



**University of International Business and Economics
International Summer School**

MAT210 Linear Algebra

Term: May 24 - June 24, 2021

Instructor: Sema Salur

Home Institution: University of Rochester

Email: semasalur@gmail.com

Class Hours: Monday through Thursday, 120 minutes each day (2,400 minutes in total)

Office Hours: TBD

Discussion sessions: TBD

Total Contact Hours: 64 contact hours (45 minutes each, 48 hours in total)

Credit: 4 units

Course Description:

In the course, the student will gain a familiarity with the theory of linear algebra and its applications. At the same time, more broadly, the student will be introduced to pure (i.e., theoretical) mathematics. That is: the student will increase his/her ability to absorb effectively abstract theory, to read and write mathematically rigorous argument, to extrapolate from fundamental principles, and to attempt creative answers to unfamiliar problems. The student will develop an intuition for theoretical constructs and familiarity with the mathematical style of rigorous argument with which to substantiate that intuition; as well as practice the patience needed to deal with sophisticated mathematical concepts.

Course Goals:

Students who satisfactorily complete this course will:

1. Be familiar with the statements and meanings of the definitions of the fundamental concepts of linear algebra, e.g., vector space, null space, linear independence, basis, dimension, linear transformation, one-to-one, onto, kernel, eigenvector, eigenvalue, orthogonal complement, diagonalizability, etc.
2. Have facility with basic calculational skills, e.g., Gaussian elimination; calculating the determinant, row space, null space, etc. of a matrix; conversion of coordinate vectors between bases; finding the matrix representation of a linear transformation with respect to given bases; determining the eigenspaces of a matrix; etc.
3. Be able to justify, with mathematical rigor, the fundamental theoretical statements of linear algebra (e.g., the fact that a matrix is invertible if and only if its determinant is nonzero; the Rank Theorem; etc.).
4. Have developed the ability to rigorously write mathematical arguments to justify (possibly previously unseen) claims based on their expanding theoretical knowledge.

Required Textbook:

Leon, Steven. Linear Algebra with Applications, 8th edition

Attendance Policy:

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. A medical certificate is required to be excused. Any absence may impact on the student's grade. Arriving late or leaving early will count as a partial absence. If a student is missing less than a point for a better grade, the better grade will be given, provided the student had no unexcused absences during the course.

Grading Policy:

There will be one midterm and a final exam in this class. All exams will be closed-book. No notes, calculators, or other electronic devices will be allowed.

The course grades will be calculated based on the following percentages:

- Homework: 30%
- Midterm: 30%
- Final Exam: 40%

The final exam will be cumulative. There will be no make-up exams.

Grading Scale:

Assignments and examinations will be graded according to the following grade scale:

A	90-100	C+	72-74
A-	85-89	C	68-71
B+	82-84	C-	64-67
B	78-81	D	60-63
B-	75-77	F	below 60

Class Rules:

All academic work should be done with the high level of honesty and integrity. Academic misconduct of any kind may result in a grade penalty or the assignment of a failing grade.

Course Schedule:

