MATH 337: Linear Algebra
Spring 2022 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.

DMS Online Exam Policy Spring 2022: In the event it is determined that DMS will conduct Common Exams online during Spring 2022, those exams will be administered in Canvas with proctoring using both Respondus LockDown Browser+Monitor on a computer (PC or Mac only; iPad and Chromebooks are not currently supported) and Webex on a phone or secondary device.

Please be sure you read and fully understand our DMS Online Exam Policy.

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 Y. Boubendir
Math 337-004	Professor E. Lushi
Math 337-006	Professor K. Carfora
Math 337-010	Professor C. Frederick
Math 337-102	Professor J. Ro

Office Hours for All Math Instructors: Spring 2022 Office Hours and Emails

Required Textbook:

Title	*Linear Algebra and its Applications*
Author	Lay
Edition	5th
Publisher	Pearson
ISBN #	978-0321982384

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 4, 2022**. 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 including $\mathbf{R}^n$ and $\mathbf{C}^n$, linear combination, span, linear independence, basis and dimension, Euclidean structure, matrices and linear transformations, invertibility, rank, null space, column space, and determinant,
- understanding of the fundamental algorithms of elementary linear algebra, Gaussian elimination and the Gram-Schmidt process, including proficiency in implementation with pen and paper and by computer program,
- the ability to use linear theory to analyze problems common in applications including systems of linear equations, detection linear dependence relations, LU factorization, eigenvalue problems, orthogonalization, QR factorization, least squares solutions, and analysis of quadratic forms,
- basic 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,
- the capacity to apply linear algebra through treatment of applications such as balancing chemical equations and computer graphics.

Course Outcomes:

Students will be able to

- understand and utilize the basic concepts, algorithms and problems of linear algebra to analyze basic applied problems,
- implement solutions to the basic 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	15%
MATLAB Assignments	15%
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**	60 - 69
B	80 - 84	**F**	0 - 59
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.

Quizzes: Regular online quizzes will focus on a collection of forteen fundamental computations that are foundational for the course. The intention of the quizzes is to provide students an opportunity to master these crucial computations on which much of the course depends.

MATLAB Projects: Regular 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.

Homework: Homework problems are assigned for each lecture (see outline below). These assignments are the broadest preparation for exams—especially for the theoretical aspects of the subject. These are not collected or graded; instructors, however, will assume that students have completed these assignments in subsequent lectures. Students having difficulties solving problems in these assignments are encouraged to get help as soon as possible to remain ready to learn new material as it is presented.

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

Midterm Exam I	Wednesday, February 23, 2022
Midterm Exam II	Wednesday, April 13, 2022
Final Exam Period	May 6 - 12, 2022

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.

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 2022 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 contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@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/studentsuccess/accessibility/

Important Dates (See: Spring 2022 Academic Calendar, Registrar)

Date	Day	Event
January 18, 2022	Tuesday	First Day of Classes
January 22, 2022	Saturday	Saturday Classes Begin
January 24, 2022	Monday	Last Day to Add/Drop Classes
March 14, 2022	Monday	Spring Recess Begins
March 19, 2022	Saturday	Spring Recess Ends
April 4, 2022	Monday	Last Day to Withdraw
April 15, 2022	Friday	Good Friday - No Classes
April 17, 2022	Sunday	Easter Sunday - No Classes
May 3, 2022	Tuesday	Friday Classes Meet
May 3, 2022	Tuesday	Last Day of Classes
May 4 - May 5, 2022	Wednesday and Thursday	Reading Days
May 6 - May 12, 2022	Friday to Thursday	Final Exam Period

Course Outline

The course outline below indicates the material covered on the exams. Individual instructors may choose to vary the order and organization of the material. All should be aware that following the first common exam the pace of the course increases consistently.

Lecture #	Section #	Subject Topic and Homework (HW) Assignment
1	1.1	*Linear Systems* *#2, 4, 10, 15, 18, 24, 29-32*
2	1.2	*Row Reduction and Row Echelon Forms* *#2, 4, 8-11, 13, 18, 20*
3	supplements	*Implementation of the Gauss-Jordan algorithm* *All exercises in the write-ups*
4	1.3	*Vector Equations* *#2, 5, 9, 11, 13, 17, 24*
5	1.4	*Matrix Equations* *#2, 4, 5 ,9, 17, 31*
6	1.5 &1.6	*Solution Sets of Linear Systems & Balancing Chemical Equations* *1.5:#1, 4, 6, 8, 11, 15, 23* *1.6:#7, 9*
7	1.7	*Linear Independence* *#1, 4, 6, 7, 14, 16, 31*
8	1.8	*Linear Transformations* *#2, 4, 7, 9, 13, 15, 22*
9	1.9	*The Matrix of a Linear Transformation* *#5, 7, 10, 15, 18, 20, 23, 25*
Common Exam I - Wednesday, February 23		
10	2.1&2.2	*Matrix Operations & Inverse Matrix* *2.1:* #4, 7, 9, 16, 23
11	2.2&2.3	*Inverse Matrix & Invertibility* *2.2: #4, 7, 16, 23, 33* *2.3: #2, 6, 9, 11, 13, 14, 23, 41*
12	2.5	*Matrix Factorizations* *#2, 4, 5, 8, 11, 15, 17*
13	2.4 & 2.7	*Partitioned Matrices & Computer Graphics* *2.4: #1-8, #25* *2.7: #1-10*
14	2.8 & 2.9	*Fundamental Subspaces of a Matrix & Dimension and Rank* *2.8: #1, 5, 18-20, 23-27* *2.9: #5, 9, 10, 11, 12, 17, 18*
15	3.1 & 3.2	*Determinants*

		3.1: #3, 4, 18, 19-22, 25-30 *3.2: #1, 4, 6, 9, 21, 22, 25, 26, 27, 28*
16	3.2 & 3.3	*Cramer's Rule* *3.3: #2, 5, 8, 11, 16*
17	5.1 & 5.2	*The Eigenvalue Problem* *5.1: #3, 7, 9, 13, 15, 17, 20* *5.2: #4, 7, 9, 13, 15, 16, 20, 21*
18	5.2 & 5.3	*Diagonalization* *#2, 4, 6, 7, 8, 12, 17, 21*
19	5.4 &5.5	*Eigenvectors and Linear Transformation & Complex Eigenvalues* *5.4: #1, 11, 12, 19-22* *5.5: #4, 5, 13, 14*
20	5.5 & supplement	*Complex Eigenvalues and Powers of Matrices*
Common Exam II – Wednesday, April 13		
21	6.1 & 6.2	*Length and Angles and Orthogonal Sets* *6.1: #1, 8, 10, 12, 14, 15, 16, 20* *6.2: #1, 4, 8, 12, 16, 17, 20, 23*
22	6.2 & 6.3	*Orthogonal Sets & the Orthogonal Projection* *6.3: #2, 4, 6, 8, 10, 12, 14, 16*
23	6.4	*The Gram-Schmidt Orthonormalization Process and the QR Factorization* *6.4: #1, 12, 16*
24	6.5 & 6.6	*Least-Squares Problems & Applications to Linear Models* *6.5: #1, 5, 17, 18* *6.6: #1, 7, 10*
25	7.1 & 7.2	*Symmetric Matrices and Quadratic Forms* *7.1: #1-10, 14, 17, 22, 26* *7.2: #2, 5, 7, 10, 13, 21*