Syllabus for Math 1410 A and B: Elementary Linear Algebra

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1 Essential Information

We begin with a list of the essential (and mandatory) details for the course:

Course Instructor

Dr. Sean Fitzpatrick
Contact: via email (sean.fitzpatrick@uleth.ca)
Office: UH C540
Office hours:

- Monday: 1 – 3 p.m.
- Wednesday: 10 a.m. – 12 p.m. and 1 – 3 p.m.
- Friday: 10 a.m. – 12 p.m.

Any exceptions to this schedule will be announced on Moodle.

Course Website:

via Moodle (moodle.uleth.ca)

Course Textbook

Elementary Linear Algebra: a book for Math 1410, based on texts by Greg Hartman, and edited by Sean Fitzpatrick. The web version (recommended) is at opentext.uleth.ca/Math1410.

You can also download a PDF version of the book, in several formats:

- single-sided colour e-book (opentext.uleth.ca/PDF/Math1410_ebook.pdf)
- black-and-white, for printing (opentext.uleth.ca/PDF/Math1410_print.pdf)
- for two-sided colour printing (opentext.uleth.ca/PDF/Math1410_colour_print.pdf)

All of these formats are provided at no cost to students.

Class Meetings

- *Math 1410A.*
  Tuesday & Thursday, 12:00 - 1:15 p.m. in Science Commons SA 6010
- *Math 1410B.*
  Tuesday & Thursday 10:30 - 11:45 a.m. in Science Commons SA 6010

First day of class is Thursday, January 8th

Tutorial Instructors

Sean Legge (faculty) and Nadi De Silva (graduate student)

Contact: via email (`sean.legge@uleth.ca`)

Tutorial Meetings

Tutorials meet on Wednesdays as follows:

- Tutorial 1: 9:00 a.m. in Anderson Hall AH118
- Tutorial 2: 11:00 a.m. in Science Commons SA6012
- Tutorial 3: 2:00 pm in University Hall C756

Course Description

(As per the Academic Calendar.)

> Linear systems. Vectors and matrices. Determinants. Orthogonality and applications. Vector geometry. Eigenvalues, eigenvectors, and applications. Complex numbers. Prerequisite(s): One of Mathematics 30-1, Mathematics 30-2, Pure Mathematics 30, Mathematics 0500, or Mathematics 0520.

For a more useful description:

Since your high school math classes spend all their time getting you ready for Calculus, you might be wondering what you're getting yourself into with a class in linear algebra. Historically, calculus was considered the "useful" course (at least, according to those in Physics and Engineering), while linear algebra was the gateway to abstract mathematics and proof.

You're still going to see some abstract math, but linear algebra has arguably become the more important subject, with applications ranging from image processing, to statistics, to machine learning. (If only time – and the calendar description – allowed us to explore the applied side of the subject!)

Ultimately, everything in linear algebra comes down to systematically solving systems of linear equations, but along the way, we create tools, like vectors and matrices, that turn out to be interesting in and of themselves. We will study these tools and their properties, and try to spend some time understanding why they're useful.

Linear algebra doesn't require quite as much background as calculus. You'll need to know how to add fractions, and factor polynomials, but you can get by without an encyclopedic knowledge of logarithms and trig functions. The tradeoff is that while calculus only ever deals with two or three variables, linear algebra is designed to study systems involving very large numbers of variables. This leads to a situation where we run out of letters and have to start numbering our variables. Many people don't like this at first, but you get used to it.

2 Welcome!

Welcome. Oki, and welcome to the University of Lethbridge. Our University's Blackfoot name is Iniskim, meaning Sacred Buffalo Stone. The University of Lethbridge acknowledges and deeply appreciates the Siksikaitsitapii peoples' connection to their traditional territory. We, as people living and benefiting from Blackfoot Confederacy traditional territory, honour the traditions of people who have cared for this land since time immemorial. We recognize the diverse population of Indigenous Peoples who attend the University of Lethbridge and the contributions these Indigenous Peoples have made in shaping and strengthening the University community in the past, present, and in the future.

