Math 107 - Introduction to Linear Algebra (Spring 2021)

Course Description
Vectors; matrices and systems of linear equations; vector spaces; linear transformations; orthogonality; algebra of complex numbers; eigenvalue problems

Course Overview
This is a first undergraduate course in linear algebra. The course starts with concrete topics such as systems of linear equations with which a typical student should already have some familiarity at elementary level. Abstract concepts such as a vector space, a linear transformation acting on the vector spaces are first introduced in connection with these concrete grounds. Second part introduces topics such as vector spaces, isomorphism, transformations in abstract terms and in a general setting. The course concludes with eigenvalue problems, and the notions of an inner product and orthogonality.

Textbook
Linear Algebra and its Applications (5th Edition)
by David C. Lay, Stephen R. Lay and Judi J. McDonald
The textbook will be available through the bookstore.

Sections
Section 1 (Emre Mengi), Tue&Thr 14:30 - 15:45
Section 2 (Emre Mengi), Tue&Thr 13:00 - 14:15
Section 3 (Doğan Bilge), Tue&Thr 17:30 - 18:45
Section 4 (Fethi Mübin Ramazanoğlu), Mon&Wed 08:30 - 09:45
Section 5 (Fethi Mübin Ramazanoğlu), Mon&Wed 14:30 - 15:45

Instructors

	Section	**Office Hours**
Fethi Mübin Ramazanoğlu (framazanoglu@ku.edu.tr)	4,5	Mon 10:00-11:00
Doğan Bilge (dobilge@ku.edu.tr)	3	To be announced
Emre Mengi (emengi@ku.edu.tr)	1,2	Thr 16:15-17:45

Teaching Assistants
Arda Tiftikçi (atiftikci18@ku.edu.tr), Kerem Başol (kbasol19@ku.edu.tr — Office Hour: Thr 09:00-10:30), Muhammed Burak Kızıl (mkizil19@ku.edu.tr), Mustafa Ahmet Aydın (maydin19@ku.edu.tr), Umur Berkay Karakaş (ukarakas18@ku.edu.tr), Muhammad Nadeem (mnadeem20@ku.edu.tr), Tolga Temiz (ttemiz16@ku.edu.tr), Waqar Ahmed (wahmed20@ku.edu.tr)

Course Webpage
`http://home.ku.edu.tr/~math107`
You can access the past exams and weekly suggested problems from the course webpage. The course material will be made available through blackboard.

Grading
Your grade at the end of the semester will be assessed based on two midterms and a final, in particular based on the following grading scheme.

- %30 (Midterm 1) + %30 (Midterm 2) + %40 (Final)

Please keep in mind that there will be a curve in the end when assessing your letter grade.

Problem Sessions
The problem sessions meet once every week. Their purpose is to provide you the opportunity to practice with your TAs and classmates, as well as to bring questions/topics that you are having difficulty with. Some of the questions solved in the problem sessions with minor modifications may appear in the midterms and in the final.

Problem session times and the TAs teaching them are as follows.

PS A (Arda Tiftikçi), Fri 16:00 - 16:50
PS B (Muhammed Burak Kızıl), Fri 15:00 - 15:50
PS C (Umur Berkay Karakaş), Fri 10:00 - 10:50
PS D (Mustafa Ahmet Aydın), Fri 09:00 - 09:50

KOLT Tutors
Yiğithan Gediz (ygediz20@ku.edu.tr)

Make-up Exams
A student can be eligible for a make-up exam only if she/he provides proper medical reports approved by the health center at Koç University or an excuse form.

The final exam will be used as the make-up exam for the midterm exams. If a student misses the final exam for a legitimate reason, a separate make-up exam will be held after the final period.

Important Dates and Holidays

- February 15, Monday — First Day of Classes
- February 15-19 — Add-Drop Period
- April 5-12 — Spring Break
- April 23, Friday — National Sovereignty and Children's Day
- May 13-15 — Ramadan Feast (Holiday)
- May 16, Sunday — Last Day for Withdrawal from a Course
- May 28, Friday — Last Day of Classes
- May 31 - June 11 — Final Examination Period

Course Calendar
This calendar is only tentative, and subject to changes. The numbers in parentheses refer to the sections from the textbook by Lay, Lay and McDonald.

Week 1 (Feb 15 - 19)
Systems of Linear Equations, Row Reduction and Echelon Forms (1.1-1.2)

Week 2 (Feb 22 - 26)
Vector Equations, Matrix Equation $A\mathbf{x} = \mathbf{b}$, Solution Sets of Linear Systems (1.3-1.5)

Week 3 (Mar 1 - 5)
Linear Independence in $\mathbb{R}^n$, Introduction to Linear Transformations (1.7-1.8)

Week 4 (Mar 8 - 12)
Matrix of a Linear Transformation, Matrix Operations (1.9, 2.1)

Week 5 (Mar 15 - 19)
Inverse of a Matrix, Characterizations of Invertible Matrices, Vector Spaces and Subspaces (2.2-2.3, 4.1)

Week 6 (Mar 22 - 26)
Null Spaces, Column Spaces, Linear Transformations on Vector Spaces, Linear Independence, Basis (4.2-4.3)

Week 7 (Mar 29 - Apr 3)
Coordinate Systems, Isomorphism, Dimension of a Vector Space (4.4-4.5)

Week 8 (Apr 12 - 16)
Rank, Change of Bases (4.6-4.7)

Week 9 (Apr 19 - 23)
Introduction to Determinants, Properties of Determinants, Cramer's Rule (3.1-3.3)

Week 10 (Apr 26 - 30)
Eigenvalues and Eigenvectors, Characteristic Equation (5.1-5.2)

Week 11 (May 3 - 7)
Diagonalization, Eigenvectors and Linear Transformations, Complex Eigenvalues (5.3-5.5)

Week 12 (May 10 - 14)
Inner Product, Length, Orthogonality, Orthogonal Sets (6.1-6.2)

Week 13 (May 17 - 21)
Orthogonal Projections, Gram-Schmidt Process, Least-Squares Problem (6.3-6.5)

Week 14 (May 24 - 28)
Inner Product Spaces, Symmetric Eigenvalue Problem, Quadratic Forms (6.7, 7.1-7.2)

Purposes and Learning Outcomes
We expect a student to be equipped with the following skills at a successful completion of the course.

– Think in abstract and general terms, for instance polynomials can also be orthogonal just like ordinary vectors
– Determine whether the solution to a linear system is unique or not
– Solve a linear system by row-reduction
– A good knowledge of basic concepts about matrices such as column space, null space, rank, rank-nullity theorem
– Perform basic operations on matrices such as the calculation of the matrix inverse
– Knowledge of characterizations of invertible matrices
– The student should be able to express a determinant as a cofactor expansion
– Knowledge of the properties of the determinant operation
– A good understanding of a vector space and related notions such as a basis, linear independence, span, coordinates relative to a basis, isomorphism
– Knowledge of what a transformation is, the properties that makes a transformation a linear transformation, and notions related to linear transformation such as their kernel, range as well as their properties
– Identification of a matrix representation of a linear transformation
– Ability to represent a change of coordinates as a linear transformation and in terms of a matrix
– Knowledge of the definitions of an eigenvalue, eigenvector and eigenspace
– Ability to determine whether a matrix is diagonalizable
– Knowledge of the properties of eigenvalues and eigenvectors of symmetric matrices
– Knowledge of the definition of an inner product, orthogonality and orthogonal projection
– Ability to find an orthonormal basis for a vector space with an inner product
– Knowledge of the definition of the least-squares problem and its motivation
– Ability to express the solution of a least-squares problem as the solution of a linear system