Department of Mathematics & Statistics
Concordia University

MAST 234
Linear Algebra and Applications I
Fall 2025

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Office Hours: Wednesdays, 12:30-14:00.

Class Schedule: Wednesdays & Fridays, 10:15–11:30.

Text: There is no mandatory textbook for this course, all the material will be available in the Lecture files and the Class work files that will be posted in the course page on Moodle. For additional reading and practicing at home most of the topics learned in this course can be found in following complementary open-source texts:
(A) *Linear Algebra with Applications*, by W. Keith Nicholson, Open Texts by Lyryx.
https://collection.bccampus.ca/textbooks/linear-algebra-with-applications-2023-a-d-vretta-lyryx-inc-446/

(B) *Linear Algebra, Theory and Applications*, by Ward Cheney & David Kincaid. The book is very good but currently out of production. Any on-line version or second-hand book of can be useful.

Prerequisites: MATH 204 or equivalent is a prerequisite for this course.

Objectives: There are two major concepts, *General Vector Spaces* and *Linear Transformations,* on which this course is based. In learning these concepts we will use related constructs such as *vectors*, *matrices* and *systems of linear equations*. The objective of the course is to master your understanding and skills in these key concepts of Linear Algebra that will be critical for further Linear Algebra courses in your curriculum.

Pedagogy: Classes are interactive and start with a lecture introducing the principal concepts of the topic considered that day, followed by problem solving by students in the lab equipped with computers. Mathematical issues that arise during problem solving are discussed in class.

Software: The software used in this course is *MAPLE.* In this course the software is only used as a platform for writing text and performing algebraic operations, and ***not* as an object of study**. The Waterloo's *Maplesoft* is making "MAPLE Student's edition" available to Concordia students at a special price (details are in Moodle). All assignments, quizzes and examinations are done using *MAPLE.*

Assignments: Assignments (homework) are given and submitted online through Moodle. Late assignments **will not** be accepted. Assignments contribute 10% to your final grade (see the Grading Scheme). *W*orking regularly on the assignments, class attendance and working on the problems in the class, is essential for success in this course.

Reading Week: No classes between October 11 and October 17, 2025.

Midterm Test: There will be **one midterm test**, written in class on **Wednesday October 22**. It will be 70 min long and will cover the material of previous weeks (see *CONTENTS* below). The test is of closed-book type, and will contribute up to 30% to your final grade (see the Grading Scheme).

NOTE: It is the Department's policy that tests missed for any reason, **including illness,** cannot be made up. If you missed the midterm because of illness (to be confirmed by a **valid medical note)** the final exam will count for 85% of your final grade, and 15% will be contributed by the assignments and the quizzes.

Final Exam: The Final Examination will be 3 hours long (**closed-book** exam, no notes or electronic material is allowed) written using Maple in the class equipped with computers.

PLEASE NOTE: Students are responsible for finding out the date and time of the final exam once the schedule is posted by the Examinations Office. Any conflicts or problems with the scheduling of the final exam must be reported directly to the Examinations Office, **not** to your instructor. It is the Department's policy and the Examination's policy that **students are to be available until the end of the final exam period. Conflicts due to travel plans will not be accommodated.**

Grading Scheme: The final grade will be based on the higher of (a) and (b) below:

(a) 10% for the assignments
5% for the best of the 2 quizzes (written in class, 30 min each)
30% for the midterm test
55% for the final examination

(b) 10% for the assignments
5% for the best of the 2 quizzes
10% for the midterm test
75% for the final examination

NOTE: Because the midterm test in option (A) contributes as high as 30% to your grade, the "Short-Term Absence form" **cannot be used as a justification for missing the midterm test** for either grading option.

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

Disclaimer: The instructor reserves the right to make changes to the course outline and course content should this be necessary for academic or other reasons.

