

MA 405 Course Syllabus

MA 405 - Introduction to Linear Algebra

Section 002

Spring 2020

3 Credit Hours

Course Description

Linear Algebra provides one of the cornerstones for much of modern Mathematics, and has important applications in Physics, Engineering, and Economics. The main purpose of this course is to introduce the basic concepts from linear algebra, explain the underlying theory, the computational techniques, and study how these concepts and results can be productively used in other areas of mathematics and physical sciences, especially in applied mathematics where multivariable models are involved.

Among the topics covered in this course will be: solving systems of linear equations using Gauss elimination, row echelon form, determinants, vector spaces, linear independence, bases, dimension, linear transformations, orthogonality, eigenvalues, and reduction of matrices to diagonal forms. If time permits, we will discuss applications of linear algebra to differential equations and/or quadratic forms. The subject involves a mixture of both the practical and the theoretical, and will provide in particular a good introduction to mathematical proofs. For this reason, the course is considered to be a difficult one in undergraduate mathematics, and the student should be prepared to invest considerable amount of time in understanding the class material and doing homework.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. **Use Mathematical Notation and Terminology.** The students will demonstrate mastery in using the mathematical notation and terminology of linear algebra. Students will read, interpret, and use the vocabulary, symbolism and basic definitions.
2. **Understand and Describe the Fundamental Concepts of Linear Algebra.** Students will identify and apply the theorems about abstract vector spaces and linear transformations; will gain a clear understanding of the basic concepts of linear algebra,

such as linear independence of vectors, spanning sets, basis, similarity, eigenvalues and eigenvectors.

- 3. Identify and Utilize Linear Algebra Tools.** The students will be able to apply course material along with techniques and procedures covered in this course to solve problems. Students will master techniques for solving linear systems by various matrix methods, compute the determinant and the inverse of a square matrix, compute various factorizations of matrices, apply the Gram-Schmidt process, calculate and analyze the characteristic equation of a matrix to determine its eigenvalues and eigenvectors. Moreover, students will apply properties and theorems about vector spaces to specific mathematical structures that satisfy the vector space axioms, will analyze the differences and similarities between spanning sets, bases, and orthogonal bases and will use the knowledge gained in this course to determine appropriate methods of proof for specific problems.
- 4. Develop Cognitive Skills.** Students will demonstrate the ability to reason with abstract linear algebra concepts, to read and comprehend mathematical arguments utilizing direct and indirect proof, case analysis, and mathematical induction. Students will develop familiarity with axiomatic approach in mathematics through the study of vector spaces and linear transformations. They will acquire a level of proficiency in manipulating linear algebra concepts, in analyzing and evaluating their applicability in their future studies, including graduate work, in academic areas requiring linear algebra as a prerequisite for work in occupational fields requiring a background in linear algebra.

Course Structure

The course is lecture-based.

Course Policies

Homework Format

Students may type homework/project solutions or write solutions on paper. If the student decides to write the solutions on paper, then the handwriting needs to be legible. If the instructor cannot read the student's handwriting then the student will not receive credit for the problem. If students type homework/project

solutions, then the instructor asks that the student submit a hard copy and not an electronic copy.

Office Hours Policy

Students are welcome and encouraged to take advantage of the instructor's office hours. Office hours are a time for students to ask specific questions on material presented in class or related concepts. Office hours are not meant for the instructor to re-teach material or solve homework problems. If students have a specific question about a homework problem, then the instructor will try to help without solving the problem completely for the student. Students who miss class should contact another student in class for notes. The instructor will devote the first 10 mins of each class to answering questions about homework problems from students as long as the students have tried the problems.

Email Policy

Any communication through email between the instructor and the student will be done professionally. Some things to avoid when emailing your instructor: slang, emoticons, lengthy emails, equations, asking for homework extensions. Things to include: a greeting and a subject.

Your instructor will try to answer email within 24 hours of it being sent during the work week (Monday - Friday). If you email your instructor on the weekend then she will respond on Monday. Occasionally, email messages get overlooked. If your email is not answered within 48 hours, feel free to send a reminder email.

Do NOT send homework questions through email. Instead, visit the instructor during her office hours or make an appointment to meet with her or ask during class.

Cell Phone & Electronics Policy

The use of cell phones and electronics in class is highly discouraged. The instructor has a zero tolerance policy for electronics during tests (except calculators when permitted). Any student caught using an electronic or having an electronic visible during a test (including headphones and cell phones in lap) will receive a 0.

