Linear Algebra

MAT 250 **Spring 2021**

Times and classroom	Tu Th 9:00 – 10:20 a.m.	**Online**
Professor	Dr. Ton Boerkoel	
Office hours	Mo – Th 12:30 – 2:00 p.m.	
Email	aboerkoel@digipen.edu	
Website	mat250s21-a.us on Moodle and Teams	

Textbook No textbook is required. Notes and homework problems will be provided.

Recommended texts: Elementary Linear Algebra, by Kolman
Introduction to Linear Algebra, by Strang
Linear Algebra, by Friedberg, Insel, Spence
Linear Algebra: a Geometric Approach, by Shifrin, Adams

Calculators The **TI-Npire CX CAS** is required.

CAS stands for **C**omputer **A**lgebra **S**ystem. Do NOT buy a TI-Nspire without CAS! This calculator will be used extensively, and programs specific for this class will be provided.

Course Description

This course presents the mathematical foundations of linear algebra, which includes a review of basic matrix algebra and linear systems of equations as well as basics of linear transformations in Euclidean spaces, determinants, and the Gauss-Jordan Algorithm. The more substantial part of the course begins with abstract vector spaces and the study of linear independence and bases. Further topics may include orthogonality, change of basis, general theory of linear transformations, and eigenvalues and eigenvectors. Other topics may include applications to least squares approximations and Fourier transforms, differential equations, and computer graphics.

In particular the course will cover the following topics: Vector spaces and subspaces, linear combinations, linear independence, spanning, bases, dimensions, linear transformations, isomorphisms, invertibility, matrices, change of coordinates matrices, row reduction and elementary matrix operations, systems of linear equations, rank, inverses, determinants and its properties, eigenvectors, eigenvalues, diagonalization, inner product spaces and norms, Gram-Schmidt process and if time allows other selected topics.

Course Objectives

We would like students to master the fundamentals of Linear Algebra, as described above, its main theorems and some of the basic proofs. We want students to be able to solve the relevant problems as e.g. found in the problem sets and recommended texts. It is hoped that the students will come to appreciate the usefulness of Linear Algebra as they grow in their understanding of higher mathematics, and that this class will contribute to the development of critical thinking skills.

The required level of mastery to pass this class will be ascertained by passing scores on tests, and homeworks. (See grading).

Course Prerequisites

MAT 200 or MAT 230.

Attendance and class policies

To optimize the learning experience and the efficient use of our time, attendance in class is expected. Attendance is automatically recorded on Teams.

Homework and participation

Working problems is essential in mastering the material. Each week the professor will suggest problems as homework. Homework will be done on Moodle, and is usually due at the beginning of class on Tuesdays. **No late homework is accepted**. Participation in class is expected. Just doing homework is not sufficient, one is expected to master the theory and be able to explain things in class when asked. It is important to keep up with the material, to study regularly at home (at least 2 hours for every hour in class) and to do as many problems as you can (See also the recommended texts.) This is a higher level math course and usually not trivial for most students. It is easy to fall behind beyond recovery. Start studying and working problems from day one. To gain the level of mastery that is expected to pass this course you will have to spend a lot of time on digesting, internalizing and practicing the material. It takes dedication, hard work and persistence. There are no quick and easy ways to mastering and understanding material at this level. 'Cramming' as a way to pass tests has proven very ineffective in studying mathematics; it doesn't lead to long term mastery. Students are required to use the TI-Nspire CAS calculator, to talk to fellow students about

the material, and ask me for assistance if needed. I cannot help you if you don't tell me you are having problems with something. I strongly recommend you come to my office hours (on Teams) when you need help. Even outside of regular office hours, you are welcome to ask questions. You can also send me emails or send me a chat message on Teams. [When sending emails include in the heading MAT 250]. It is absolutely essential to be very dedicated and apply yourself, not just to pass the class but to appreciate the material fully and get most out of the course. Linear Algebrais a very rich and wonderful area of mathematics, as well as being incredibly important and useful. Studying and mastering it will be a lot of fun!

Special needs

If students have disabilities and will need formal accommodations in order to fully participate or effectively demonstrate learning in this class, they should contact the Disability Support Services Office at (425) 629-5015 or dss@digipen.edu. The DSS Office welcomes the opportunity to meet with students to discuss how the accommodations will be implemented. Also, if you may need assistance in the event of an evacuation, please let the instructor know.