Welcome, also, to this course! Like most of your courses, Math 1410 will be facilitated using the Moodle (`moodle.uleth.ca`) learning management system. You'll want to spend time as soon as you can familiarizing yourself with your course Moodle pages, and plan to check each one on a daily basis.

Don't hesitate to reach out if you have questions. If you have questions that are not related to the course, you can ask those too, and we'll try to answer, or to direct you to someone who can.

There's some great general advice for first year students (`www.uleth.ca/services-for-students/what-do-i-do-if`) on the U of L website, including links to Academic Advising and advice on study skills from the Student

Success Centre. Other resources can be found on the University's Health and Safety website (`www.uleth.ca/services-for-students/health-safety`).

3 Navigating the Course (a short how-to guide)

Doing well in mathematics doesn't require any special talent. It mostly requires good organization, a bit of perserverance, and knowing when to ask for help. (See Section 4, p. 4 for ways to get help.)

We try to keep the workload fairly consistent throughout the semester, which may be unlike other courses that tend to ramp up toward a midterm or big assignment. Figure out what needs to be done each week, set aside time to get it done, and stick to your schedule.

There are a few non-mathematical skills that you might lack coming into the course that take time to develop, but will come in handy throughout your education:

- Reading the textbook. The way you read a textbook is very different than other books! You should expect to jump around, skim in some places, read deeply in others, and always be willing to pause to ask questions, try examples, etc.
- Managing your time. The easiest way you can get yourself into trouble in a math class is to leave your work to the last minute.

  This also means allowing yourself time to wrestle with a problem: you learn by doing, and by fighting with the material.
- Studying. Keeping up with the homework should give you some confidence that you can manage the computational problems, but you can expect to be tested on your knowledge of definitions, concepts, theorems, etc.. A great way to set yourself up for success is to take notes as you read the book. If something has a heading (like Definition, Theorem, or Key Idea), it is probably something you want to make a note of! When you review your notes, try to come up with examples on your own, and think of where you've seen these things used during class.

Online homework. Online homework is assigned every week. Your answers are graded automatically by the computer, you get immediate feedback on whether or not your answer is correct, and you usually get unlimited attempts to get a question right if you make a mistake on your first try. (Multiple choice questions are a notable exeception to this policy.)

One of the best things you can do is to start the online homework right away. The exercises will be more useful to you if you work on them at the same time that you are seeing similar problems in class, and/or in the textbook.

Doing the problems early gives you plenty of time to ask for help on the ones you get stuck on, and doing a few each night is much less stressful than leaving them all for an hour before the homework is due.

Class meetings. We have two 75 minute classes and one 50 minute tutorial every week. I strongly recommend doing the readings *before* class: everything seems easier when you're seeing it for the second time.

We will spend about 50 minutes in each class doing examples and other material. The last 20 minutes of most classes will be used for a quiz.

The tutorial each week will involve a short assignment that you will be able to work together on, with help from the instructors in the room. The point of the tutorial assignment is to give you some initial exposure to the types of questions we expect you to be able to do, as well as some feedback on how you're doing. This is a low-stakes opportunity to find out if you don't know how to do a certain type of problem, or if the way that you've been doing a question is not the way we'll expect you to do it on a test.

One last bit of advice would be to find a study group. You will learn more by sharing (and critiquing) ideas with classmates, and meeting regularly will help you stay on track with your homework.

4 Getting Help

It is normal — in fact, one might say *expected* — that you will need help with understanding the material at some point during the course. (There's a reason the university pays to keep all these instructors around.)

The easiest place to ask for help is during class! Both lectures and tutorials will involve small group discussion, with an instructor and TAs circulating through the room. Put up your hand, and we'll come over as soon as we can.

There are also ways to ask for help outside of class.

Student Hours. Student hours (sometimes called office hours) are times set aside by the course instructor to be available to the students in the course. You can come for help with the course material, to ask more general questions, or simply to introduce yourself.