Corrections to Grading

If you believe an error has been made in grading on a test, then write a statement making your case and bring it to your instructor. The instructor will give partial credit to a partially correct solution that was neatly presented and does not include a fatal error. What constitutes a fatal error will be discussed during the semester. You have 1 week after the test is returned to request re-grading. Do not alter the original work! If the work looks altered in any way, then the instructor will not change the grade.

Policy on Grade Curving

Other than dropping your lowest homework and quiz grade, I will NOT curve grades in this course. It is theoretically possible for everyone in the class to get an A (or an F). Your performance depends only on how you do, not on how everyone else in the class does. It is therefore in your best interests to study and do all the homework (not only the homework that must be turned in).

Instructor's commitment

You can expect your instructor to be courteous, punctual, well organized, and prepared for lecture and other class activities; to answer questions clearly and in a non-negative fashion; to be available during office hours or to notify you beforehand if they are unable to keep them; to provide a suitable guest lecturer when they are traveling; and to grade uniformly and consistently according to the posted guidelines.

The **Math Multimedia Center** is a tutorial center for undergraduate students that need help in their mathematics courses (100- through 300-level), and is staffed by math graduate students familiar with the material taught in these courses.

Location: SAS Hall 2103/2105

Hours: Monday - Friday 8:00 am - 5:00 pm

You can also get help with your courses (not only math) at the NCSU Undergraduate Tutorial Center.

Instructors

Samantha Kirk (Slkirk) - *Instructor*

Email: slkirk@ncsu.edu

Phone: N/A

Office Location: SAS 3213

Office Hours: To be determined.

Course Meetings

Lecture

Days: MWF

Time: 12:50 PM - 1:40 PM

Campus: Main

Location: 214 Daniels Hall

This meeting is required.

Course Materials

Textbooks

Linear Algebra with Applications - Steven Leon

Edition: 9th

ISBN: 9780321985507

Cost: New: \$140 at book store, but you can buy the book used and online. Both D.H. Hill and Hunt libraries have a copy of this book and you can borrow it for a certain period of time (in hours).

This textbook is required.

Expenses

None.

Materials

None.

Requisites and Restrictions

Prerequisites

MA 241 required

(MA 225 is recommended)

Co-requisites

MA 341 is recommended

Restrictions

None.

General Education Program (GEP) Information

GEP Category

This course does not fulfill a General Education Program category.

GEP Co-requisites

This course does not fulfill a General Education Program co-requisite.

Transportation

This course will not require students to provide their own transportation. Non-scheduled class time for field trips or out-of-class activities is NOT required for this class.

Safety & Risk Assumptions

None.

Grading

Grade Components

| Component | Weight | Details |
|----------------|--------|---|
| Homework | 20% | The instructor will assign a set of homework problems for the students to complete each week. A handful of those problems will need to be turned in for a grade. Students may work together, but they must write their own solutions. The lowest homework grade will be dropped. |
| Projects | 20% | There will be 1-3 projects assigned. Students will be asked to work in groups of 2-3. This projects will be proof-based and students must write their own solutions. More details will be given when the project(s) are assigned. |
| Weekly Quizzes | 10% | You will have a quiz once a week on a day determined by students. The quiz will take ~5 minutes to complete and will be given at the start of class. The lowest quiz grade will be dropped. |
| Midterm | 15% | There will be one closed book, closed notes in-class test. The date will be near the middle of the course and determined by the students. No re-tests will be given. If you miss a test because of an undocumented or unexcused absence, a zero will be entered for that test grade. Students who are unable to take the test and have a documented excuse will be able to schedule an alternate time to take the exam. This should be scheduled as soon as possible after the exam, ideally within a week. |
| Final Exam | 35% | The final exam is mandatory, cumulative and will be held in the usual classroom. The final exam will take place on Friday, May 1st, from 1PM - 4PM. |

Letter Grades

This Course uses Standard NCSU Letter Grading Scale

| | | | | |
|----|---|----|---|-----|
| 97 | ≤ | A+ | ≤ | 100 |
| 93 | ≤ | A | < | 97 |
| 90 | ≤ | A- | < | 93 |
| 87 | ≤ | B+ | < | 90 |
| 83 | ≤ | B | < | 87 |
| 80 | ≤ | B- | < | 83 |
| 77 | ≤ | C+ | < | 80 |
| 73 | ≤ | C | < | 77 |
| 70 | ≤ | C- | < | 73 |
| 67 | ≤ | D | < | 70 |
| 63 | ≤ | D | < | 67 |
| 60 | ≤ | D- | < | 63 |
| 0 | ≤ | F | < | 60 |

Requirements for Credit-Only (S/U) Grading

In order to receive a grade of S, students are required to take all exams and quizzes, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to <http://policies.ncsu.edu/regulation/reg-02-20-15>.

