

## 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.

**Testing** at NCSU testing centers will be by appointment only. Students are required to schedule appointments at least one business day in advance at <http://go.ncsu.edu/takemytest>. On the Moodle page you may find links to schedule an appointment for testing at on-campus location or to request a remote proctor. All exam dates are listed in this syllabus and in the schedule on Moodle. It is in your best interest to schedule your exams as early as possible to avoid dates filling up.

**Communication:** I will answer emails during business hours. Please include the course title in the email subject line and sign emails with your full name.

Office hours will be online (through Zoom) and posted in Moodle. Information about using Zoom is available on Moodle. If you cannot make scheduled office hours, email me and make an appointment.

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 the instructor and respectful and appropriate communication is required.

### 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:

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. Additionally, since this section is online and there is little oversight of when you watch lectures and engage with the notes, it requires an extra amount of self motivation and discipline. I encourage you attend office hours, engage in the discussions on Moodle, and ask lots of questions. I want help out with problems and understanding concepts no matter how big or small, but you have to reach out to me and engage. 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, three term tests, and online homework assignments. The weighting of these components are as follows:

Homework = 20 %  
Three term tests = 45 %  
Final Exam = 35 %

*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. I encourage you to collaborate on homework and understanding the material in the course. But make sure that you individually understand everything and can do the problems as you will have to work alone on the exams and the point of the class is that you individually leave it having learned the material.

### **Term Tests 45%**

There will be three closed book, closed notes term tests that you will have to arrange to take at one of Delta testing centers or at a remote testing center (see [https://online-distance.ncsu.edu/current\\_students/testing-services/](https://online-distance.ncsu.edu/current_students/testing-services/)) during the following days: Test 1 *February 3-4*, Test 2 *March 4-5*, and Test 3 *April 2-3*. 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 at those times (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 35%**

The final exam is mandatory, cumulative and will need to be scheduled during *April 27-29* - see [https://online-distance.ncsu.edu/current\\_students/testing-services/](https://online-distance.ncsu.edu/current_students/testing-services/).

**Homework Assignments** will be assigned through Moodle, either written or on-line. The written assignments will have to be uploaded in Moodle (pdf). The on-line assignments are 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.

The lowest 2-3 homework grades will be dropped. Use these drops wisely. The homework assignments are available in Moodle.

### **Corrections to the grading**

If you believe an error has been made in grading on a test send an email to the instructor with an explanation. I will give partial credit to partial correct solution that was neatly presented. You have *1 week after the test is returned* to request re-grading.

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

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).

**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.

### **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. Undergraduates will be limited to a maximum of 16 hours of course withdrawals after census date and before the drop date March 4, 2019 for their entire undergraduate career at NC State. These course withdrawals will count as attempted hours for course repeat, financial aid satisfactory academic progress, and tuition surcharge calculations.

### **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 Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 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 (REG02.20.1)" You must discuss accommodations with me prior to a test date.

If you have any questions about accommodations, please contact me and the Disability Services Office. I want to help and to make sure everyone can learn their best in the course.

### **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. An informational brochure about academic integrity is available from the university and students are encouraged to obtain a copy.

"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)

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.

**Electronic course components**

Please be advised that any Collaborate 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.
- 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.
- Please mark the test dates on your calendar and schedule your tests early.