CONTENTS

Week	Lectures TOPICS	Sub-Topics considered	Complementary Reading (KN Text)
1	**Lecture 1** Linear Systems Row Equivalent Matrices & GJ Method for LS	• Review of systems of linear equations. o Matrix form of a system o Matrix of the system; augmented matrix o Elementary Row Operations o Row Echelon Form o GJ Solutions for a system of linear equations	**Sections** **KN: 1.1, 1.2**
2	**Lecture 2** Span of Vectors Matrices Consistent systems RANK	• Review of vectors and matrices o Vectors in R^n. Linear combination of vectors o Matrix Operations, Matrix-vector products • Span of a set of vectors • Matrix Rank, Column & Row Spaces • Rank Theorems, Consistency of systems Ax=b	**Sections** **KN: 1.2, 2.1, 2.2, 2.3**
3	**Lecture 3** Homogeneous Systems Linear Dependence	• Linear dependence of vectors/vector sets • Homogeneous Systems of Equations Null Space of a matrix	**Sections** **KN: 1.3, 5.2, 5.4**
4	**Lecture 4** Operations on Matrices Determinants	**QUIZ 1** (on the material covered in previous weeks) • Operations on matrices o Multiplication of matrices: definition and properties o Special matrices Determinants (an introductory overview)	**Sections** **KN: 2.3, 2.4, 3.1, 3.2, 5.4**
5	**Lecture 5** Matrix Inverse	• Left and Right inverses of Matrices. • Invertible matrix (square) Properties of invertible matrices.	**Sections** **KN: 2.4, 3.2**
6	**Lecture 6** General Vector Spaces and Subspaces	• Examples of Vector Spaces R^n & Euclidean vector spaces Polynomials as vectors • Definition of Vector spaces, and its Properties • Linear Independence in Vector spaces. Vector Subspaces	**Sections** **KN: 6.1,6.2, 6.3**
7	**Lecture 7** Linear Transformations in R^n	**MIDTERM TEST** (based on the material of Lectures 1-6) Linear transformations in R^n o Domain, Co-domain, Range: o The Linearity properties: definition and examples o Matrices and linear maps: Theorems 1-3. o Composition of linear mappings (Theorem 2.3.8)	**Sections** **KN: 2.2, 2.3, 2.6**

8	**Lecture 8** Basis, Coordinatization Transition Matrices	• Basis for a vector space & Dimension Theorems on Spans and Basis • Coordinate vector, Coordinatization • Coordinates in different basis Transition matrices from one basis to another.	**Sections** **KN: 6.3, 6.4**
9	**Lecture 9** LINEAR MAPS (GENERAL) LINEAR MAPS &MATRICES	• Linear transformations in abstract vector spaces, other than R^n • Rank-Nullity Theorem • Matrix representation of a linear transformation Matrices of linear mappings of a vectors space into itself. Similar matrices	**Sections** **KN: 9.1, 9.2, 5.5**
10	**Lecture 10** EIGENVALUES & EIGENVECTORS, EIGENTHEORY	**QUIZ 2** (on the material covered in Weeks 7, 8, 9 • Eigentheory Basics ○ Eigenvectors and eigenvalues of matrices ○ Characteristic polynomial Eigenvectors and eigenvalues of a linear operator	**Sections** **KN: 3.3, 5.5. 9.3**
11	**Lecture 11** DIAGONALIZATION OF SQUARE MATRICES & APPLICATIONS	• Diagonalizable matrices and diagonalizable linear operators ○ Conditions of diagonalizability: basis of eigenvectors. ○ Numerical methods for diagonalization by MAPLE ○ Application of diagonalization (Dynamical systems)	**Sections** **KN: 5.5, 9.2**
12	**REVIEW**	Review Classes	

Student Services
You may wish to access the many services available to you as a Concordia student. An overview of these resources can be found here: https://www.concordia.ca/students/services.html

Academic Integrity and the Academic Code of Conduct
This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: https://www.concordia.ca/conduct/academic-integrity.html" *[Undergraduate Calendar, Sec 17.10.2]*

Behaviour
All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

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