Math 1B03 (Linear Algebra I)
Sections 1 and 2 (C01/C02)
Course Outline for Term 1 2019-2020

Home page. `https://ms.mcmaster.ca/~vantuyl/courses/2019_fall_math1B03.html`

This course is an introduction to linear algebra. We are interested in both a computational approach (e.g., computing solutions to a linear system of equations) and a theoretical approach (e.g., an understanding of the underlying idea of a vector space). We will have lectures three times a week, plus weekly assignments and labs. The prerequisites for this course are one of Grade 12 Calculus and Vectors U, Grade 12 Geometry and Discrete U, or MATH 1F03.

Section 1 (C01) Class Time and Location Information.

Time: Monday, Wednesday, Thursday 4:30-5:20
Place: TSH (Togo Salmon Hall) B128

Section 2 (C02) Class Time and Location Information.

Time: Monday, Thursday 9:30-10:20, Tuesday 10:30-11:20
Place: TSH (Togo Salmon Hall) B128

NOTE: Both sections will be following the same schedule. The tests and assignments will also be the same.

Section 1 (C01) Instructor Information.

Instructor: Andres Zuniga
Office: Hamilton Hall 407
Office Hours Monday 2:20-3:20PM, Wednesday 3:20-4:20PM
Email `andres.zuniga@math.mcmaster.ca`

Section 2 (C02) Instructor Information.

Instructor: Adam Van Tuyl*
Office: Hamilton Hall 419
Phone: x27016
Office Hours Monday 2:20-3:30PM, Thursday 10:30-11:30AM
Email `vantuyl@math.mcmaster.ca`

* Dr. Adam Van Tuyl is the course coordinator.

Textbook Information.

- **(Required)** *Elementary Linear Algebra - Applications Version (11th Edition)*, by Anton and Rorres, Wiley. Note that we will use Chapter 10 of the 9th Edition to review complex numbers. A PDF version of this chapter will be on the website.
- **(Optional)** Student Solutions Manual for Elementary Linear Algebra - Applications Version.
- A copy of the textbook and student solution manual are available on reserve in Thode Library

Course Objectives. MATH 1B03 is the first course on linear algebra. By the end of this course, students should be able to:

- *do computations involving matrices* For example, you should be able to solve systems of linear equations using Gauss-Jordan elimination and matrix methods and find eigenvalues/eigenvectors of a matrix. Labs and assignments will facilitate this objective.

- *explain some theoretical underpinnings of linear algebra.* For example, you should be able to understand the language of vector spaces to develop a theory that supports and describes what is observed in the computations above. As well, you will practice critical thinking skills by demonstrating understanding of the concepts encountered in both computational and theoretical contexts. Labs and assignments will facilitate this objective.

Topics. Our goal is to cover the following topics: vector spaces given by solutions to linear systems; linear independence; dimension; determinants; eigenvalues and eigenvectors; diagonalisation; and complex numbers.

Assignment Information. There will be six assignments made available through online submission. They will be automatically graded if submitted before the deadline expires. A link to the assignments will be on the class webpage. The questions are either multiple choice questions or require you to submit a numerical answer. See the calendar at the end of this sheet for due dates.

Lab Information. There will be five labs which will require the use of Matlab (version 7 or later). These will be submitted using the online lab system. A link to the assignments will be on the class webpage. You can access Matlab in the campus computer labs in BSB anytime in the opening hours (check opening hours), as long as there is not another class using them. There are scheduled lab times exclusive for MATH1B03, which can be found on the class webpage.. You do not have to attend any scheduled lab times, but TAs will be available if you need help at the times given on the Lab information page. Matlab can be purchased at the campus bookstore or online directly from Mathworks (`https://www.mathworks.com/store/`).

Although Matlab is not available online, for most of your assignments, you can also use Octave Online (`https://octave-online.net/`). The syntax of Octave is very similar to that of Matlab.

