# MAT223 H1-F Linear Algebra I
# Summer 2018

## Contact Information.

| Sections | LEC0101 | LEC5101 |
|---|---|---|
| Lecture Times | Tue. & Thu. 1-4 | Tue. & Thu. 6-9 |
| Lecture Rooms | WB116 | BA1170 |
| Instructors | Jeffrey Im | Fulgencio Lopez |
| Emails | jim@math.toronto.edu | fulgencio.lopez@mail.utoronto.ca |
| OH Locations | HU1028 | BA6181 |
| OH Times | Tue. & Thu. 9-10 | Tue. & Thu. 5-6 |

**Course Description.** This is the introductory linear algebra course - a topic with possibly the widest influence and greatest applications of any type of mathematics. It is a required course for Actuarial Science, Computer Science, Economics, Physics, Statistics and Mathematics specialists and majors, and is a prerequisite to MAT 224, APM 236, PHY 350, STA 257 and many other 200 and 300 level math and statistics courses. You should expect to see many examples of applications in lectures, in the course, and later in your life. We will introduce matrices and vectors to solve linear systems and geometric problems, then discover some of their important theoretical aspects. The course is heavy on computation and light on proofs, but you will need to understand and apply some definitions and theorems.
**Prerequisite:** High school calculus.
**Antirequisite:** MAT240 H1
**Note:** This is a Science course (Physical and Mathematical Universes, (5)) for breadth or distribution requirem ents.
**Text:** *Linear Algebra and its Applications*, $5^{\text{th}}$ Edition
**Authors:** David Lay, Steven Lay, and Judi McDonald;
**ISBN-13:** 978-0-321-98238-4

**Course Webpage.** http://www.math.toronto.edu/jim/223.html

**Blackboard.** We will only use Blackboard for grades. There is a syllabus on there, but it will not be updated. See the course webpage for the most up to date syllabus.

## Course Objectives.

At the completion of this course, students will be able to:

1. Analyse and solve small linear systems via matrix manipulation
2. Interpret and solve linear geometry problems in two and three dimensions
3. Compute various properties of a given matrix, including inverse, rank, determinant, eigenvalues and eigenvectors

## Grade Distribution.

| | |
|---|---|
| Two assignments, | 25% |
| Midterm, | 35% |
| Final exam, | 40% |

## Course Policies.

- **Tutorials**
  - Tutorials begin on the week of May 14th for five weeks.
  - There are no tutorials during the first week.
  - You must register for a tutorial, and attend the tutorial you are registered in.
  - To prepare for tutorials, you should attempt to solve as many of the recommended questions as you can, and make notes of where you got stuck on the questions you couldn't solve.
  - The TA will explain how to approach problems, demonstrate methods to solve them, and give enough details for a motivated student to write a complete solution. They will not give a lecture, and they need not solve anything if you do not ask them to.
  - Make an effort to participate in tutorials, and you will find you learn much more than you would on your own.
- **Assignments**
  - There will be two assignments which are to be submitted at your Thursday tutorial sections.
  - We recommend you spend at least 6 hours per week solving questions and that you start on these as soon as they're available so that you have plenty of time to think about them. Work together with other students at regular times to stay motivated and help each other.

- **Tests**
  - There will be one midterm on the week of May 28.
  - The final exam will be cumulative, with more emphasis on chapters 3 and 5.
  - If you have a conflict with a class or another test, there will be an early sitting from 4:10-6:00.
  - There are no make-up tests. If you miss a test for a medical reason, the weight will be added to the final exam.
- **Medical Notes**
  - Medical notes will be accepted ONLY from MDs with a valid CPSO number. You must present me with a University of Toronto Verication of Student Illness or Injury form within three business days of the missed quiz or test. Failure to submit proper, valid and timely documentation will result in a grade of 0 on the quiz or test.
  - The form is only considered valid if completed by a qualifed medical doctor - not an acupuncturist, chiropractor, naturopath or other health care professional. The form must be original and have all required fields filled properly and legibly, including the doctors CPSO number.
  - Upon submission of the documentation review of the medical note will be done before it is accepted as valid. The review may include following up with your doctor, your college registrar, or other departmental advisors.
  - Presenting a false medical excuse is a severe offence and will be dealt with through the Office of the Dean of the Faculty of Arts and Science.