Our class are big, so it's unlikely that I'll get to know everyone during class time. But it's worth your time to make sure that your instructors get to know you! At some point in the future, you'll find yourself looking for a reference: for a job, a scholarship, or perhaps for graduate school. If I've never had a conversation with you outside of class, chances are the best I can write in a letter will be, "I can confirm that this person took Calculus with me in Fall 2025. They earned a A- in the course." Chances are that you'd want someone writing a letter to be able to say a bit more about you.

Campuswire discussion forum. We use Campuswire (`campuswire.com`) as an online homework Q&A forum. Instructions on how to sign up will be posted on Moodle.

Campuswire has some nice features, including support for mathematical notation, easy uploading of screenshots, and the ability to remain anonymous to your peers when asking a question.

5 Assessments and Grading

The various graded components of the course are explained below.

Online Homework The homework will focus on building fluency with computational procedures. You can expect a new problem set every week. Homework will be assigned via our WeBWorK server, and accessed through Moodle.

Online homework will be due every ***Friday*** at 11:59 pm, beginning with Homework 1 on January 16th.

Tutorial Every tutorial will involve an assignment to be completed. You will be encouraged to work on these problems (and submit) in groups. Tutorials will focus primarily on the computational procedures that need to be learned, and are a good indication of the sorts of problems you'll be expected to complete on the tests.

To get the most out of your tutorials, it is highly recommended that you try at least a few homework problems in advance.

Note: there is no tutorial on Wednesday, January 7th (the first week of class). However, there *will* be a tutorial on Wednesday, April 8th (the last week of class). Our timetable software is unable to distinguish between classes with a weekly 3-hour lecture and weekly tutorials, so you will not see the April 8th tutorial in your timetable.

Quizzes During the last 20 minutes of most lectures there will be a short quiz. Each quiz will consist of one or two questions, with each question tied to one of the learning outcomes listed in Section 8, p. 9. Each question will be graded according to the proficiency scale in Table 5.1, p. 5.

Tests There will be three tests.

Tests will take place on the following dates:

- *Test 1* (Chapters 1 and 2): Tuesday, February 10th
- *Test 2* (Chapters 3 and 4): Thursday, March 12th
- *Test 3* (Chapters 5, 6, and 7): Tuesday, April 7th

Final exam The final exam will contain one problem for each learning outcome in the course. *You do not have to complete every problem.* The purpose of the final exam is to give you one last opportunity to demonstrate proficiency in any learning outcomes you have not yet achieved. If you were able to demonstrate proficiency on a learning outcome twice during the quizzes and tests, you do not have to do it again.

Final exams are scheduled by the Registrar's Office toward the end of January. Once the exam timetable is released, you'll be able to look up your exam dates on the Bridge. Do not book any end-of-term travel until you know your exam schedule!

Your quiz and test questions will be graded according to the scale below. Note that although we are using numerical values to indicate your progress in each learning outcome, these values are not percentage scores. They are a coarse indicator of your understanding of a particular outcome.

Table 5.1 Math 1410 Proficiency Scale

3:	Proficient. You have demonstrated that you understand the procedure, and any errors in your work are insignificant.
2:	Minor errors. You mostly understood what you were doing, but made one or two small, but significant, mistakes. You can be marked proficient by fixing your mistakes during office hours.
1:	Approaching proficiency. You have made progress toward demonstrating understanding, but there are significant errors or omissions in your work. You will need to try again on a future quiz, test, or exam.
0:	Not yet proficient. Either you have not yet attempted a problem for this learning outcome, or there was not enough progress in your attempt for us to assess your understanding.

A maximum of 80 points can be earned in this course, as detailed below. Your score, in points, will be converted to a letter grade using Table 5.2, p. 6.

