

## MA 405. Introduction to Linear Algebra and Matrices (Online)

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**Moodle page:** <http://moodle.wolfware.ncsu.edu>

**Lectures** will be posted on the Moodle course site. They should be viewed according to the schedule posted on the Moodle page.

**Communication:** We will be using Zoom for online office hours and the link will be posted in Moodle. I will be available to answer lecture and homework questions on **Tuesdays, 9-10 and Thursdays, 3-4.**

Moodle forums will be used for most communications in this course. You are encouraged to discuss concepts and homework in the forums with your fellow students; the discussions will be monitored by me. There will be no office hours during the testing days and the forum will be disabled. I will read all thoughtful and signed messages/emails but will not promise to answer all of them especially if the information is clearly displayed on the Moodle page.

### Course text

There is no assigned textbook for this course. The class notes and video lectures are available in Moodle. The following texts are good resources but we will not necessarily be following the order of the topics or the notation:

1. *Linear Algebra Done Right*, by Sheldon Axler, Springer International Publishing : Imprint: Springer, 2015 ISBN: 9783319110806 - available through NCSU libraries.
2. *Linear Algebra - A Free text for a standard US undergraduate course*, by Jim Hefferon - link to open source book available in Moodle

### Catalog Description

Prerequisite: MA 241 (Co-requisite MA 242)

This course offers a rigorous treatment of linear algebra, including systems of linear equations, matrices, determinants, abstract vector spaces, bases, linear independence, spanning sets, linear transformations, eigenvalues and eigenvectors, similarity, inner product spaces, orthogonality and orthogonal bases, factorization of matrices. Compared with MA 305 Introductory Linear Algebra, more emphasis is placed on theory and proofs. MA 225 is recommended as a prerequisite. Credit is not allowed for both MA 305 and MA 405.

### Course overview

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 and/or Fibonacci sequences. 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. Credit is not allowed for both MA 305 and MA 405.

### Learning Objectives

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.

### **Grading Policy**

The grading will be assigned on a 10-point scale: **A: 90 – 100, B: 80 – 89, C: 70 – 79, D: 60 – 69, F:  $\leq$  60**

The cutoffs for the +/- grades are determined at the end of the semester. Your final grade in this course will be determined by marks earned on the final exam, two term tests, and homework assignments. The weighting of these components are as follows:

Homework = 30 %  
Two term tests = 40 %  
Final Exam = 30 %

*Note:* I do 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 help your classmates, while keeping the academic integrity policy in mind.

### **Term Tests 40%**

There will be two term tests that you will have to write during a 2 hour window during the following days: *May 28* and *June 11*. *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 during those days (with a documented excuse, not just that you don't want to) will contact the instructor to schedule an alternate time to take the exam.

### **Final Exam 30%**

The final exam is mandatory, cumulative and you will have a 4-hour window to write it on June 17, 2020.

**Homework Assignments** will be posted on Moodle and are due by 11pm (Eastern) on the listed day. Some assignments will be required to be submitted online as PDF via the link posted in Moodle. The written assignments should be written up neatly or typed in LaTeX. All solutions must be completely justified to receive credit. You will also have on-line assignments that will be completed using an Internet-based homework service called WeBWorK (WW) linked to Moodle. Each assignment must be accessed first through Moodle to be able to see it in WeBWorK.

If you are having a busy week, please let me know as occasional extensions are acceptable. Otherwise, written homework may be submitted late for a 10% penalty.

At least two of the lowest homework grades will be dropped. Use these drops wisely.

### **Corrections to the grading**

If you believe an error has been made in grading on a test or homework send an email to the instructor with an explanation. I will give partial credit to partial correct solution that was neatly presented. You have *2 days after the assignment/test is returned* to request re-grading. The entire assignment/test may be re-graded, and the grade is subject to remain the same, increase, or decrease.

### **Test Make-Up Policy**

*Make-up policy for missing a test:* (1) All anticipated absences must be excused at least three days in advance of the test date. These include University or work 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). (2) Emergency absences must be reported within two days of the test date and must be appropriately documented. (3) If the absence is excused, coordination will be necessary between you and the instructor to arrange an appropriate alternative testing window. (4) Make-ups due to oversleeping, car trouble, or any other excuse not approved by the University will be subject to instructor availability. There will be an automatic 10% deduction from the test.