Academic dishonesty

Academic dishonesty in any form will not be tolerated in this course. Cheating, copying, plagiarizing, or any form of academic dishonesty (including doing someone else's individual assignments) will result in, at the extreme minimum, a zero on the assignment in question, and could result in a failing grade in the course or even expulsion from DigiPen.

Religious Accomodation

DigiPen Institute of Technology provides reasonable accommodations to students who may be absent from activities or incur significant hardship due to religious holidays or observances. These holidays or observances must be part of a religious denomination, church, or religious organization, and the course instructor must be notified in writing during the first two weeks of the course. The institute's policy for grievances is published in the course catalog.

Tests

There will be 2 tests and a final. No messy tests will be graded. Missing a test without a timely, valid excuse will result in a 0 score for the test. If you have to miss a test due to circumstances beyond your control you have to inform the instructor in advance or if that is not possible within the next 24 hours to schedule a make-up test. Reasons given for missing an exam are judged as to whether or not they are justified by the instructor, the chair of the department and/or the Institute. The test schedule is, tentatively, as follows:

Test 1	Thursday	February 11,	2021
Test 2	Thursday	Mar 25,	2021
Test 3 (Final)	Finals week	April 19-23,	2021

Grading

A Total score (T) will be calculated as follows: Test 1 , 2 and 3 are each worth 30%, and the Homework is worth 10%. No Test scores will be dropped.

$$\mathrm{T} \;=\; (T1 + T2 + T3) \cdot 0.30 + H \cdot 0.10$$

The grade for the course is then determined as follows:

A	if	93%	$\leq$	T	$\leq$	100%
A^-	if	90%	$\leq$	T	$<$	93%
B^+	if	87%	$\leq$	T	$<$	90%
B	if	83%	$\leq$	T	$<$	87%
B^-	if	80%	$\leq$	T	$<$	83%
C^+	if	77%	$\leq$	T	$<$	80%
C	if	73%	$\leq$	T	$<$	77%
C^-	if	70%	$\leq$	T	$<$	73%
D	if	60%	$\leq$	T	$<$	70%
F	if			T	$<$	60%

[Changes to this syllabus, when needed, will be announced in class]

Tentative Schedule

MAT 250 **Spring 2021**

Week 1 Jan 5, 7 — Introduction. Vector Spaces and Fields.

Week 2 Jan 12, 14 — Row reduction, $A\vec{x} = \vec{b}$. Linear Combinations, Linear Independence.
HW 1 Due Tuesday January 12, 2021

Week 3 Jan 19, 21 — Span. Subspaces. LU factorization.
HW 2 Due Tuesday January 19, 2021

Week 4 Jan 26, 28 — Bases, Dimensions, Coordinates, Change of Basis Matrices: ${}_{\beta}C_{\alpha}$.
HW 3 Due Tuesday January 26, 2021

Week 5 Feb 2, 4 — Linear Transformation. One-to-one and Onto. Isomorphisms.
HW 4 Due Tuesday February 2, 2021

Week 6 Feb 9, 11 — **Test 1** (Wed 2.11.20) Linear Transformations, Bases and Matrices.
HW 5 Due Tuesday February 9, 2021

Week 7 Feb 16, 18 — Matrices of Linear Transformations: ${}_{\beta}[T]_{\alpha}$.
HW 6 Due Tuesday February 16, 2021

Week 8 Feb 23, 25 — Nullspace and Range; Nullity and Rank. The Main Dimensions Theorem.
HW 7 Due Tuesday February 23, 2021

Spring Break Mar 1–5

Week 9 Mar 9, 11 — Rank. Compositions of Linear Transformations. Inverse Matrices.
HW 8 Due Thursday March 11, 2021

Week 10 Mar 16, 18 — Determinants and their properties.
HW 9 Due Tuesday March 16, 2021

Week 11 Mar 23, 25 — **Test 2** (Wed 3.25.20). Eigenvectors and Eigenvalues. Trace and Det.
HW 10 Due Tuesday March 23, 2021

Week 12 Mar 30, Apr 1 — Diagonolization. Inner product Spaces.
HW 11 Due Tuesday Mar 30, 2021

Week 13 Apr 6, 8 — Gram–Schmidt Orthogonalization. QR factorization.
HW 12 Due Tuesday April 6, 2021

Week 14 Apr 13, 15 — Projections onto subspaces. Least Square Approximation.
HW 13 Due Tuesday April 13, 2021

Week 15 Apr 19-23 — **Finals week.** **Test 3**

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