Test Information. There will be two tests (duration 75 mins), tentatively set for the evenings of:

- Wednesday evening, October 2 (7:00-8:15PM)
- Wednesday evening, November 6 (7:00-8:15PM)

Room location will be provided at a later date. The topics covered on the test will be announced on the course webpage. Also, if you have a conflict, instructions will be given on the webpage. Students must bring ID cards. Calculators are **NOT ALLOWED** on any of the tests or the exam.

Final Examination Information. The final examination (duration 2.5 hours) will be scheduled by the registrar. The registrar will publish more information on the exams at a later date. The exam will cover all the material from the course; details on topics covered will be announced on the course webpage.

Marking Scheme Information. Your final mark will be calculated in two ways:

Weight 1		**Weight 2**	
Final examination	40%	Final examination	60%
Midterm tests	2 at 20% each = 40%	Max of Midterm 1 and 2	20%
Labs and Assignments	11 at $1.\overline{81}$% each = 20%	Labs and Assignments:	11 at $1.\overline{81}$% each = 20%

Your final mark will the highest of the above two numbers.

Course Support. In order to help you succeed in this course, the following services are available to you.

- **Practice Problems.** Suggested problems and practice tests/exams will be made available on the class webpage.
- **Tutorials.** There is a one hour tutorial each week. The tutorials are intended to provide additional material to help students learn the course material, and provide opportunities to ask additional questions and seek help. Although attendance in tutorials is not mandatory, it is strongly encouraged. There are two tutorial sections:
  T01: Mo 3:30PM - 4:20PM in TSH B128
  T02: Fr 2:30PM - 3:20PM in TSH B128
- **Drop-In Centre.** More personalized assistance can be obtained by coming to the Math Drop-In Centre on the first floor of Hamilton Hall. Tutors are freely available to assist with linear algebra questions. More detailed times and information is available on their web site:
  `http://www.math.mcmaster.ca/~mcleac3/Site/HelpCentreSite.html`

OFFICIAL McMASTER POLICIES

1. Policy on Academic Ethics. You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at:

`http://www.mcmaster.ca/academicintegrity/`

The following illustrates only three forms of academic dishonesty: (1) plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. (2) improper collaboration in group work, and (3) copying or using unauthorized aids in tests and examinations.

2. Academic Accommodation of Students with Disabilities. Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail `sas@mcmaster.ca`. For further information, consult McMaster Universitys Academic Accommodation of Students with Disabilities policy.

3. Requests for Relief for Missed Academic Term Work. If you have missed work, it is your responsibility to take action.

If you are absent from the university for medical and non-medical (personal) situations lasting fewer than 3 days, you may report your absence, once per term, without documentation, using the McMaster Student Absence Form (MSAF). Please see

`http://academiccalendars.romcmaster.ca/content.php?catoid=13&navoid=2208`
`#Requests_for_Relief_for_Missed_Academic_Term_Work`

Absences for a longer duration or for other reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. **In Math 1B03, the percentages of the missed work will be transferred to the final examination.** Please note that the MSAF may not be used for term work worth 25% or more, nor can it be used for the final examination.

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar Requests for Relief for Missed Academic Term Work. Please note these regulations have changed beginning Fall 2015.

4. Academic Accommodation for Religious, Indigenous or Spiritual Observances (RISO). Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's

Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

5. Important Message. The instructor and university reserve the right to modify elements of the course during the term. The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

6. On-line Statement for Courses Requiring Online Access or Work. In this course we will be using Crowdmark and `https://www.childsmath.ca/childsa/forms/main_login.php`, a local website hosted by the department. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

MATH 1B03 (PROVISIONAL) CALENDAR - FALL 2019

We will be using the following schedule. Please note that there may be changes; always refer to the website for the most recent information.

