

## Faculty of Science Course Syllabus (Section A)

Math 2135, Linear Algebra

Winter 2024

*Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.*

*Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.*

**Instructor:** Prof. Peter Selinger, Chase 303  
Email: [selinger@dal.ca](mailto:selinger@dal.ca) (please mention "2135" on the subject line)

**Lectures:** MWF 11:35-12:25, LSC C244

**Office hours:** TBA

**Course delivery:** In-person

### Course Description

This course is a continuation of Math 1030 with an emphasis on foundations and the theory of vector spaces and linear transformations. Additional topics include inner product spaces, symmetric and orthogonal transformations, bilinear forms, similarity and diagonalization, the solution of linear differential equations, and various applications in mathematics, physics and computer science.

### Course Objectives/Learning Outcomes

The difference between Math 2040 and this course is that Math 2135 is a proof-based course. Not only will proofs be given in class, but students will learn to write proofs themselves. The course is suitable for honours students and others with an interest in rigorous mathematics.

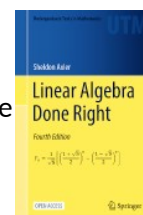
Topics include: Complex numbers, fields, vector spaces, subspaces. Span and linear independence, bases, dimension. Linear maps, null space and range, dimension theorem, matrices, isomorphism of vector spaces, products and quotients. Eigenvalues, eigenvectors, and invariant subspaces, diagonalizability. Inner product spaces, orthogonality, orthonormal bases, Gram-Schmidt orthogonalization procedure. Unitary, self-adjoint, and normal operators, the spectral theorem.

### Course Prerequisites

Math 1030 and Math 1000. Exclusions: Math 2040.

### Course Materials

Textbook: "Linear Algebra Done Right", 4th edition, by Sheldon Axler. The book is freely available from [linear.axler.net](http://linear.axler.net). There is also a set of videos to accompany the book.



### Course Assessment

Participation	5%	Participation in class, office hours, and discussion forums.
Homework	25%	Assigned throughout the semester, to be handed in <b>on Brightspace</b> .
Midterm	20%	Wednesday, Feb 28, in class.
Final Exam	50%	3 hours – Scheduled by the Registrar. Must pass final exam to pass the course.

**Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale**

A+ [90-100]	B+ [77-80)	C+ [65-70)	D [50-55)
A [85-90)	B [73-77)	C [60-65)	F [0-50)
A- [80-85)	B- [70-73)	C- [55-60)	

**University Policies and Statements**

*See Brightspace for "University Policies and Statements" and "Student Resources and Support".*

**Course Policies**

1. The Mathematics Learning Centre, which is located in Room 119 on the 1st floor of the Chase Building, is a great study space. Although Math 2135 is not officially served by the Learning Centre, you can drop by if you have difficulties with fundamental concepts. Tutors are available Monday–Friday 11:30–4:30 and 6:30–7:30 on a first come, first served basis, free of charge. The Learning Centre also has large tables where you can work together.
2. Calculators, textbooks, and notes are not permitted for Midterm Tests or the Final Examination.
3. Late homework will not be accepted except with the instructor's prior permission.
4. A missed midterm cannot be written at another time. If you miss the midterm without prior permission, then it will count as a 0. Exceptions are made in two cases: (1) if you obtain the instructor's prior permission to miss a midterm, or (2) if you have an officially valid excuse such as a medical doctor's note. In these cases, the weight of the missed midterm will be shifted to the final exam (e.g., the final exam will then count 75% instead of 50%). There is no make-up option for the final exam except in cases of an officially valid excuse such as a medical doctor's note.
5. Student Declaration of Absence forms will be accepted for missed homework, but not midterms or final exams. To miss a midterm or final exam, you must have a doctor's note signed by a medical professional.
6. Students are encouraged to study in groups, but each student must complete their own individual homework and exams. Homework must be written in your own words.
7. You are not permitted to copy answers from the internet or to ask anybody on the internet for help with your homework, including programming assignments. You may not use artificial intelligences to help with your homework. We may use plagiarism software and other technological means to detect academic integrity issues.
8. 5% of your grade is for participation. There are at least three ways to participate: you can ask or answer a question in class; you can ask or answer a question in office hours; or you can ask or answer a question in the Brightspace discussion forum. Each time you do so, you receive 1 participation point, up to a maximum of 5 points. 5 points equals 5%. I reserve the right to not award points in case of frivolous activity (e.g.: don't ask what is 1+1; don't ask questions you already know the answer to; don't answer your own question just to get a point; don't conspire to answer a friend's question just to get a point, etc. The point is participation).
9. You are welcome to email me with questions or issues that are private or personal to you. When asking math-related questions in the normal course of things, please use the discussion forum on Brightspace. This way, you can get participation points, and others can benefit from seeing your question and any answers that are already there. You are welcome and encouraged to answer each other's questions and be helpful, but obviously don't just post the answers to the homework in the discussion forum.

**Course content**

We will cover approximately the following textbook chapters: 1A-C, 2A-C, 3A-D, 5A, 5D, 6A-C, 7A-C.