NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 631 : Linear Algebra
Fall 2018 Graduate 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: Similar in aim and content to MATH 630 but with more emphasis on mathematical rigor. Linear systems of equations, matrix algebra, linear spaces, orthogonality, eigenvalues and eigenvectors, diagonalization, and matrix decomposition. Applications.

Number of Credits: 3

Prerequisites: MATH 222 and MATH 337, or departmental approval.

Course-Section and Instructors

Course-Section	Instructor
Math 631-001	Professor E. Michalopoulou

Office Hours for All Math Instructors: Fall 2018 Office Hours and Emails

Required Textbooks:

Title	*Matrix Theory*
Author	Joel Franklin
Edition	2000 ed.
Publisher	Dover Publications
ISBN #	978-0486411798

University-wide Withdrawal Date:The last day to withdraw with a **W** is **Monday, November 12, 2018**. It will be strictly enforced.

REFERENCE TEXTS

- *Applied Numerical Linear Algebra* by James Demmel, SIAM, 1st Edition
- *Applied Linear Algebra* by Ben Noble and James Daniel, Pearson, 3rd Edition
- *Numerical Linear Algebra and Applications* by Biswa Nath Datta, SIAM, 2nd Edition

The three texts are on reserve at the library.

COURSE GOALS

Course Objectives

- To develop the concepts needed to perform matrix algebra.
- To solve systems of equations.
- To learn the concept of eigenvalues and eigenvectors and how to find them; to understand how eigenvalues and eigenvectors are used to solve science and engineering problems.
- To learn matrix decomposition methods and where they are useful.
- To learn how to use numerical methods to efficiently and effectively solve linear algebra problems.

Course Outcomes

- Students demonstrate the understanding of linear equations and what approaches should be taken to solve them.
- Students demonstrate the understanding of the role of eigenvalues and how they can be used in decompositions for solving complex problems in the sciences and engineering.
- Students demonstrate the ability to apply numerical methods to solve linear algebra problems with accuracy, precision, and efficiency.

Course Assessment: Assessment will be performed with homework assignments, a midterm exam, and a final exam that will test the understanding of the above concepts. Assignments will be posted on moodle.

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:

Homework	25%
Midterm Exam	35%
Final Exam	40%

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

A	87 - 100	**C+**	65 - 70
B+	81 - 86	**C**	55 - 64
B	71 - 80	**F**	< 55

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.

Exams: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

Midterm Exam	October 24, 2018
Final Exam Period	December 15 - 21, 2018

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: To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

- http://math.njit.edu/students/policies_exam.php

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

ADDITIONAL RESOURCES

Accommodation of Disabilities: Disability Support Services (DSS) 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 Chantonette Lyles, Associate Director of Disability Support Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Fenster Hall, Room 260. A Letter of Accommodation Eligibility from the Disability Support 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 Disability Support Services (DSS) website at:

- http://www5.njit.edu/studentsuccess/disability-support-services/

Important Dates (See: Fall 2018 Academic Calendar, Registrar)

Date	Day	Event
September 4, 2018	T	First Day of Classes
September 10, 2018	M	Last Day to Add/Drop Classes
November 12, 2018	M	Last Day to Withdraw
November 20, 2018	T	Thursday Classes Meet
November 21, 2018	W	Friday Classes Meet
November 22 - 25, 2018	R - Su	Thanksgiving Recess
December 12, 2018	W	Last Day of Classes
December 13 & 14, 2018	R & F	Reading Days
December 15 - 21, 2018	Sa - F	Final Exam Period

Course Outline

Lecture	Chapter	Topic
1 - 3	1	Determinants and their Properties, Matrix Arithmetic, the Inverse of a Matrix and Cramer's rule, Derivatives of Determinants.
4 - 7	2	Theory of Linear Equations, Vector Spaces, Subspaces , Span, Basis, Dimension, Rank, General Linear Systems, Least-squares Solutions, Elementary Row Operations, LU Decomposition.
8 - 12	4	Eigenvalues, Eigenvectors and Canonical Forms, Unitary Matrices, the Gram-Schmidt Process, Hermitian Matrices, Positive Definiteness, Shur's Theorem - Unitary Triangularization, Normal Matrices.
13	3	Application of Matrix Analysis to Differential Equations, Exponential of a Matrix, Solution of Differential Equations by Eigenvalues and Eigenvectors.

14	**REVIEW**	
15	**MIDTERM EXAM - OCTOBER 24, 2018**	
16	3	Continuation: Application of Matrix Analysis to Differential Equations, Exponential of a Matrix, Solution of Differential Equations by Eigenvalues and Eigenvectors.
17 - 20	6	Variational Principles and Perturbation Theory, the Rayleigh Principle, the Courant Minimax Theorem, the Inclusion Principle, Criteria for Positive Definiteness, Hadamard's Inequality, Weyl's Inequality, Gershgorin's Theorem.
19 - 22	6	Variational Principles and Perturbation Theory, the Rayleigh Principle, the Courant Minimax Theorem, the Inclusion Principle, Criteria for Positive Definiteness, Hadamard's Inequality, Weyl's Inequality, Gershgorin's Theorem.
21 - 27		Numerical Linear Algebra (topics include LU decomposition, SVD, iterative methods for linear systems, eigenvalue and eigenvector computation, Givens and Householder transformations).
28	**REVIEW FOR FINAL EXAM**	