MATH 337: Linear Algebra
Spring 2025 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: Matrices, determinants, systems of linear equations, vector spaces, linear transformations, eigenvalues, eigenvectors, and related topics.

Number of Credits: 3

Prerequisites: MATH 112 with a grade of C or better or MATH 133 with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 337-002	Professor J. Luke
Math 337-004	Professor T. Nguyen
Math 337-006	Professor E. Lushi
Math 337-008	Professor T. Askham
Math 337-010	Professor J. Luke
Math 337-102	Professor J. Porus

Office Hours for All Math Instructors: Spring 2025 Office Hours and Emails

Required Textbook:

Title	*A First Course in Linear Algebra*
Author	Ken Kuttler
Edition	Version 2021 A
Publisher	Lyryx Learning Inc
Link	Available in Canvas

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 1, 2024**. It will be strictly enforced.

COURSE GOALS

Course Objectives:

The course seeks to develop

- understanding of the fundamental concepts of linear structure that support theoretical, applied and computational analysis primarily in finite dimensional vector spaces including linear combination, span, linear independence, basis and dimension, Euclidean structure, matrices and linear transformations, invertibility, rank, fundamental, and determinant,
- understanding of the fundamental algorithms of elementary linear algebra, Gaussian elimination and the Gram-Schmidt process, including proficiency in implementation both with pen and paper and by computer program,
- the ability to use linear theory, including spectral theory, to analyze problems common in applications including systems of linear equations, detection of linear dependence relations, LU factorization, diagonalization, orthogonalization, QR factorization, least squares solutions, and the singular value decomposition,
- basic computational proficiency, both with pen and paper and by computer program, with the use of the fundamental algorithms of elementary linear algebra for the solution of common problems including those listed above,
- mastery of the basic elements of two fundamental problems of linear algebra, solving linear systems and diagonalizing matrices, from both a theoretical and computational perspective.
- the capacity to apply linear algebra through treatment of applications such as balancing chemical equations, linear dynamics, and computer graphics.

Course Outcomes:

Students will be able to

- understand and utilize the basic concepts and methods of linear algebra to analyze basic applied problems,
- solve linear equations of equations and find eigenvalues and eigenvectors to enable diagonalization,
- implement basic solutions to problems of applied linear algebra both by hand and computer program (MATLAB),
- apply their understanding of linear algebra in appropriately formulated applications.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Quizzes	10%
Submitted Homework	10%
MATLAB Assignments	10%
Midterm Exams	20% (x2)
Final Cumulative Exam	30%

Your final letter grade will be based on the following tentative curve.

A	90 - 100	**C**	70 - 74
B+	85 - 89	**D**	50 - 69
B	80 - 84	**F**	0 - 50
C+	75 - 79		

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced.

Religious Observance: NJIT is committed to supporting students observing religious holidays. Students must notify their instructors in writing of any conflicts between course requirements and religious observances, ideally by the end of the second week of classes and no later than two weeks before the anticipated absence.

> **AI Usage Policy**: AI usage is not permitted in this course for solving problems in-class/homework assignments, quizzes, and exams. Violation of the policy will result in a grade of zero on any impacted assignment(s) and will be reported to the dean of students for supplemental discipline.

Nature of the Course. This is a first course in applied linear algebra. Hence, computation, in addition to the essential theory, has a central role. Learning and practicing techniques for computation, both with pen and paper and by electronic computer, are a major emphasis. Applications and modelling, though less central than computation, are given significant attention. Due to the applied audience of this course, the technical aspects of mathematical proof are deemphasized. Technical terms from logic, such as *modus ponens*, *quod erat demonstrandum*, or *reductio ad absurdum*, are only rarely encountered. Nevertheless, mathematics must be understood as precisely and exactly as possible and focus on statements of fact (theorems) that are always true for reasons that are understood. Finally, the multifold nature of the course requires substantial amounts of time to understand the theory, practice computations and understand examples of application. Students should plan, at a minimum, to use the full 9 hours per week for the course expected under the regulations of the Middle State Commission and New Jersey Department of Higher Education.

Course Lessons: The primary material for the course is contained in 25 lessons (MATLAB live scripts posted in Canvas). The textbook is a secondary source used primarily for reference. It is recommended that lessons be read before they are covered in class and reviewed with care in preparation for exams.

Common Quizzes: Online common quizzes will focus on a collection of 15 fundamental computations that are foundational for the course. The intention of the quizzes is to provide students an opportunity to begin mastery of these crucial computations on which so much of the course depends. Full preparation for exams will generally require regular practice beyond these initial quizzes. Instructors may supplement the common quizzes with quizzes specifically for their sections.