- There are 25 learning outcomes, and each demonstration of proficiency earns one point. You can demonstrate proficiency of each learning outcome twice, for a total of 50 points.
- Each tutorial you successfully complete will earn you 2 points, up to a maximum of 20 points.
- Your overall homework grade (out of 100) will be divided by 10 and rounded to the nearest point, for a maximum of 10 points.

Table 5.2 Conversion of points to letter grades in Math 1410

A+	78-80
A	74-77
A-	71-73
B+	68-70
B	64-67
B-	61-63
C+	58-60
C	54-57
C-	51-53
D+	47-50
D	42-46
F	0-41

Grading policies.

- *Missed quizzes and tests.*

  You can make up a missed quiz during office hours, a maximum of two times. Note that every learning outcome will appear at least three times: on a quiz, a test, and the final exam.

  If you miss a test, I can try to reschedule it, but our capacity for accommodating make-up tests is limited. Please give plenty of notice if you know in advance that you will not be able to attend a test.

- *Tutorial grades.*

  Tutorials are graded for feedback, and receive a grade of either 1 or 2.

  A grade of 2 indicates that you have demonstrated sufficient understanding of the material. It doesn't necessarily mean that everything is correct, but that any errors are minor, and don't indicate misunderstanding. A grade of 1 indicates that you were unable to demonstrate sufficient understanding of the material. This could mean either significant errors, or incomplete work. We will do our best to return your feedback prior to the next tutorial.

  If you receive a grade of 1 on a tutorial, you can upgrade your score to a 2 by attending office hours (either Sean Fitzpatrick or Sean Legge) to demonstrate how to do the question correctly.

- *Homework grades.*

  In lieu of extensions, the reduced scoring period will be used for online homework. This gives you an automatic 5 day extension, but work done during reduced scoring has a 5% penalty. For example, if there are 12 questions on the assignment, and you complete 8 before the due date, and the remaining 4 during reduced scoring, your overall grade would be $8 + 0.95(4) = 11.8$ out of 12, or 98.3%.

  There will be 12 homework assignments in total, and your grade will be based on the best 10 out of 12 homework grades.

6 Communication

The following communication channels are available in this course:

1. *Forums.*

   There will be a primary course Q&A forum using Campuswire (`campuswire.com/c/GDDF4EABC/feed`). A registration link and PIN code will be provided on Moodle. If you do not want to use your U of L email, we can send you an invite to a different address.

   Some reasons we like Campuswire:

   (a) Students can choose to remain anonymous (to their peers) when asking a question.

(b) You can set up chat rooms, either public or private, dedicated to specific topics.

(c) You can create a *live room* with support for video chat.

The Campuswire forum should be your primary communication channel. In particular, any questions about homework and course content should be asked on Campuswire, since I can reply there with mathematical notation. You will also get a much faster reply on the forum than you will from email.

2. *The WeBWorK "Email Instructor" button.*

   At the bottom of each page in WeBWorK is a blue button that says "Email Instructor". If you just want advice on how to solve a problem, please use Campuswire. However, if you have tried a problem several times, and can't figure out why your answer isn't being marked right, or if you have some other technical problem, you can use this button to send me a message. These messages contain a link that goes straight to your question, which makes it much easier for me to take a look at what you're doing.

3. *Email.*

   You can email your instructors for questions that aren't related to course content. For example, if you have to miss class, or a test, you can email us to let us know.

7 Course policies (an FAQ)

This section deals with questions about accommodations, missed tests, and other exceptional (yet common) cases.

1. *Can I email you if I have a question?*

   If it's about the homework, please use the Campusewire discussion forum. Otherwise, yes. In particular, please feel free to get in touch about scheduling conflicts, learning accommodations, etc.

   You don't need to let me know every time you miss a class. If your question might require a longer answer, it's probably better if you ask me in person, in my office.

2. *What calculator should I buy?*

   Unless you already own one, or need it for another class, don't waste your money on a graphing calculator. There are websites/apps like Desmos (`desmos.com`) that are free, and much more powerful (and user-friendly) than a graphing calculator.

   For tests and the final exam, any ***non-graphing*** calculator will be permitted.

