MATH R134: LINEAR ALGEBRA

Originator
jzuniga

College
Oxnard College

Discipline (CB01A)
MATH - Mathematics

Course Number (CB01B)
R134

Course Title (CB02)
Linear Algebra

Banner/Short Title
Linear Algebra

Credit Type
Credit

Start Term
Fall 2021

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. Students will investigate 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. C-ID: MATH 250.

Taxonomy of Programs (TOP) Code (CB03)
1701.00 - Mathematics, General

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
Will not be required

Grading method
Letter Graded

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
52.5
Total Maximum Contact/In-Class Hours
52.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
105
Maximum Outside-of-Class Hours
105

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
157.5
Total Maximum Student Learning Hours
157.5

Minimum Units (CB07)
3
Maximum Units (CB06)
3

Prerequisites
MATH R121

Requisite Justification

Requisite Type
Prerequisite

Requisite
MATH R121

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	Students will perform basic operations involving matrices and determinants.
2	Students will find the dimension of spaces such as those associated with matrices and linear transformations.

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

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

Lecture/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 R^n
7. Real vector space and subspaces
8. Linear independence / dependence, and spanning
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 R^n
18. Angle and orthogonality in inner product spaces
19. Orthogonal and orthonormal bases: Gram-Schmidt process

Laboratory or Activity Content

None

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Problem solving exercises

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Group projects
Individual projects
Mathematical proofs
Objective exams
Oral presentations
Problem-Solving Assignments
Problem-solving exams
Quizzes
Skills demonstrations
Skill tests

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Collaborative group work
Class activities
Class discussions
Distance Education
Group discussions
Instructor-guided use of technology
Lecture

Small group activities

Describe specific examples of the methods the instructor will use:

Problem solving exercises from the textbook.

Suppose a 3x5 coefficient matrix for a system has three pivot columns. Is the system consistent? Why or why not?

Suppose a system of linear equations has a 3x5 augmented matrix whose fifth column is a pivot column. Is the system consistent? Why or why not?

The instructor will show how to proof that mathematical statements related to linear algebra are true/false staments.

Let *A* and *P* be square matrices, with *P* invertible. Show that $\det(PAP^{-1})=\det A$.

Suppose that *A* is a square matrix such that $\det(A^3)=0$. Explain why *A* cannot be invertible.

Representative Course Assignments

Writing Assignments

Writing structured algebraic proofs using proper mathematic notation, for example:
"Prove that the determinant of the inverse of matrix A is equal to the reciprocal of the determinant of A."

Critical Thinking Assignments

Compare the relationship between a invertibility of thecoefficient matrix and the solutions to a system of linear equations.

Participate in class and small group discussion about the different forms the invertible matrix theorem is applied.

Reading Assignments

Critical reading and thinking skills in application problems, for example:
"You need to buy some filing cabinets. You know that Cabinet X costs $10 per unit, requires six square feet of floor space, and holds eight cubic feet of files. Cabinet Y costs $20 per unit, requires eight square feet of floor space, and holds twelve cubic feet of files. You have been given $140 for this purchase, and the office has room for no more than 72 square feet of cabinets. How many of each model should you buy to maximize storage volume?"

Other assignments (if applicable)

Understanding of mathematical computational procedures, for example:
"Find the eigenvalues and eigenvectors for the given matrix."

Outside Assignments

Representative Outside Assignments

1. Reading assignments.

We will learn how an augmented matrix, a vector equation, and system of linear equations have the same solution set. We will study how the invertibility of a square matrix can help us determine if system of linear equations has a solution or not, if the columns in the matrix are linearly independent, etc. from the invertible matrix theorem.

2. Practice problems - The purpose of homework is to practice and develop the concepts presented in class.

Example:

a. Let $\mathbf{v}=[1, -3, 2]$, $\mathbf{v}_2=[-3, 9, 6]$, $\mathbf{v}_3=[5,-7,h]$. Justify each answer.
   i. For what values of *h* is $\mathbf{v}_3$ in Span$\{\mathbf{v}_1,\mathbf{v}_2\}$, and
   ii. For what values of *h* is $\{\mathbf{v}_1,\mathbf{v}_2,\mathbf{v}_3\}$ linearly independent?

b. If *L* is *nxn* and the equation $L\mathbf{x}=\mathbf{0}$ has the trivial solution, do the columns of *L* span R^n? Why?

Articulation

C-ID Descriptor Number

MATH 250

Status

Approved

Comparable Courses within the VCCCD

MATH M31 - Introduction To Linear Algebra
MATH V22 - Introduction to Linear Algebra

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Lay, D., Lay, S., and McDoland, J. (2021). *Linear Algebra And It's Applications* (6th). Pearson, New York.

Resource Type
Software

Description
MyMathLab student access. Pearson, New York.

Distance Education Addendum

Definitions

Distance Education Modalities

Hybrid (51%–99% online)
Hybrid (1%–50% online)
100% online

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.

Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.

Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Students will post a discussion board topic. Students will complete homework, quizzes, exams, and group projects via Canvas.
Other DE (e.g., recorded lectures)	Students will watch online lecture videos.
E-mail	Respond to specific email questions.

Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Students will post a discussion board topic. Students will complete homework, quizzes, exams, and group projects via Canvas.
Synchronous Dialog (e.g., online chat)	Students will share their thoughts via the discussion board. Students will interact with instructor and peers through online via Zoom.
Other DE (e.g., recorded lectures)	Students will watch online lecture videos.
E-mail	espond to specific email questions.

100% online Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Students will post a discussion board topic. Students will complete homework, quizzes, exams, and group projects via Canvas.
Synchronous Dialog (e.g., online chat)	Students will share their thoughts via the discussion board. Students will interact with instructor and peers through online via Zoom.
Other DE (e.g., recorded lectures)	Students will watch online lecture videos.
E-mail	Respond to specific email questions.

Examinations

Hybrid (1%–50% online) Modality

Online
On campus

Hybrid (51%–99% online) Modality
Online
On campus

Primary Minimum Qualification
MATHEMATICS

Review and Approval Dates

Department Chair
09/02/2020

Dean
09/02/2020

Technical Review
09/09/2020

Curriculum Committee
09/09/2020

Curriculum Committee
12/09/2020

CCCCO
MM/DD/YYYY

Control Number
CCC000536686

DOE/accreditation approval date
MM/DD/YYYY