Follow-up Problems: For each of the 25 lessons in the course there are follow-up problems with complete solutions provided. Full preparation for exams will include careful study of these problems. It is recommended that students attempt to solve problems on their own before consulting the solutions. These follow-up problems are neither collected nor graded, though the attention to these problems is transparently obvious on exams.

Submitted Homework: For each of the 25 lessons in the course there is a worksheet, posted in Canvas and designated as "Spot-Check Homework." Each of these worksheets should be completed and submitted on paper to the instructor at the class meeting following the completion of the lesson. Late submissions are accepted only in case of excused absences verified by the Office of the Dean of Students. These worksheets are designed to be straightforward and brief once an adequate understanding of the lesson material is obtained. These worksheets are graded on an all-or-nothing basis. That is, credit is awarded only for papers that are essentially completely correct. Moreover, to receive credit solutions must be presented neatly and orderly without extraneous material. N.B. Though students may work together and even review the work of others, work submitted must be that of the submitter and not copied from other students or other sources.

MATLAB Projects: Periodic MATLAB projects will cover the implementation and use of basic algorithms in linear algebra. The coding of the algorithms is not only a tool of application but also a pathway for understanding. Common exams will feature problems requiring proficiency with MATLAB implementation of basic algorithms.

Exams: There will be two exams during the semester and a cumulative final exam during the final exam week:

Common Exam I	February 19, 2025
Common Exam II	April 9, 2025
Final Exam Period	May 10 - May 16, 2025

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

For a single midterm exam missed with an excuse verified by the Office of the Dean of Students, the grade of the final exam will be applied to the missed exam. N.B. Math Department's Examination Policy: "Students missing TWO OR MORE exams cannot demonstrate mastery of the course material and, therefore, cannot complete the course successfully within a given semester."

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2025 Hours)

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please If you need an accommodation due to a disability please contact the Office of Accessibility Resources and Services at oars@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

https://www.njit.edu/accessibility/

Important Dates (See: Spring 2025 Academic Calendar, Registrar)

Date	Day	Event
January 21, 2025	Tuesday	First Day of Classes
January 27, 2025	Monday	Last Day to Add/Drop Classes
March 16, 2025	Sunday	Spring Recess Begins
March 22, 2025	Saturday	Spring Recess Ends
April 3, 2025	Thursday	Wellness day
April 7, 2025	Monday	Last Day to Withdraw
April 18, 2025	Friday	Good Friday - No Classes
April 20, 2025	Sunday	Easter Sunday - No Classes Scheduled
May 6, 2025	Tuesday	Thursday Classes Meet
May 7, 2025	Wednesday	Friday Classes Meet
May 7, 2025	Wednesday	Last Day of Classes

May 8, 2025	Thursday	Reading Day 1
May 9, 2025	Friday	Reading Day 2
May 10 - May 16, 2025	Friday to Thursday	Final Exam Period

Course Outline (schedule may vary at instructor discretion)

Meeting	Lesson	Topic
1	I.1	Column Vectors, Linear Combinations, Lengths and Angles
2	I.2	Small Linear Systems and Clipping
3	I.3	Gauss-Jordan I: Preliminaries
4	I.4	Gauss-Jordan II: Implementation
5	I.5	Parametric Vector Form
6	I.6	Vectors and Matrices
7	I.7	Matrix Inverse
8	R.1	Common Exam I Review
9	II.1	Matrix Factorization with Elementary Matrices
10	II.2	Orthogonal Matrices
11	II.3	Projection Matrices
12	II.4	Determinants
13	II.5	Characteristic Polynomials and 2x2 Diagonalization
14	II.6	Span, Independence and Basis
15	II.7	The Four Fundamental Subspaces
16	II.8	The 3x3 Diagonalization Problem
17	II.9	Orthogonal Projection, Least Squares and Linear Regression
18	II.10	The nxn Diagonalization Problem
19	R.2	Common Exam II Review
20	III.1	Discrete Linear Dynamics
21	III.2	Continuous Linear Dynamics
22	III.3	Gram Schmidt & QR
23	III.4	Orthogonal Diagonalization
24	III.5	Singular Value Decomposition I
25	III.6	Singular Value Decomposition II
26	III.7	Singular Value Decomposition III
27	III.8	Geometry of Linear Maps on the Plane
28	R.3	Final Exam Review