Week 1: September 3-7	
No Tutorials, Assignments, or Labs	
Lecture 1	Introduction 1.1 Systems of Linear Equations
Lecture 2	1.2 Gaussian Elimination
Week 2: September 9-13	
ASSIGNMENT #1: Due at 11:59pm on Friday Sept. 13	
Lecture 3	1.2 Gaussian Elimination (Continued)
Lecture 4	1.3 Matrices and Matrix Operations
Lecture 5	1.3 Matrices and Matrix Operations (Continued) 1.4 Inverses, Properties of Matrices
Week 3: September 16-20	
LAB #1 (Matlab): Due at 11:59pm on Friday Sept. 20	
Lecture 6	1.4 Inverses, Properties of Matrices (Continued)
Lecture 7	1.5 Elementary Matrices
Lecture 8	1.5 Elementary Matrices (Continued) 1.6 More Linear Systems and Invertible Matrices
Week 4: September 23-27	
ASSIGNMENT #2: Due at 11:59pm on Friday Sept. 27	
Lecture 9	1.6 More Linear Systems and Invertible Matrices (Continued)
Lecture 10	1.7 Diagonal, Triangular, and Symmetric Matrices 1.8 Linear Transformation
Lecture 11	1.8 Linear Transformations (continued)
Week 5: September 30 - October 4	
MIDTERM #1 Evening of Wednesday, October 2 LAB #2 (Matlab): Due at 11:59pm on Friday Oct. 4	
Lecture 12	10.5 Application (Graph Theory)
Lecture 13	2.1 Determinant by Cofactor Expansion
Lecture 14	2.2 Evaluating Determinants by Row Reduction
Week 6: October 7-11	
ASSIGNMENT #3 Due at 11:59pm on Friday Oct. 11	
Lecture 15	2.3 Properties of Determinants (including Cramer's Rule)
Lecture 16	5.1 Eigenvalues and Eigenvectors
Lecture 17	5.1 Eigenvalues and Eigenvectors (Continued)
Week 7: October 14-18	
FALL BREAK - no classes	

Week 8: October 21-25	
LAB #3 (Matlab) Due at 11:59pm on Friday Oct. 25	
Lecture 18	5.2 Diagonalization
Lecture 19	5.2 Diagonalization (Continued)
Lecture 20	10.1 (from 9th Edition) Complex Numbers 10.2 (from 9th Edition) Division of Complex Numbers

Week 9: October 28-November 1	
ASSIGNMENT #4 Due at 11:59pm on Friday Nov. 1	
Lecture 21	10.2 (from 9th Edition) Division of Complex Numbers 10.3 (from 9th Edition) Polar Form of a Complex Number
Lecture 22	5.3 Complex Eigenvalues and Eigenvectors
Lecture 23	3.1 Vectors in 2-space, 3-space, and n-space

Week 10: November 4-8	
MIDTERM #2 Evening of Wednesday, Nov. 6 LAB #4 (Matlab) Due at 11:59PM on Friday, Nov. 8	
Lecture 24	3.2 Norm, Dot product, and Distance in $\mathbb{R}^n$.
Lecture 25	3.3 Orthogonality 3.4 The Geometry of Linear Systems
Lecture 26	3.4 The Geometry of Linear Systems (Continued) 3.5 Cross Product

Week 11: November 11-15	
ASSIGNMENT #5 Due at 11:59pm on Friday Nov. 15	
Lecture 27	4.1 Real Vector Spaces
Lecture 28	4.1 Real Vector Spaces (Continued) 4.2 Subspaces
Lecture 29	4.2 Subspaces (Continued)

Week 12: November 18-22	
LAB #5 (Matlab) Due at 11:59pm on Friday Nov. 22	
Lecture 30	4.3 Linear Independence
Lecture 31	4.3 Linear Independence (Continued) 4.4 Coordinates and Basis
Lecture 32	4.4 Coordinates and Basis (Continued)

Week 13: November 25-November 29	
No lab or assignment this week	
Lecture 33	6.3 Gram-Schmidt Process
Lecture 34	6.3 Gram-Schmidt Process (Continued) 4.5 Dimension
Lecture 35	4.5 Dimension (Continued) 4.7 Row Space, Column Space, and Null Space

Week 14: December 2-5	
ASSIGNMENT #6 Due at 11:59pm on Tuesday, Dec. 3	
Lecture 36	4.7 Row Space, Column Space, and Null Space (Continued) 4.8 Rank, Nullity, and the Fundamental Matrix Spaces
Lecture 37	Review