3. *This week is super busy and I don't think I can finish the homework on time. Can I have an extension?*

   Extensions are handled automatically through the reduced scoring period. We drop your two lowest homework grades, so if it's a really bad week, you can get away with leaving one assignment unfinished.

4. *What happens if I get sick?*

   First and foremost, do not come to class and make everyone else sick! I'll do my best to be accommodating of any illness that interrupts your studies. There is no need to provide details of the illness. If you miss a week or more of work, please get in touch to make a plan for catching up. One of the biggest challenges in math is that once you fall behind, it's difficult to catch up on your own.

5. *What exactly does academic honesty mean?*

   In short, that any work you represent as your own, is your own. Much of your work can be done in groups, but not all of it. I will assume that you have access to a calculator, including online software that gives you step-by-step solutions.

   Use of these tools while practicing is acceptable, but take care that you are not overly reliant on them. What is not acceptable is having someone else do your work for you. This includes tutors, classmates, friends, family members, online "homework help" sites. If you submit work that somebody else did for you, you are committing an academic offence.

If you have someone else write a test or exam for you, not only have you committed an academic offense, but the person impersonating you is at risk of criminal fraud charges under Canadian law.

Penalties for academic dishonesty are outlined in the New student code of conduct (`www.ulethbridge.ca/policy/resources/new-student-code-conduct-policy`). Depending on the severity of the offence, penalties for a first offence can range from a grade of zero on an assessment, to an F in the course. Academic offences are also reported to the Dean of Arts & Sciences. They keep a record of each offence, and students with multiple offences can be subject to supplementary discipline.

6. *Do "acceptable online tools" include the use of AI?*

   If you are just doing extra practice and nobody better is around to talk to, you can use AI to check your work. If you use AI to do your homework (for marks) you're committing an academic offence.

   Do I have any way of finding out if you use AI to complete your online homework? Probably not. But the overall weight of your homework is quite small, and the point of the homework is to prepare for the tests.

   Existing cognitive research (`www.media.mit.edu/publications/your-brain-on-chatgpt/`) suggests that large language models are very good at tricking you into thinking you're engaging with content, while in fact you end up retaining about as much as if you had done nothing at all.

   The point of everything you do in a university class is the process, not the outcome. The process is where learning takes place. If you hand it off to someone (or something) else, you're depriving yourself of that learning opportunity.

7. *Does that mean I'm not allowed to get help with my homework?*

   Not at all! Working with classmates on your homework is a great way to learn. But keep in mind that your course instructors will be available for help, free of charge. (OK, maybe not free of charge, but you've already paid for it with your tuition.) We will be responding on the discussion forum regularly, There will be time to ask questions in every class, and there will be online office hours. The Student Success Centre will also be running free help sessions (details TBA).

   Some of you may still decide to pay for tutoring, and that's fine. But you have a duty to disclose sources of help on an assignment, and the individual tests are still tests, even if you won't have someone watching over your shoulder.

8. *I missed a test! What do I do? Do I get a zero?*

   See the grading policies, p. 6 above. In most cases, this will result in an additional 5% added to the weight of the final exam. With advance notice, there are some circumstances where we might be able to reschedule, but this is not guaranteed.

9. *What about the final exam?*

   If you are unable to write the final exam, you will need to contact Academic Advising. They are responsible for authorizing rescheduling of exams. Usually if you miss an exam due to illness, an incomplete grade is recorded. You will write a makeup exam at a later date, at which point your grade will be updated. If you miss the final exam because your parents booked you on a Carribean cruise, you are unfortunately out of luck.

10. *Do I need a doctor's note?*

    No. This wastes health care resources and your time. (That was my answer before the pandemic, and it's doubly so now.) Just email me to say you were sick. However, if you miss more than one test due to illness, we'll need to meet to discuss how to adjust your grade.

11. *I receive learning accommodations. What arrangements can I make?*

    First, make sure that you have registered with the University's Accessible Learning Centre (`www.ulethbridge.ca/accessible-learning-centre`). No need to let me know: they notify me of every student with accommodations.