Week 1

Assignment

Section 1.1: Systems of Linear Equations

Supplementary Problems: 6gh, 8, 9, 10, 11

Section 1.2: Row Echelon Form

Supplementary Problems: 5dkl, 6, 7, 8, 17

Section 1.3: Matrix Arithmetic

Supplementary Problems: 6, 7, 13a, 15, 17

Section 1.4: Matrix Algebra

Supplementary Problems: 3, 7, 12, 20, 21, 26, 29

Section 1.5: Elementary Matrices

Supplementary Problems: 8a, 10c, g, 15, 17, 18, 24, 27

Section 2.1: Matrix Determinant

Supplementary Problems: 1, 3dg, 6, 8 (use proof by induction), 10

Week 2

Assignment

Section 2.2: Properties of Determinants

Supplementary Problems: 3df, 5, 6, 12, 14, *15, 16

Section 2.3: Matrix Adjoints

Supplementary Problems: 1bd, 6, 10, *12

Section 3.1: Vector Spaces

Supplementary Problems: 6, 8, 10, 15

Section 3.2: Subspaces

Supplementary Problems: 5, 8, 13, 17, 19, 20

Section 3.3: Linear Independence

Supplementary Problems: 2b, 5b, 6, 15, 16, 20

Section 3.4: Basis and Dimension

Supplementary Problems: 10, 13, 17, 19

Week 3

Assignment

Midterm Exam

Section 3.5: Change of Basis

Supplementary Problems: 2, 3, 4, 6, 7, 9, 10

Section 3.6: Row Space and Column Space

Supplementary Problems: 1, 3, 4ef, 8, 10, 14, 17, 19, 24, 26

Section 4.1: Linear Transformations

Supplementary Problems: 1, 3, 7, 8, 9ab, 12, 13, 14, 16, 19, 21, 22

Section 4.2: Matrix Representations of Linear Transformations

Supplementary Problems: 3, 5, 6, 7, 9, 14, 16, 17, 18b, 20

Week 4

Assignment

Section 4.3: Similarity

Supplementary Problems: 2, 3, 6, 8, 9, 11, 12, 14, 15a*, 15b

Section 5.1: Scalar Product

Supplementary Problems: 3ab, 15

Section 5.2: Orthogonal Subspaces

Supplementary Problems: 1bc, 6, 7, 8, 14, 15, 17

Section 15.3: Method of Least Squares

Supplementary Problems: 1c, 2, 9, 11, 14

Section 5.4: Inner Product Spaces

Supplementary Problems: 3, 4ab, 7ab, 10, 11

Week 5

Assignment

Section 5.4: Inner Product Spaces, Part II

Supplementary Problems: *9, 12, 13, 15, 16, 21, 22, *33

Section 5.5: Orthonormal Sets

Supplementary Problems: 2, 5, 6, 8, 12, 15, *20, *36

Section 6.1: Eigenvalues and Eigenvectors

Supplementary Problems: 1acf, 2, 3, 6, 9, 12, 21, *32

Section 6.3: Diagonalization

Supplementary Problems: 1ace, 3, 6

Final Exam

General Comments:

1. In order to train your minds in mathematical thinking, much of lecture will consist of the “Socratic Method” of questioning. Even if silently, do try to puzzle out the answers. An analogy: the lecture should be a “mental exercise” class. Knowledge cannot be given: it must be stolen. Engage your mind.
2. Many problems will not be solvable at first (or second) viewing. Be patient: clarify any unknown concepts, try to reduce the problem, brainstorm to unearth possibly relevant concepts, and follow your intuition. It may help to, after a period of hard work, put the problem away. Do not worry if you cannot do every problem: what is important is that you try.
3. If you find yourself getting lost in the material, come to office hours immediately! It is much easier to lead a student’s mind individually rather than in a group.
4. Note that we may not dot every i or cross every t in class: you are responsible for reading the text. In particular, it is to your advantage to read the material before coming to class; in this way the student becomes an active participant rather than a passive recipient.
5. Basic etiquette should be maintained. For example: to give your classmates time to think, please do not blurt out answers unless called upon (or overcome with excitement); please do not walk out of class without prior explanation, etc.
6. Using a cell phone in class is not permitted; students using phones will be penalized 5 percentage points on the next exam.
7. Tests will check your understanding of the lectures as well as cover homework-type problems; it will benefit you to check after each lecture to see if you’ve understood the line of the arguments. Precise knowledge of the theory is vital!

Online Possibility:

Due to the on-going pandemic, there is a possibility that in-person courses are changed to online ones. UIBE ISS will notify the students once the decision has been made.

If the in-person courses are to be changed to online courses, we will make a few adjustments:

1. **Lecture:** Each lecture will be uploaded on UIBE's online learning platform on a daily basis. Students are required to watch them according to the course schedule.
2. **Discussion:** There will be an open session on ZOOM every Wednesday. The attendance of the discussion is important as it is part of your final score.
3. **Office hours:** I will release the office hours once the course starts. You are very welcome to send me emails to book my time. We will have video or audio calls through ZOOM. Please be noted to book them at least 3 days in advance.
4. **Exam:** All students will attend the exams at the same time but at their own places. To ensure a fair exam, you are required to turn on your web cameras during the exam. Once you encounter any unexpected technical issues that most likely stop you from submitting your exam on time, contact the TA and/or the Instructor immediately.