### **Attendance policy**

Please consult <https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>. As this course is a distance course, no attendance is taken. However, you are expected to work through the material at the set pace in order to meet the quiz and homework deadlines. Any desired extensions should be communicated to me before the due date arises.

### **Add/Drop Regulation**

Undergraduate students are expected to complete all courses for which they are enrolled as of census date (the official enrollment date defined as the 10th day of fall and spring terms and the 3rd day of summer terms). Undergraduate course drops after census date will now be considered to be course withdrawals and will result in W grades on the transcript.

### **Students with 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, 2751 Cates Avenue, 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/>).”

### **Student Evaluations**

Online class evaluations will be available for students to complete during the last three weeks of classes. You will receive an email message directing you to a website where you can login using your Unity ID and complete the evaluation. All evaluations are confidential; instructors will not know how any one student responded to any question, and students will not know the ratings for any instructors.

### **Academic Integrity Statement and Academic Dishonesty**

Both faculty and students at North Carolina State University have a responsibility to maintain academic integrity - see the NCSU policy/ the Code of Student Conduct at <https://policies.ncsu.edu/policy/pol-11-35-01/>.

”Academic dishonesty is the giving, taking, or presenting of information or material by a student that unethically or fraudulently aids oneself or another on any work which is to be considered in the determination of a grade or the completion of academic requirements or the enhancement of that student’s record or academic career.” (NCSU Code of Student Conduct)

**Exams & Final:** Students will neither give nor receive any assistance on any term test or the final exam. Use of cell phones and graphing calculators during exams is not permitted.

**Homework:** Students may discuss homework questions on the Moodle forum or via Zoom. You are allowed to work together on homework assignments; however, each student must turn in his or her own work.

Scholarly activity is marked by honesty, fairness and rigor. A scholar does not take credit for the work of others, does not take unfair advantage of others, and does not perform acts that frustrate the scholarly efforts of others. The violation of any of these principles is academic dishonesty. Penalties for a violation: For the first violation, you will receive a zero for your work and be put on academic integrity probation for the remainder of your stay at NCSU. The second violation may result in your suspension from NCSU. Both situations will involve the Office of Student Conduct.

**Non-Discrimination Policy.** NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation that are based upon a persons race, color, religion, sex, national origin, age, disability, gender identity, genetic information, sexual orientation, or veteran status. NC State’s policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05>. 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.

**Electronic course components**

Please be advised that any Zoom office hours may be recorded for current and potential future educational purposes. By your continued participation in this recorded course, you are providing your permission to be recorded. Instructor is not responsible for ensuring privacy or accessibility of electronic materials that are not required components of the course (e.g., links to supplemental information that is not part of the required reading list).

Required statement: "Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student course- work. All students are expected to respect the privacy of each other by not sharing or using such information outside the course."

**Other Remarks**

- A good way to contact your instructor is by email (not phone). Please make sure that you include your name and the course number and section in the subject line of your email.
- Try to find the information on your own first and indicate what you have already attempted to do to resolve the issue
- Add the exam dates to your calendar and set appropriate reminders
- NO email will be read or answered unless the email includes a specific detailed subject line (for example: MA 405 HW04 Problem 3), the course number, your name,
- WeBWorK homework questions should be sent to me from the specific WeBWorK problem you are working on so I can easily access it and offer suggestions; your message should indicate your approach to trying to solve the problem. if needed, follow up with a reply to the WW email with a scan of your work.
- Your email address registered with the NCSU online directory will be used for announcements associated with this class. It is your responsibility to maintain a valid email address and check/empty your Inbox regularly.
- The test and homework grades will be recorded in the gradebook in Moodle. Please notify me immediately if you notice any discrepancies in your grades. Keep all your quizzes and tests for future reference.
- Please check the course webpage regularly, as it will be continuously updated with announcements, any changes in the schedule, homework problems, solutions, review sheets, and other additional course materials.

**Good Luck!**