NC STATE UNIVERSITY

MA 523-601 Spring 2026

Linear Transformations and Matrix Theory Course Syllabus

[Click here for an HTML version of this syllabus](#)

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Course Information

- **Instructor:** Ilse Ipsen
- **Email:** [Email me at ipsen@ncsu.edu](mailto:ipsen@ncsu.edu)
- **Office:** SAS 4234
- **Office Hours:** MW 9:30-10:30am: zoom and in person (SAS 4234), and by appointment.
- **Course Modality:** This course is an online, asynchronous Distance Education course.
- **Course website:** Find our course on [NC State Wolfware.](#)

Course Description

(3 credit hours) Vector spaces, linear transformations and matrices, orthogonality, orthogonal transformations with emphasis on rotations and reflections, matrix norms, projectors, least squares, generalized inverses, definite matrices, singular values.

Prerequisites. An undergraduate linear algebra class, such as MA305 or MA405.

Learning Objectives

Upon completion of this course, students will be able to master the following:

- The mathematical concepts of matrices and vectors, and their basic operations (inner product, transpose, scalar multiplication, addition, multiplication, and outer product), and their time complexity.
- The mathematical problems of solving linear systems and least squares problems, and the existence and uniqueness of their solutions.
- The fundamental matrix decompositions (pivoted LU, Cholesky, QR), and their use in the solution of linear systems and least squares problems.
- The Singular Value decomposition (SVD), and its use for the solution of least squares problems and low- rank approximation of matrices.
- Generation and manipulation of matrices in Matlab, and the fundamental Matlab commands.
- The properties of floating point arithmetic and its effect on the accuracy of matrix operations.
- The concept of sensitivity of a mathematical problem to perturbations (conditioning), and the behavior of matrix operations in floating point arithmetic (numerical stability).

Course Structure

Learning activities include reading assignments, quizzes, videos, homework assignments, Matlab programs, and exams.

Lecture Materials

This course is completely asynchronous, which means that students have no real-time class meeting requirements. Learning materials, activities, assignments, and assessments are delivered through Moodle, a secure and easy-to-use online learning platform.

The course consists of 5 modules, each of which lasts between one to several weeks.

Live sessions

No in-person/synchronous meetings are required for this course.

Communication and Getting Help

Forum

We will use **Piazza** for class discussion and homework questions. You are encouraged to use Piazza to discuss concepts and homework with discretion-hints and suggestions are okay,

but full solutions will be deleted. You can post under your name or you may be anonymous to your classmates; however, the instructor will be able to see who you are. Please be respectful of your fellow classmates' ideas and attempts. If you have a math question you are not sure should be a public post, it is better to send me a direct message as a private post on Piazza.

Enroll in this class Piazza through the Piazza link near the top of Moodle.

Request: when asking a question about a specific item (like an item in Moodle), please include a direct link to that item (e.g. the Moodle url). It helps everyone answer your question a lot faster.

Email

Contact me for confidential and private discussions about grades, scheduling office hours, etc. Please include MA 523 in the subject line. In general, I may not respond to messages outside of business hours (M-F, 9am-5pm), and it may take 24-72 hours for me to respond to an message. Math questions are generally best asked in office hours or on our forum, not by email.

Textbooks

We will use free online textbooks which can also be found through the NC State Library:

- I. C. F. Ipsen: Numerical Matrix Analysis

- Åke Björck: Numerical Methods in Matrix Computations

- Roger A. Horn and Charles R. Johnson: Matrix Analysis, 2. edition

- David S. Watkins: Fundamentals of Matrix Computations

- P. J. Olver and C. Shakiban: Applied Linear Algebra

LaTeX resources

The links below provide learning materials and software for LaTeX. Additional resources are located in Moodle.

- Learning LaTeX — Griffiths & Higham (NCSU library) — Library record for the book "Learning LaTeX".
- LaTeX Project — software and documentation — Official LaTeX distribution and documentation.
- LaTeX Wikibook — comprehensive guide — Community-maintained LaTeX reference and examples.

- [Getting started with LaTeX — primer (Trinity College Dublin)](#) — Introductory tutorial and examples.
- [MiKTeX — easy-to-install LaTeX for Windows](#) — Windows installer and documentation for MiKTeX.
- [Using TeX notation in Moodle forums](#) — Moodle documentation for inserting math with TeX.

Homework

There are written assignments submitted via Gradescope, programming projects, Moodle quizzes (with infinitely many attempts).