**Academic Integrity.** You are expected to follow the Code of Student Conduct. It might be difficult to parse, so I recommend reading this summary from the faculty of Arts and Science and their tips to avoid misconduct.

All of the graded work in this course is done under supervision. You should not fear that other students are cheating to get higher grades. Conversely, if you do attempt to cheat, you should fear that you will be caught.

Do not do anything during quizzes or tests that may be construed as cheating, e.g. looking at other student's work, or looking at your notes, textbook, or phone.

Here is some advice from Nick Hoell, previous instructor and coordinator:

> "Cheating (including plagiarism) is very serious and, consequently, will be taken **very** seriously. Cheating can result in failure **or worse.** Dont do it! I caution you, the instructors of MAT223 are extremely diligent in pushing for the **maximum possible penalties** for those found cheating. Any collusion or fabrication during or after test/quiz situations will be vigorously pursued. This includes talking (or making other extraneous noises of any kind) during a test. We dont tolerate any kind of chatter during tests.
>
> **One other thing.** There are students for whom the statement "The test is now over, please put your pens and pencils down while we collect the tests" seems to not entirely register. We consider egregious dismissals of our requests to stop writing to be a form of academic integrity violations which we enforce with the same stringency as talking during a test. **Its not worth the risk!** Every semester there are students who dont heed this warning, and every semester this situation is dealt with through administrative channels that have serious consequences for the student."

**Tentative Course Outline.** The last page has the planned coverage for the course, with recommended exercises from the sections in the textbook. The content of tutorials will be the previous week's material. Note that section 2.5 (Matrix factorizations) and any sections covered in the last week are not being tested - they are for educational purposes only.

| Week | Content |
|---|---|
| May 6-12 | • Systems of linear equations. Row reduction and echelon form. Vector equations. Matrix equations.<br>• 1.1: 1-4, 11-18, 23,24.<br>• 1.2: 1-10, 17-22<br>• 1.3: 1-6, 9-14, 17, 18, 23, 24.<br>• 1.4: 1-4, 11-12, 17-20, 23, 24, 31, 32. |
| May 13-19 | • Solution sets of linear systems. Linear independence. Linear transformations. The matrix of a linear transformation.<br>• 1.5: 1-6, 21-24, 29-32.<br>• 1.7: 1-14, 21-26, 33-38.<br>• 1.8: 1-6, 9-12, 17, 19-22.<br>• 1.9: 1-12, 17-30.<br>• **Tutorials begin.** |
| May 20-26 | • Matrix operations. Inverse of a matrix and $2 \times 2$ determinants. Characterization of invertibility.<br>• 2.1: 1-12, 15, 16, 27, 28.<br>• 2.2: 1-6, 9, 10, 13-18, 25, 26, 29-33.<br>• 2.3: 1-8, 11-16.<br>• **Assignment 1 due on Thursday.** |

| Week | Content |
|---|---|
| May 27-June 2 | • Subspaces. Dimension and rank. Determinants. Properties of determinants. Cramer's rule.<br>• 2.8: 5, 6, 8-26.<br>• 2.9: 9-12, 15-21.<br>• 3.1: 1-4, 9, 10, 15, 16, 19-21, 25-32, 39, 40.<br>• 3.2: 5-7, 15-22, 24, 25, 27-30.<br>• 3.3: 19-24, 27, 28.<br>• **Midterm on Friday.** |
| June 3-9 | • Eigenvectors and eigenvalues. Characteristic equation. Diagonalization.<br>• 5.1: 1-12, 17-22.<br>• 5.2: 1-10, 21, 22.<br>• 5.3: 7-16, 21-26.<br>• **Assignment 2 due on Thursday.** |
| June 10-16 | • The dot product on $\mathbb{R}^n$. Orthogonality. Gram-Schdmit orthogonalization. Matrix representations revisited. The spectral theorem.<br>• 6.1: 1-8, 19. (a), (b), (e); 20 (a), (b), (c); 22, 23, 25-31.<br>• 6.3: 1-10, 13, 14, 17-22, 23 (a)-(c); 24 (a), (b); 26, 32.<br>• 6.4: 1-8.<br>• 5.4: 1-4, 8, 11-17.<br>• **Last week of classes and tutorials.** |
| June 17-24 | • **Final Exam**: Cumulative, but with more emphasis on content covered in the last half of class. |