DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics & Statistics
MATH 2040 (Online)
Matrix Theory and Linear Algebra 2
Winter 2021

Instructor(s): Professor Suresh Eswarathasan

Email: *sr766936@dal.ca* ("MATH 2040" must be mentioned in the subject line to receive a reply. I can only respond to emails between 8am-5pm Monday-Friday; please give me at most 24 hours to respond)

Official Synchronous Schedule: MWF, 10:35am-11:25am AST

Office Hours: On Zoom or Collaborate BB via appointment; synchronized class times can be used as office hours as well. There will be additional TAs available with their own office hours.

Lectures: **Asynchronous lectures** via video clips that will be uploaded at the beginning of each week. Official synchronized times will be used in a manner as suggested by students as well as for quizzes.

Tutorials: No tutorials will be held.

Course Description
This course is a continuation of MATH 2030. Topics include: vector spaces and linear transformations, complex numbers, inner product spaces, orthogonal and unitary transformations, quadratic forms, diagonalization of symmetric and hermitian matrices, the solutions of linear differential equations, and various applications in mathematics, physics, and computer science

Course Prerequisites
MATH 2030, and MATH 1000 or MATH 1500 or MATH 1215.

Learning Objectives
Students will learn advanced concepts of linear algebra, including real and complex vector spaces, inner product spaces, linear transformations, and orthogonality. We will discuss the use of vectors in representing and manipulating data, including image data, audio data, and statistical data. We will discuss many applications, including compression, coding theory, and cryptographic applications.

Course Materials

- Textbook: We will use an open source textbook, "Matrix Theory and Linear Algebra" (revised by P. Selinger), which will be made available on Brightspace.
- Course website on Brightspace is accessed through dal.brightspace.com

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Course Assessment

Weekly Webwork	*50%*	*Due Fridays before 11:59pm AST (Halifax)*
5 Quizzes	*50% (12.5% each, top 4 of 5)*	***Friday January 22, SYNCHRONOUS CLASS TIME***
		Friday February 12, SYNCHRONOUS CLASS TIME
		Friday March 5, SYNCHRONOUS CLASS TIME
		Friday March 26, SYNCHRONOUS CLASS TIME
		Friday April 7, SYNCHRONOUS CLASS TIME

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

A+ (90-100)	**B+** (77-79)	**C+** (65-69)	**D** (50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F** (<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)	

Course Policies

- Any excuse must be valid as per the current Dalhousie University guidelines. Given the fluidity of the situation, particularly in light of the COVID-19 pandemic, the university may change these policies and therefore certain leniencies will be in place. Medical notes are not absolutely required for Webwork extension requests or missed quizzes.
- Students are expected to use the Student Declaration of Absence form for missed quizzes or homework extension requests, and can be used as many times as needed.
- If a student misses a deadline, arrangements can be made (following one-on-one discussions) for later submissions or substitutions.
- Regarding missed quizzes and make-ups, the instructor must be contacted and a one-on-one discussion with a legitimate excuse, as per Dalhousie University guidelines, must be held.
- Students are expected to work on their own and consult regularly with the instructor as they progress through the exercises.

Course Content (**dates are approximate, applications may vary)**

- January 6-8: Complex numbers. Vector spaces.
- January 11-15 Applications: Hamming codes, authentication, secret sharing.
- January 18-22 Linear transformations.
- JANUARY 22 QUIZ 1, HELD DURING SYNCHRONOUS MEETING TIME
- January 25-29 Applications: transformations in 2d and 3d geometry. Perspective.
- February 1-3 (FEBRUARY 1 – LAST DAY TO DROP WITHOUT "W"): Inner product spaces, orthogonal and orthonormal bases. Gram-Schmidt procedure, projections.
- FEBRUARY 5 – MUNRO DAY (NO CLASS)
- February 8-10 QR-decomposition. Applications: Least square approximation, principal components analysis.
- FEBRUARY 12 QUIZ 2, HELD DURING SYNCHRONOUS MEETING TIME
- February 15-19 STUDY BREAK (NO CLASS)

- February 22-26 Orthogonal and unitary transformations. Fourier transform. Wavelets.
- March 1-5 Applications: signal processing, audio compression, image compression.
- MARCH 5 QUIZ 3, HELD DURING SYNCHRONOUS MEETING TIME
- MARCH 8 LAST DAY TO DROP WITH "W"
- March 8-12: Diagonalization of symmetric and hermitian matrices.

- March 15-17: Quadratic forms.
- March 22-26: Jordan normal form
- MARCH 26: QUIZ 4, HELD DURING SYNCHRONOUS MEETING TIME
- March 29-31: Applications: machine learning.
- APRIL 2: GOOD FRIDAY (NO CLASS)
- April 5-7: WEDNESDAY FOLLOWS A FRIDAY SCHEDULE
- APRIL 7: QUIZ 5, HELD DURING SYNCHRONOUS MEETING TIME