MATH 265: Basic Linear Algebra
2025–2026, Spring Term

Course Syllabus

Instructor	Dr. Kemal Cem Yılmaz	**Time and Venue**	on Tue., 09:45–12:30, class Z-41
E-mail	cemyilmaz@iyte.edu.tr		at Eng. Faculty Building D
Address	Office 116, Dept. of Mathematics		

Course Description

Linear systems of equations arise in various applications of engineering, and linear algebra provides the mathematical framework for understanding and analyzing these systems. It makes systematic use of vectors and matrices to represent them, which naturally leads to the study properties of matrices and relevant topics.

This is a one semester course with 3 credits and 4 ECTS. The course covers the fundamental concepts of linear algebra including matrix arithmetic, determinants, systems of linear equations, vector spaces, linear transformations, finite-dimensional inner product spaces, eigenvalues and eigenvectors.

Expectations and Learning Outcomes

This course has no prerequisites. You are expected to be motivated to learn new concepts and to maintain a regular and consistent study routine. Upon successful completion of this course, you are expected to achieve the following learning outcomes:

1. Perform matrix operations and use them to represent linear systems
2. Use elementary row operations to solve systems of linear equations.
3. Analyze the solution structure of linear systems using row reduction, matrix inverses, and LU factorization.
4. Determine bases and the dimension of a finite-dimensional vector space, compute the rank and nullity of matrices and interpret their relationship.
5. Use the notions of rank and nullity to determine whether a linear system has no solution, a unique solution, or infinitely many solutions.
6. Represent and analyze linear transformations via matrices in different bases and relate their algebraic and geometric properties.
7. Compute and interpret determinants and use them to characterize invertibility and the unique solvability of linear systems.
8. Work with inner products, norms, orthogonality, and projections. Construct orthonormal bases using the Gram–Schmidt process.
9. Compute eigenvalues and eigenvectors, analyze algebraic and geometric multiplicities, and determine the diagonalizability of a matrix.

Course Materials

Communication. All announcements will be posted via Microsoft Teams. Please use the code

`wagnlny`

to enroll our Team Room "*Math 265: Basic Linear Algebra, Spring 25-26*" in Microsoft Teams.

Teaching. We may utilize from GeoGebra™ and MATLAB™ to present some simulations during the classes. GeoGebra is free. We have a campus wide license for MATLAB. You can visit

https://bidb.iyte.edu.tr/matlab/

to have the product on your device.

Textbooks. The following textbook will serve as the primary course resource.

- Steven J. Leon, *Linear Algebra with Applications*, 8th ed., Pearson, 2010.

Please see the Course Outline part below for the detailed content of the course and the relevant textbook chapters to be covered. The following textbook is recommended as a supplementary resource.

- David C. Lay, Stephen R. Lay, Judi J. McDonald, *Linear Algebra and its Applications*, 5th ed., Pearson, 2016.

Those who are looking for a more advanced textbook may refer to the following resources.

- S. Lang, *Linear Algebra*, undergraduate text in mathematics, 3rd ed., Springer, 1987.
- K. Hoffman, R. Kunze, *Linear Algebra*, 2nd ed., Prentice Hall, Inc., 1971.

Electronic sources. You can use the following set of video lectures that will aid you to improve your learning on linear algebra and Fourier series.

- Linear Algebra - Video Lectures (1)
- Linear Algebra - Video Lectures (2)

Grading Policy

Homework. Each week you will be given a set of exercises via WebWork. The assignments will be based on the topics covered in that week's lectures. Each homework will be announced on Subday at 15:00 via Microsoft Teams. Answers to each assignment will be available on the following Saturday at 21:00. Solving these exercises and submitting your works are not mandatory, but it is strongly expected. In this way, you are encouraged to maintain a regular weekly study schedule rather than studying just for exams.

Exams. You will have 2 Midterm Examinations 30% of your overall grade each and 1 Final Examination %40 of your overall grade. Each exam will be graded out of 120 points. The extra 20 points will consists of homework questions.

Provided that you correctly solve the homework problems that appear in the exams, you can earn up to an additional 20 points.