Test Information

Test Dates

- Test 1: 19 - 20 February
- Test 2: 26 - 27 March
- Final Exam: 29 April - 1 May

Proctors

All examinations will be proctored through DELTA. You will either take your exam with DELTA, or coordinate remote proctoring with DELTA, according to which situation best describes you:
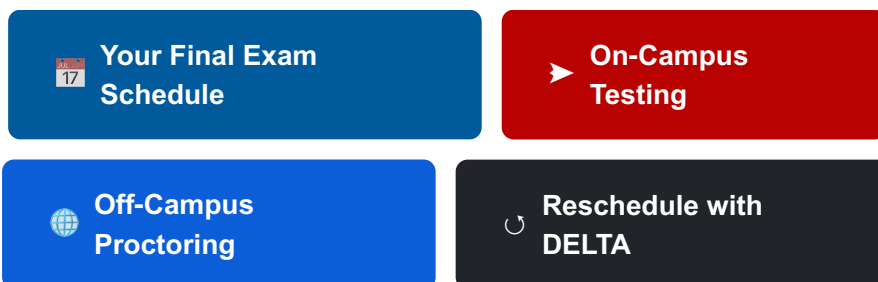
- If you live less than 50 miles away from Raleigh, NC, then you will take your tests on our campus through the Distance Education Testing Centers. Students should be mindful of closing hours for both Testing Centers, and give themselves plenty of time to complete their exams. For information, please visit [DELTA on-campus testing services.](#)
- Those students who live more than 50 miles away from Raleigh, NC do not have to take their tests on NCSU campus. They may use a proctor in their town for testing. The proctor must be approved in advance through DELTA (not the instructor). It can take up to 1 week to verify a proctor and set up all needed contact info, so please do this early! Please visit the remote proctor website at [DELTA remote proctoring.](#)

I encourage you to look through DELTA Testing Service's website, especially their [frequently asked questions (FAQs)](#).

Note: the word *remote* in this context means that you are using a professional testing site (for example, a testing center, a local library, a college, etc.) other than DELTA. Remote testing does not mean testing at home.

Quick Links

Please sign up your preferred time and date as soon as possible. Time slots fill up fast:

| 📅 17 **Your Final Exam Schedule** | ➤ **On-Campus Testing** |
| **Off-Campus Proctoring** 🌐 | ↺ **Reschedule with DELTA** |

Calculators

Calculators are not permitted on exams.

Test Format

Each exam will be a written, in-person exam administered at an approved testing location. You must bring appropriate photo identification and any permitted materials specified in this syllabus and in my course announcements.

If you take the written exam at DELTA, then you will complete it on an iPad with an Apple Pencil.

Regrading

If a grading error is found after looking at the posted answer key then you should provide a written explanation of the error attached to the original test or submit a regrade request through Gradescope, to the instructor within 1 week. Do not alter the original work. The entire test may be re-graded and the test grade is subject to remain the same, increase or decrease at the discretion of the instructor.

Classroom Expectations

1. **Course Structure:** This is an online class; you are responsible for your own learning and for pacing yourself within course guidelines.

   ◦ Watch the video lectures scheduled each week and follow the Course Calendar.
   ◦ Track all due dates in Moodle and on the Course Calendar.
   ◦ Complete all assignments in a timely fashion.
   ◦ Post your math questions in the course forum for discussions and Q&A.
   ◦ Optional: attend live sessions.

2. **Communication and announcements:** Please check your email, the course forum, and the Moodle site regularly. All announcements sent by email will also be saved under Announcements on Moodle. You are responsible for knowing the content of course emails.

3. **Respect and professionalism:** Treat everyone in class (students and instructor) with respect and courtesy. Be active and prepared in any live sessions. Come to office hours ready to ask questions and communicate with others.

4. **Accountability:** You are responsible for resolving any confusion about assignments, due dates, exams, accommodations, etc., in a prompt manner.

5. **Academic integrity:** Do not submit work that is not yours. It is understood that your name on any assignment indicates your adherence to the NC State Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."

6. **Exam device policy:** Review the permitted items before each exam. Keep phones and other forbidden devices powered off and stored away during exams to avoid accidental use.

Student Success

Student well-being is important to success at NC State. Every student, faculty member, and staff member enriches the community through varied perspectives, knowledge, and experience. Our classroom should be a space where every student is respected and heard.

In an effort to affirm and respect the identities of all students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than those listed in the student directory.

I welcome any suggestions you have for making our classroom more welcoming.

Grading

Grade Weighting and Numerical Conversion

Your grade will be determined by the following breakdown:

- Assignments: 40%
- Midterms: 30% (1 hour)
- Final: 30% (1 hour)

Grades are tracked in real-time in the Moodle **Gradebook**.