If there are any adjustments I can make to facilitate your learning, please do not hesitate to get in touch with me. All students deserve an equal opportunity to learn. Note that the HTML textbook is designed with accessibility in mind, and should work with screen readers.

12. *Life intervened and I can't keep up this week. What do I do?*

    Send me an email. Extensions are usually granted as long as they're granted ahead of time. Online homework extensions need to be in place before solutions become available. Book an appointment with me as soon as you feel like you're falling behind and I'll do my best to get you up to speed.

8 Learning outcomes for Math 1410

This page outlines the list of competencies each student is expected to achieve in Math 1410. The online homework, tutorial assignments, and tests are all designed to help you achieve these outcomes.

By the end of the course, you should be able to:

A. Complex numbers and Vectors

1. Perform basic operations with complex numbers, including addition, multiplication, conjugation, and modulus
2. Perform vector addition and scalar multiplication, and interpret these operations geometrically
3. Compute dot products, and determine angles and orthogonality
4. Compute cross products, and determine areas of triangles and parallelograms
5. Compute vector projections, and use them to solve minimum distance problems
6. Determine and interpret equations of lines and planes, and compute intersections

B. Systems of equations

1. Translate between a system of equations and the corresponding augmented matrix
2. Use row operations to reduce a matrix to reduced row-echelon form (RREF)
3. Identify when a matrix is in RREF, and use the RREF to determine the general solution to a system of equations
4. Determine when a solution to a linear system exists, and when it is unique
5. Express a system of equations in matrix-vector form, and write the solution as a vector

C. Matrix algebra

1. Perform addition and scalar multiplication of matrices
2. Perform matrix multiplication
3. Determine the inverse of a matrix
4. Solve problems involving properties of the matrix inverse

D. Operations on matrices

1. Compute the trace and transpose of a matrix, and use properties of these operations
2. Use cofactor expansion to find the determinant of a matrix
3. Use row operations to find the determinant of a matrix
4. Solve problems involving properties of the determinant
5. Use determinants to compute the inverse of a matrix

E. Matrix transformations and eigenvalues

1. Use matrices to describe transformations of the plane.
2. Solve problems involving properties of linear transformations
3. Compute eigenvalues and eigenvectors of a matrix
4. Work with properties of eigenvalues and eigenvectors
5. Determine whether or not a matrix can be diagonalized, and if so, perform the diagonalization

9 Course schedule

I will attempt to follow the schedule below, bearing in mind that some adjustments are always needed Numbers below refer to textbook sections (like 2.3) or quizzes (like Q7).

Table 9.1 Schedule for Winter 2026

Week	Tuesday	Wednesday (tutorial)	Thursday
Jan. 8		***No tutorial***	Intro
Jan. 13–15	Ch. 1	1.2, 1.3, 1.4	2.1, 2.2, Q1
Jan. 20–22	2.3, Q2	2.1, 2.2, 2.3	2.4, Q3
Jan. 27–29	2.5, Q4	2.4, 2.5	2.6, Q5
Feb. 3–5	3.1, 3.2, 3.3, Q6	2.6	3.4, Q7
Feb. 10–12	Test 1	3.1 – 3.4	3.6
Feb. 24–26	4.1, 4.2, Q8	3.6, 4.1, 4.2	4.3, 4.4 Q9
Mar. 3–5	4.5, Q10	4.3, 4.4, 4.5	6.1, 6.2, Q11
Mar. 10–12	6.3, Q12	6.1, 6.2, 6.3	Test 2
Mar. 17–19	6.4	6.3, 6.4	6.5, Q13
Mar. 24–26	5.1, 5.2, Q14	6.5, 5.1, 5.2	7.1, Q15
Mar. 31–Apr. 2	7.2, Q16	7.1, 7.2	7.3, Q17
Apr. 7–9	Test 3	7.3	Review, Q18