including linear transformations where students would be expected to verify appropriate axioms, determine the standard matrix of linear transformations, find the inverse of a matrix, calculate the determinant and use the result to determine if the matrix is invertible, determine if vectors are linearly independent, solve the matrix equation $Ax = b$ in parametric form and based on that write the geometric description of the solution, solve an application problem involving linear systems, e.g., balancing chemical equations.</p> <p>2) An exam including vector spaces where the student would be expected to verify axioms for a vector space with standard and non-standard operations, subspaces where students would be expected to verify appropriate axioms, determine whether a set of vectors is linearly independent, find a basis for the null space of a matrix, and perform a change of basis on a vector given two bases.</p>

Assignments

Reading Assignments

1. Read Chapter 1 on linear systems.
2. Read Chapter 3 on determinants.

Writing Assignments

Daily homework assignments from the text such as:

1. Calculating the determinant of a matrix.
2. Diagonalizing a linear transformation.

Outside-of-Class Assignments

Other assignments such as research into applications or group projects assigned at instructors' discretion.

SECTION F - Textbooks and Instructional Materials

Material Type

Open Educational Resource (OER)

Author

David Austin

Title

Understanding Linear Algebra

Edition/Version

Summer 2025 Updated Version

Publisher

PreTeXt

Year

2025

SECTION G - Diversity, Equity and Inclusivity

How does your course and/or course outline of record reflect strategies for accommodating and engaging diverse student populations, advancing equitable outcomes, and fostering inclusion for all students?

This course supports diverse student populations through the use of multiple representations of concepts, varied applications, and technology. Strategies may also include collaborative learning, transparent assessment practices, low-cost resources, and opportunities for students to connect course material to their own experiences, fostering equitable outcomes and an inclusive classroom environment.

Course Codes (Admin Only)

CB00 State ID

CCC000291468

CB10 Cooperative Work Experience Status

N - Is Not Part of a Cooperative Work Experience Education Program

CB11 Course Classification Status

Y - Credit Course

CB13 Special Class Status

N - The Course is Not an Approved Special Class

CB23 Funding Agency Category

Y - Not Applicable (Funding Not Used)

CB24 Program Course Status

Program Applicable

Allow Pass/No Pass

No

Only Pass/No Pass

No