	Grade	Weight	Weighted Grade
Midterm 1	100 + 20	30%	36
Midterm 2	100 + 20	30%	36
Final	100 + 20	40%	48
TOTAL			120

Attendance. Attendance to the lectures is not mandatory, but it is strongly suggested. Should you attend the courses as an active participant during the whole semester continuously, your letter grade may be rounded to the upper one (for those whose letter grade is very close to the upper one).

Based on the above criteria, your Total Grade will be evaluated by the following formula:

$$\text{Total Grade} = 30\% \text{ of M-I} + 30\% \text{ of M-II} + \%40 \text{ of F.}$$

Your Letter Grade will be evaluated according to your Total Grade. Unless indicated otherwise, evaluation of the letter grades will based on the catalog system declared in IZTECH Graduate Education Regulations.

Total Grade	Letter Grade
90–100	AA
85–89	BA
80–84	BB
75–79	CB
70–74	CC
65–69	DC
60–64	DD
50–59	FD
0–49	FF

Office Hours

- Thursday, 13:30-15:00

If you are not available during these hours, send me an e-mail at least 1 day before you want to meet, so we can set up a suitable meeting hour both for us.

Important Dates and Calendar

Midterm 1 .... on Tuesday, 31th of March
Midterm 2 .... on Tuesday, 12th of May
Final Exam .... TBA

Detailed information for exams and quizzes will be announced via Microsoft Teams. See also Academic Calendar.

February

S	M	T	W	T	F	S
01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March

S	M	T	W	T	F	S
01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

S	M	T	W	T	F	S
			01	02	03	04
05	06	07	08	09	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May

S	M	T	W	T	F	S
					01	02
03	04	05	06	07	08	09
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

S	M	T	W	T	F	S
	01	02	03	04	05	06
07	08	09	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Holidays & Spring Break	Class Days
Exams and Quizzes	Final Weeks

Course Outline

Below is a list of topics that will be covered throughout the semester (section numbers may change depending on the edition of the book).

§1 Matrix Operations (Sections 1.3 and 1.4)

Matrices; equality of matrices; scalar multiplication and addition of matrices, their properties; transpose of matrices; scalar product of vectors; matrix-vector and matrix-matrix multiplication; properties of matrix multiplication.

§2 Linear System of Equations (Sections 1.1, 1.2 and 1.5)

Expressing linear systems in matrix form, coefficient and augmented matrices; elementary row operations; row-equivalent systems; Gauss elimination and row-echelon form; reduced row-echelon form; Gauss-Jordan elimination; elementary matrices associated with the elementary row operations; the inverse matrix as a product of elementary matrices; computation of inverse by Gauss-Jordan elimination; LU factorization.

§3 Vector Spaces (Chapter 3)

Vector space axioms, subspace of a vector space; linear dependence and independence; spanning set for a vector space, basis and dimension; row space and column space; rank of a matrix, null space of a matrix, rank-nullity theorem; change of a basis.

§4 Linear Transformations (Sections 4.1 and 4.2)

Linear transformations; the image and the kernel; matrix representations of linear transformations in standard basis; some specific linear transformations dilations and contractions, reflections, rotations, translations; matrix representations in arbitrary basis.

§5 Determinants, Cramer's Rule for Solving Linear Systems (Sections 2.1, 2.2)

Geometric interpretation of the determinant, understanding what a determinant measures and how to formulate this notion; determinant of an $n-$dimensional matrix, minors, cofactors; properties of determinants; invertibility of matrices and unique solvability of linear systems via determinants, Cramer's rule for solving linear systems of equations.

§6 Finite-Dimensional Inner Product Spaces and Orthogonality (Sections 5.1, 5.2, 5.4, 5.5, 5.6)

The inner product in $\mathbb{R}^n$, inner product space axioms, the norm induced by the inner product in $\mathbb{R}^n$; orthogonal subspaces, orthogonal complement; scalar projection, vector projection, orthogonal projection onto a subspace; orthogonal sets and orthogonal bases; Gram-Schmidt orthogonalization; orthogonal decomposition theorem; the four fundamental subspaces.

§7 Eigenvalues and Eigenvectors (Sections 6.1 and 6.3)

Eigenvalues and eigenvectors of a matrix, their geometric interpretation; characteristic polynomial; eigenspace; matrices whose eigenvalues are not distinct, algebraic and geometric multiplicity; diagonalization; complex eigenvalues.