Conversion from Numerical Grade to Letter Grade

A student's numerical average will be converted to a letter grade as follows (do not expect any additional rounding, extra credit, or curves):

<div align="center">

Standard Conversion Table

Grade	Range
A+	97-100
A	93-96.99
A-	90-92.99
B+	87-89.99
B	83-86.99
B-	80-82.99
C+	77-79.99
C	73-76.99
C-	70-72.99
D+	67-69.99
D	63-66.99
D-	60-62.99
F	0-59

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Requirements for Credit-Only (S/U) Grading

In order to receive a grade of S, students are required to take all exams, 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 REG 02.20.15 - Credit-Only Courses.

It is the student's responsibility to check if an S grade gives progress towards their degree(s).

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at REG 02.20.04 - Audits.

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Policies on Incomplete Grades

NC State Policy

At the discretion of the instructor, students may be given an IN grade for work not completed because of a serious interruption in their work not caused by their own negligence. An IN must not be used, however, as a substitute for an F when the student's performance in the course is deserving of failing. An IN is only appropriate when the student's record in the course is such that the successful completion of particular assignments, projects, or tests missed as a result of a documented serious event would enable that student to pass the course.

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. See the university policy on incomplete grades: REG 02.50.03 - Grades and Grade Point Average.

Course Schedule

The course schedule is tentative and subject to change. Adjustments may be made to accommodate the pace of the class and unforeseen circumstances. All major changes will be announced in class and posted on Moodle.

- Course Calendar: HTML

Important Dates

For holidays and other university closures, please consult the general NC State Academic Calendar.

Your final exam schedule is already determined; find it here: NC State Final Exam Calendar. You are responsible for reviewing your final exam sessions to arrange a suitable time for this course.

List of Topics

Here are the major topics of MA 523, with the approximate regular-semester time allocated to each:

- **Module 0: Introduction to Matlab and Computational Setup** (~1 week). Major topics include Matlab onramp and basic Matlab usage.

- **Module 1: Vectors, Matrices, and Matrix Operations** (~3 weeks). Major topics include vectors and matrices, basic matrix operations, matrix-vector products, matrix multiplication, inverses, and special matrices.
- **Module 2: Floating Point Arithmetic and Numerical Representation** (~2 weeks). Major topics include toy floating point systems and IEEE double precision arithmetic.
- **Module 3: Linear Systems, Norms, and Conditioning** (~2.5 weeks). Major topics include linear systems and sensitivity, vector and matrix norms, conditioning of linear systems, and numerical linear solvers.
- **Module 4: Singular Value Decomposition and Applications** (~3 weeks). Major topics include foundations of the SVD, square and special matrices, rank, norms, optimality, distance from singularity, applications to statistics and PCA.
- **Module 5: Least Squares and Data Fitting** (~1.5 weeks). Major topics include least squares problems, data fitting, column spaces, and regularization.

Course Continuity

To ensure course continuity, changes made to the method of instructional delivery, course structure, course schedule, number of assignments, grading or other aspects of the course after the start of the term will be communicated to all students in written form (e.g., by an instructor announcement) when course changes are implemented.

Additional Information

Student Expenses

Late Assignments

Generally no late assignments are accepted in this course. Please plan your work carefully and submit assignments by their stated deadlines. Extensions may be occasionally granted by the instructor for extenuating circumstances, which are best documented with NC State Absence Verification.

For longer-term, recurring, or more serious illness or other interruptions to your participation in this class, you should reach out to your instructor as soon as you can.

Late Examinations

There are no make-up exams in this course.

Attendance

Since this course is an asynchronous online course, there is no daily attendance. Instead, each student's participation in Moodle is tracked to check for regular activity. For complete

attendance and excused absence policies, please see Attendance Regulations ([NCSU REG 02.20.03](#)).

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct ([NCSU POL11.35.01](#)). Your submission of any exam indicates "I have neither given nor received unauthorized aid on this test or assignment." Violations of academic integrity will be handled in accordance with the Student Discipline Procedures ([NCSU REG 11.35.02](#)).

Posting any course material to websites like Chegg, ChatGPT, and Course Hero is a violation of copyright law and course policy and is strictly prohibited. Violations of this policy will be reported to the [Office of Student Conduct](#).

- Tests: Proctored tests are closed book assessments. You may not consult any internet resources nor receive help from anyone else. Do not share information about the content on the exams with anyone else in the class. See the calculator policy in the Test Information section of this syllabus.
- Homework: You may consult your notes, the textbook, each other, or online resources.
- Forum discussion boards: You are encouraged to discuss mathematical concepts and problems with your classmates. However, you must arrive at your own solutions with your own work. Do not seek nor state final answers on the forum; focus on understanding the concepts.

