# MATH SHU-142
# Honors Linear Algebra II

## Course Information

This is the second semester of a 2-semester sequence in linear algebra for advanced mathematics majors. This course starts with introducing the basic practical knowledge of linear algebraTopics covered include inner products, norms, orthonormal bases, Schur's theorem and Riesz representation theorem, orthogonal complement, orthogonal projection and best approximation, the adjoint operator, self-adjoint and normal operators, spectral theorem, positive operators and isometries, polar decomposition and singular value decomposition, generalized eigenvectors and nilpotent operators, characteristic and minimal polynomials, Jordan form, computing a Jordan basis, complexification of a real vectors space, normal operators on real inner product spaces, isometries and 2x2 block diagonalization, alternative definition of trace and determinant.
The goal of this course is, on one hand, to provide the practical tools for application in various disciplines and courses such as Differential Equations, Analysis, or Probability and, on the other hand, to acquire the theoretical knowledge necessary to properly write mathematical proofs.

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| Prerequisite: | Honors Linear Algebra I |
| Credits: | 4 |
| Duration: | 14 weeks |
| Commitment: | 2 lectures and 1 recitation of 75 minutes weekly, total of 52.5 hours in class |
| Instructor: | Shengkui Ye (sy55@nyu.edu) |
| Schedule & classroom: | Available on albert.nyu.edu |
| Office hours: | Published and updated on Brightspace. |

**Tentative program**

- Dot product, orthogonal basis, projections, Gram-Schmidt orthogonalization process, Least square solutions.
- Inner product on real vectors spaces and complex vector spaces, isometries and unitary matrices
- Upper triangular (Schur) representation of an operator, Spectral theorem for self-adjoint and normal operators, Polar and singular value decompositions, Structure of orthogonal matrices
- Bilinear and quadratic forms， Diagonalization of quadratic forms， Silvesters Law of Inertia，Positive definite forms. Minimax characterization of eigenvalues and the Silvester's criterion of positivity，Positive definite forms and inner products
- minimal polynomials, Jordan form, computing a Jordan basis

**Bibliography**

Course textbooks

- Sergei Treil. *Linear Algebra Done Wrong* (2017), freely available from author's webpage: http://www.math.brown.edu/ treil/papers/LADW/book.pdf.
- Linear algebra done right by Sheldon Axler, Third edition. Undergraduate Texts in Mathematics. Springer, Cham, 2015.
- David C. Lay. *Linear Algebra and Its Applications* (5th ed.), available at the library.

# Evaluation and Grading

The grade for this course will be determined according to the following weights:

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| Midterm Exam | 30% |
| Final Exam | 40% |
| Assignments | 30% |

Each student's grade will depend solely on that student's performance. There is no grade curving, grade normalization, or any form of extra credit.

### Exam dates

Exam dates will be announced some weeks in advance.

### Exam norms

During exams, the possession of any electronic device, including cell phones, is not allowed, regardless of whether the student is actually using it or not. So is the use of books, notes, calculators, or any other object extraneous to the exam. Students who fail to observe these norms will receive grade zero on that test. Please note that this is part of the grading policy of this course. It is applied independently of eventual academic penalties carried out by the administration, for which the process is subject to general university policies.

### Late assignments

Any late assignments won't be accepted.

### Grade dissemination and grade review requests

Once papers are graded, the scores will be posted on NYU-Brightspace/Gradescope. From that day, students have two weeks to request a grade review or to point out any discrepancy between the gradebook and the graded paper.

### Absences due to religious observance

Any student absent from class because of religious beliefs shall not be penalized for any class, examination, or assignment deadline missed on that day or days. The instructor will try to avoid scheduling examinations and assignment deadlines on known religious holidays. The student who anticipates being absent because of a religious observance will be expected to notify the instructor at most two days after the exam date is announced so that the instructor can either change the exam date or make appropriate accommodations.

### Exam schedule conflicts

There are two types of conflicts. Direct conflicts are two examinations scheduled at the same time. Overload conflicts are three examinations scheduled on the same day. In case of a conflict, the student will be expected to notify the instructor at most two days after the exam date of this course is announced so that the instructor can either change the exam date or make appropriate accommodations.

### Letter grade

A: Excellent performance showing a thorough knowledge and understanding of the topics of the course; all work includes clear, logical explanations, insight, and original thought and reasoning.

B: Good performance with general knowledge and understanding of the topics; all work includes general analysis and coherent explanations showing some independent reasoning, reading and research.

C: Satisfactory performance with some broad explanation and reasoning; the work will typically demonstrate an understanding of the course on a basic level.

D: Passable performance showing a general and superficial understanding of the course's topics; work lacks satisfactory insight, analysis or reasoned explanations.

F: Unsatisfactory performance in all assessed criteria.

## Course Policies

### Attendance

Students are encouraged to attend and actively participate in every class.

## Academic Integrity

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. It is a basic guiding principle for all academic activity at NYU-Shanghai, and all members of the University community are expected to act in accordance with this principle. NYU has an established academic integrity policy, described at the web address:

www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/academic-integrity-for-students-at-nyu.html

Students who receive help on any exam or quiz via books, notes, classmates, watches, cell phones, calculators, etc., will receive grade F in the course. Depending on the severity of the violation, the university administration may impose further penalties such as suspension or expulsion.

## Students with Disabilities

Academic accommodations are available for students with disabilities. Please contact the Moses Center for Students with Disabilities for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance.