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Spring 2024

MATH 337: Linear Algebra

Mathematical Science Department

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MATH 337: Linear Algebra
Spring 2024 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 E. Lushi
Math 337-006	Professor J. Luke
Math 337-008	Professor R. Goodman
Math 337-102	Professor M. Potocki-Dul

Office Hours for All Math Instructors: Spring 2024 Office Hours and Emails

Required Textbook:

Title	*A First Course in Linear Algebra*
Author	K. Kuttler and I. Farah
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	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.

Common Quizzes: Online quizzes, given on a roughly weekly basis, will focus on a collection of fourteen 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 much of the course depends. Instructors may supplement the common quizzes with quizzes specifically for their sections.

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.

Homework: Homework assignments are provided to assist students to develop their understanding and skills with linear algebra. These assignments are neither collected or graded. Students should develop and use judgment as to which exercises are needed for them to develop adequate understanding of the material. The standing advice, particularly at the beginning of the course, is that it is better to do too much than too little. Students are urged to seek assistance with problems and exercises with which they have struggled unsuccessfully.

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

Common Exam I	
Common Exam II	
Final Exam Period	May 3 - May 9, 2024

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 2024 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 2024 Academic Calendar, Registrar)

Date	Day	Event
January 16, 2024	Tuesday	First Day of Classes
January 22, 2024	Monday	Last Day to Add/Drop Classes
March 10, 2024	Sunday	Spring Recess Begins
March 16, 2024	Saturday	Spring Recess Ends
March 29, 2024	Friday	Good Friday - No Classes
April 1, 2024	Monday	Last Day to Withdraw
April 30, 2024	Tuesday	Friday Classes Meet
April 30, 2024	Tuesday	Last Day of Classes
May 1, 2024	Wednesday	Reading Day 1
May 2, 2024	Thursday	Reading Day 2
May 3 - May 9, 2024	Friday to Thursday	Final Exam Period

Course Outline

The lecture schedule is suggested only and will vary depending on the section instructor's discretion.

Meeting	Lesson	Topic
1	I.1	Preview and Review I
2	I.2	Review II
3	I.3	Gauss-Jordan I (row echelon forms and row operations)
4	I.4	Gauss-Jordan II (forward, normalization, backward; by hand & by MATLAB)
5	I.5	Parametric Vector Form
6	I.6	Vectors and Matrices (operations, inner & outer product, Cauchy-Schwarz & triangle)
7	I.7	Matrix Inverse
8	I.8	Matrix Factorization with Elementary Matrices (LU, LDU, LDUxrref(A), Cxrref(A), ~Cx~R)
9	I.9	Linear Transformations
10	R.1	Common Exam I Review
11	II.1	Families of Matrices (Gram matrices, orthogonal columns, orthogonal matrices, projections, orthogonal projections, stochastic, doubly stochastic, permutations)
12	II.2	Determinants
13	II.3	Characteristic Polynomials
14	II.4	Euclidean Geometry
15	II.5	Span, Independence and Basis
16	II.6	Four Fundamental Subspaces
17	II.7	Eigenvectors
18	II.8	Gram-Schmidt & QR
19	II.9	Orthogonal Projection, Least Squares and Linear Regression
20	II.10	Diagonalization
21	II.11	Discrete Linear Dynamics

22	R.2	Common Exam II Review
23	III.1	Continuous Linear Dynamics
24	III.2	Orthogonal Diagonalization
25	III.3	Singular Value Decomposition I
26	III.4	Singular Value Decomposition II
27	III.5	Things not covered
28	R.3	Final Exam Review

Updated by Professor J. Luke - 1/5/2024
Department of Mathematical Sciences Course Syllabus, Spring 2024