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at <http://policies.ncsu.edu/regulation/reg-02-20-04>.

Policies on Incomplete Grades

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <http://policies.ncsu.edu/regulation/reg-02-50-3>.

Late Assignments

All homework/projects will be assigned at least one week before their due dates. Students are expected to start working on their homework/projects as soon as it is assigned. Homework/projects will be collected on the day it is due at the beginning of class. If the homework is turned in to the instructor after the initial collection on the same day it will receive a 15 point deduction for lateness. Each subsequent day will result in an additional 15 point deduction.

Attendance Policy

For complete attendance and excused absence policies, please see <http://policies.ncsu.edu/regulation/reg-02-20-03>

Attendance Policy

Attendance is expected every day as it is critical for the understanding of the material and not attending class serves as its own penalty because this material takes much longer to learn independently. You are responsible for keeping up with missed work so that you do not fall behind. Office hours will not be utilized to re-teach material presented in class.

Absences Policy

Tests: All anticipated absences must be excused in advance of the test date. These include university duties or trips (certified by an appropriate faculty or staff member), required court attendance (certified by the Clerk of Court), or religious observances (certified by the Department of Parent and Family Services 515-2441). Emergency absences must be reported as soon as possible once returning to class and must be appropriately documented (illness by an attending physician or family emergencies by Parent and Family Services). If you are sick on a test day and decide not to come to class, go to the health center or other medical facility. Students who miss a test and have a university-approved excuse must submit appropriate documentation.

Makeup Work Policy

See policy on late work. If you have an excused absence (sickness that's documented, court attendance, religious observance) for missing a homework assignment then you should talk to instructor as soon as possible. It is at the instructor's discretion to accept makeup work for excused absences. Remember that homework is assigned **at least** 1 week in advance. The longer you have to complete a homework assignment the less likely the instructor will accept makeup homework unless the excuse covers several days.

Additional Excuses Policy

None.

Academic Integrity

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01>

Academic Honesty

See <http://policies.ncsu.edu/policy/pol-11-35-01> for a detailed explanation of academic honesty.

Honor Pledge

Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment."

Electronically-Hosted Course Components

There are no electronically-hosted components for this course.

Accommodations for Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01) (<https://policies.ncsu.edu/regulation/reg-02-20-01/>).

Non-Discrimination Policy

NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation ("Prohibited Conduct") that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively, "Protected Status"). Additional information as to each Protected Status is included in NCSU REG 04.25.02 (Discrimination, Harassment and Retaliation Complaint Procedure). NC State's policies and regulations

covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05> or <https://oied.ncsu.edu/divweb/>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

Course Schedule

NOTE: The course schedule is subject to change.

**Lecture MWF 12:50 PM - 1:40 PM — All the Topics We Plan to Cover —
01/06/2020 - 04/22/2020**

MA405 Tentative Schedule

We will cover the following topics in order. Some lectures may last more than one class period and some less. Any deviations from the order of topics will be pointed out in class. The course is self contained but it is assumed that the student has added vectors, seen matrices, and seen a system of equations before. The numbers in parenthesis are sections in Leon.

- Matrices and Systems of Equations (1.1-1.6)
- Gaussian Elimination
- Determinants (2.1, 2.2)
- Vector Spaces. Examples. Subspaces (3.1,3.2)
- Linear Independence, Basis, coordinates, Dimension (3.3, 3.4)

- Change of Basis, coordinates (3.5)

- Row space, Column space (3.6)
- Null Space/ Rank Theorem.
- Linear Transformations, range, kernel (4.1)

- Matrix representation (4.2)
- Similarity (4.3), isomorphism
- Norms - Supplemental material
- Scalar product in \mathbb{R}^n . Orthogonal subspaces (5.2).
- Inner product Spaces (5.4)
- Orthonormal sets (5.5)
- Gram-Schmidt orthogonalization and examples (5.6, 5.7)
- Eigenvalues & Eigenvectors (6.1)
- Systems of Differential Equations (6.2)
- Eigenspaces, Diagonalization. Similarity (6.3)
- Hermitian matrices (6.4)
- Singular value decomposition (6.5)
- Quadratic forms (6.6)
- Positive definite and nonnegative matrices (6.7, 6.8)
- Orthogonal Complements. Least squares approximation. SVD (A mix of 1.1, 6.5)

- Time permitting we might discuss the Jordan form at the end of the semester.