East China Normal University

GEC International Summer School

MAT205: Linear Algebra II

Term: June 16th to July 18th, 2025
Class Hours: Monday through Friday, 110 minutes each day (2,750 minutes in total)
Instructor: Mu He
Home Institution: Xi'an Jiaotong-Liverpool University
Office Hours: TBD
Email: mu.he@xjtlu.edu.cn

Course Description

This course provides a comprehensive introduction to linear algebra, focusing on fundamental concepts and techniques essential for understanding advanced mathematical structures and applications. Topics covered include linear equations, vector spaces, linear mappings, matrix representation of linear mappings, determinants, eigenvectors, eigenvalues, and diagonalizable operators. Additionally, the Cayley-Hamilton theorem, bilinear and quadratic forms, inner product spaces, orthogonal diagonalization of symmetric matrices, and canonical forms are explored in depth. Through lectures and review sessions, students will develop a solid foundation in linear algebra and acquire essential analytical skills applicable across various disciplines.

Prerequisite: MAT 21.

Course Objectives

By the end of the course, students should be able to:

1. Understand linear equations over a field and their solutions.
2. Grasp the basics of vector spaces and their properties.
3. Explore linear mappings and their representation using matrices.
4. Learn about determinants and their role in linear algebra.
5. Understand eigenvectors, eigenvalues, and their applications.
6. Study diagonalizable operators and their significance.
7. Explore the Cayley-Hamilton theorem and its implications.
8. Gain insight into bilinear and quadratic forms.
9. Understand inner product spaces and orthogonal diagonalization.
10. Learn about canonical forms and their importance in linear algebra.

Required Text

Derek J. S. Robinson, *A Course in Linear Algebra with Applications,* 2nd
Edition, (2006), World Scientific Publications.

Course Hours

The course has 25 class sessions in total. Each class session is 110 minutes in
length, for a total of 2750 minutes of in-class time. The course meets from Monday
to Friday. ECNU awards 3 credits for this course. Different universities may count
course credits differently. Consult officials at your own home institution.

Attendance

Summer school is very intense and to be successful, students need to attend *every
class*. Occasionally, due to illness or other unavoidable circumstance, a student
may need to miss a class. ECNU policy requires a medical certificate to be excused.
Any absence may impact on the student's grade. Moreover, ECNU policy is that a
student who has more than 3 absences will fail the course. Arriving late or leaving
early will count as a partial absence.

Grading Policy

ECNU awards grades of A, A-, B+, B, B-, C+, C, D, and F. Most colleges and
universities do not award transfer credit for grades of D or F.

In this course, grading will be based on the following:

Assignments*2	10%*2=20%
Participation	10%
Midterm Exam	30%
Final Exam	40%

General Expectations

Students are expected to:
- Attend all classes and be responsible for all material covered in class and otherwise assigned. Any unexcused absence may impact a student's grade.
- Arrive to class on-time: Late arrivals are disruptive to your fellow students and to the conduct of the class.
- Complete the day's required reading and assignments before class.
- Review the previous day's notes before class; make notes about questions you have about the previous class or the day's reading.
- Refrain from texting, phoning or engaging in computer activities unrelated to class during class (不要用手机). It is highly disrespectful to the professor and to the class.
- Participate in class discussions and complete required written work on time.

Course Schedule

The planned schedule sketched out below may be modified to suit the interests or abilities of the enrolled students or to take advantage of special opportunities or events that may arise during the term.

Week 1

- *Day 1*
  - *Overview of the course*
- *Day 2*
  - *Solving Linear Systems and Matrix Operations Review*
- *Day 3*

- o *Introduction to Vector Spaces: Definition of vector spaces and fundamental properties*
- – *Day 4*
  - o *Linear Mappings*
- – *Day 5*
  - o *Tutorial/Discussion*

Week 2

- – *Day 1*
  - o *Determinants: permutations and properties of determinants*
  - o *Applications of determinants in linear algebra*
- – *Day 2*
  - o *Eigenvectors and Eigenvalues: computing eigenvalues and eigenvectors of matrices.*
- – *Day 3*
  - o *Eigenvectors and Eigenvalues: further exploration of eigenvectors and eigenvalues.*
- – *Day 4*
  - o *Eigenvectors and Eigenvalues: applications of eigenvectors and eigenvalues*
- – *Day 5*
  - o *Tutorial/ Discussion*
  - o *Assignment 1 due*

Week 3

- – *Day 1*
  - o *Diagonalizable Operators*
- – *Day 2*

- o *Cayley-Hamilton Theorem: statement and proof of the Cayley-Hamilton theorem*
- – *Day 3*
  - o *Bilinear and Quadratic Forms*
- – *Day 4*
  - o *Midterm Review Session*
  - o *Discussion/Tutorial*
- – *Day 5*
  - o *Midterm*

Week 4

- – *Day 1*
  - o *Inner Product Spaces*
- – *Day 2*
  - o *Inner Product Spaces: Orthogonal diagonalization of symmetric matrices*
- – *Day 3*
  - o *Canonical Forms*
- – *Day 4*
  - o *Canonical Forms and their Applications*
- – *Day 5*
  - o *Tutorial/Discussion*
  - o *Assignment 2 due*

Week 5

- – *Day 1*
  - o *Advanced Linear Algebra Techniques: special matrices and their properties*

- *Day 2*
  - *Applications of Bilinear and Quadratic Forms*
- *Day 3*
  - *Synthesis of learning outcomes and final reflections on linear algebra*
- *Day 4*
  - *Final Exam Review Session*
  - *Tutorial/Discussion*
- *Day 5*
  - *Final Exam*

Academic Honesty

Students are expected to maintain high standards of academic honesty. Specifically, unless otherwise directed by the professor, students may not consult other students, books, notes, electronic devices or any other source, on examinations. Failure to abide by this may result in a zero on the examination, or even failure in the course.