Artifical Intelligence

You are not allowed to use any artificial intelligence (AI) tools, such as chatbots, text generators, paraphrasers, summarizers, or solvers, to complete any part of your assignments. Any attempt to use these tools will be considered academic misconduct and will be dealt with according to the university's academic integrity policy. You are expected to complete all work independently and without the assistance of AI-generated content. If you have questions about what constitutes acceptable use of AI tools, please consult with the instructor before submitting your work.

Disability Resources

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 ([NCSU REG 02.20.01](#)).

Students who receive accommodations are responsible for filing those accommodations officially with DRO before the tests occur. It is not appropriate to tell the instructor that you should receive accommodations without going through the official channels. The instructor will only adjust test conditions after receiving the official Accommodation Letter Notification from DRO. Adjustments are never made retroactively to past examinations.

Digital Course Components

Because of the way our course is structured, students need internet connectivity in order to read course materials and complete assignments. NC State's Online and Distance Education provides technology requirements and recommendations for computer hardware.

For access to computing hardware, please see the NC State University Libraries Technology Lending and the general Library Computing resources. There are several computers available for use around campus, including in the Mathematics Tutoring Center.

Digitally hosted course components will include but are not limited to Moodle and Zoom.

Software

There are several resources available to assist students with technical or computer issues. Please consult Office of Information Technology - NC State University.

Here are some of the primary applications commonly used in online mathematics courses:

- Moodle and Wolfware: Our course is hosted online on Moodle, where you can find the course content, a link to this syllabus, and the gradebook.

  - Moodle Accessibility Statement
  - Moodle Privacy Notice
  - NC State WolfWare Privacy Statement

- Panopto: NC State uses Panopto for video hosting.

  - Panopto Accessibility Features
  - Panopto Privacy Policy
  - Panopto Support

- Piazza: this site hosts our class forum. You will use **Piazza** to ask questions regarding the lecture or homework.

  - Piazza Accessibility Statement
  - Piazza Privacy Policy
  - Piazza Support Center

- [Google Meet](): when needed.

  - [Google Meet Accessibility features]()
  - [Google Meet Security and Privacy]()
  - [Google Meet Help]()

- [Zoom](): when needed.

  - [Zoom Accessibility Statement]()
  - [Zoom Privacy Policy]()
  - [Zoom Support]()

- [Gradescope](): We will use Gradescope for collecting and returning written work.

  - [Gradescope Accessibility Information]()
  - [Gradescope Privacy Policy]()
  - [Gradescope Help Center]()

- [MathWorks](): We will use MathWorks MATLAB for programming assignments.

  - [MATLAB Accessibility Statement]()
  - [MATLAB Privacy Policy]()
  - [MATLAB Support]()

You must address the accessibility of these websites for yourself during the course drop/add period.

The 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). However, the instructor will judiciously consider the privacy, copyright, and accessibility of supplemental links provided to students and warn them of any known issues or concerns in this regard. See Online Course Material Host Requirements ([NCSU REG 08.00.11]()).

Electronically Hosted Components

Please be advised that live meetings for this course 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. If you would like for your likeness to be edited out of a recorded video, please contact me and I will edit the video accordingly.

Required Statement

Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All

students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Additional NC State Rules and Regulations

Your rights and responsibilities

Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

- Equal Opportunity and Non-Discrimination Policy Statement, POL 04.25.05 - Equal Opportunity and Nondiscrimination Policy
  with additional references at NC State Office of Equal Opportunity
- Code of Student Conduct, POL 11.35.01 - Student Conduct
- Grades and Grade Point Average, REG 02.50.03 - Grades and Grade Point Average
- Credit-Only Courses, REG 02.20.15 - Credit-Only Courses
- Audits, REG 02.20.04 - Audits

Non-Discrimination Policy

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at

POL 04.25.05 - Equal Opportunity and Nondiscrimination Policy or the Office of Equal Opportunity

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.

Support

Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

1. Counseling Center
2. Health Center
3. Share a Concern
4. Pack Essentials

Course Evaluations

ClassEval is the end-of-semester survey for students to evaluate instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8am on the first day of finals.

- Contact ClassEval Help Desk
- ClassEval website
- Information about ClassEval and how the information is used

Required statement

This course engages diverse scholarly perspectives to develop critical thinking, analysis, and debate and inclusion of a reading does not imply endorsement. *This statement is required per UNC Policy Manual 400.1.6, adopted 12/19/2025.*

Syllabus Modification Statement

Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order we will cover them in. Minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.

This syllabus was designed by Bevin Maultsby to meet the standards in REG 02.20.07 (Last Revised: May 27, 2020), found at NC State REG 02.20.07 - Course Syllabus according to the May 27, 2020 revision.