

**University of Manitoba**  
**Department of Mathematics, Faculty of Science**  
**September–December 2024**

**Course Number and Title:** MATH 1210 Techniques of Classical and Linear Algebra

**Class Times and Locations:**

Monday, Wednesday, Friday 9:30 – 10:20 in Wallace 221

**Tutorial Times and Locations:**

**B01:** Friday 8:30 – 9:20 in University College 236

**B02:** Friday 10:30 – 11:20 in University College 236

**B03:** Friday 1:30 – 2:20 in Allen 330

**B04:** Friday 2:30 – 3:20 in Allen 330

**Instructor information:** D. Trim, Office: 306 St. Paul's; Phone 204-255-2740

**Email:** [Donald.Trim@umanitoba.ca](mailto:Donald.Trim@umanitoba.ca)

**Only emails using your university email address will be responded to.**

**Office hours:**

**Monday, Wednesday, Friday 10:30-12:30; Tuesday, Thursday 10:00- 11:20**

I will endeavour to be in my office at these times, but unforeseen circumstances may sometimes prevent me from being there, and I apologize for this. If these hours do not fit your schedule, we can discuss an alternative time for an appointment. If my door is open at any time outside official office hours, feel free to ask me any questions concerning the course. If the door is closed, I am either not in or prefer not to be disturbed. When you have difficulty with a certain exercise, and you wish to discuss it with me, bring whatever attempts you have made to solve the problem. This makes it much easier for me to diagnose what is troubling you.

**Web Page:** The web page for the course can be found at [home.cc.umanitoba.ca/~dtrim/](http://home.cc.umanitoba.ca/~dtrim/)

Follow the links to this course.

## **Calendar Description of Course:**

To introduce a variety of practical algebraic concepts and skills necessary for the study of calculus and advanced engineering mathematics. The emphasis of this course is in the development of methodology and algebraic skill necessary for successful completion of subsequent engineering mathematics courses.

## **A more Detailed Description of the Course:**

Subject matter for the course breaks into three units. The first unit is Chapter 1 wherein you will prove results by mathematical induction, and use sigma notation to represent sums symbolically. The second unit is Chapters 2 and 3. In Chapter 2, you will learn to represent complex numbers in Cartesian, polar, and exponential forms, and how to add, subtract, multiply, divide, and find roots of complex numbers. In Chapter 3, you will become familiar with properties of polynomial equations, and use the rational root theorem, Descartes' rules of signs, and a bounds theorem to find roots of polynomial equations. The last unit consisting of Chapters 4-9, is commonly referred to as linear algebra. Matrices and how to add, subtract, and multiply them are discussed in Chapter 4. In order to have a geometric interpretation of material in Chapters 6-9, vectors and their application to equations for lines and planes in three-space are presented in Chapter 5. In Chapter 6, you will learn how to solve systems of linear equations by Gaussian and Gauss-Jordan elimination. Chapter 7 introduces determinants and applies them to linear systems through Cramer's rule. This chapter also discusses the concept of linear dependence and linear independence of sets of vectors. Inverses of matrices are introduced in Chapter 8. You will learn how to calculate inverse matrices by the direct and the adjoint methods, and use them to solve linear systems. Chapter 9 deals with linear transformations, their representations as matrices, and eigenvalues and eigenvectors.

**Goals:** The course has four main goals:

1. to introduce you to sigma notation and proof by mathematical induction
2. to introduce you to complex numbers, and to familiarize you with properties of, and solution techniques for, polynomial equations
3. to introduce you to three-dimensional geometry
4. to familiarize you with the basics of linear algebra, including matrices and their inverses, solving systems of linear equations, determinants, linear transformations, eigenvalues and eigenvectors.

**Instructional Objectives:** At the completion of the course, the student is expected to be able to:

1. decide when and how to use mathematical induction to prove mathematical results
2. use sigma notation to represent summations in compact form
3. write complex numbers in Cartesian, polar, and exponential form, and find roots of complex numbers
4. find solutions of polynomial equations using the factor theorem, the rational root theorem, the bounds theorem, and Descartes' rules of signs
5. calculate dot and cross products of vectors, and use vectors to find equations for lines and planes in space
6. use augmented matrices along with Gaussian and Gauss-Jordan elimination to solve systems of linear equations
7. evaluate determinants and use Cramer's rule and inverse matrices to solve linear systems
8. determine whether a set of vectors is linearly independent or dependent
9. represent linear transformations as matrices and find their eigenvalues and eigenvectors

**Textbook:** Notes for Course MATH 1210: Techniques of Classical and Linear Algebra by Donald Trim (2012)

These notes contain all of the material for the course. You should digest the material thoroughly, not only to pass this course, but because the material is essential to many of your future courses in Engineering. You will not master mathematics simply by reading it; you must engross yourself in it. Here are some suggestions on how to study with the notes:

1. Ideally, pre-read material before each class. Sections are covered in class in the that appear in the notes. You will get much more out of class if you have some prior knowledge of the material.
2. Attend class. Learning begins in class, but only begins here. The amount of learning acquired in class is directly related to how much you put into the class. You should attempt to be involved in class discussions. You are much more likely to remember a discussion if you are involved in it.
3. You may take notes or you may choose not to take notes. If you do take notes, copy, or paraphrase, only what is on the board. Do not attempt to copy everything that I say; that, as you will soon see, is impossible. I love mathematics, and as my excitement grows, so also can my speed of delivery. But remember, I wrote the notes so everything important is there.
4. As soon as possible after class has finished, and therefore when ideas are still fresh in your mind, read the corresponding material in the notes, and do some

of the exercises. This is when real learning starts to take place. If you encounter difficulties with exercises that have no asterisk, then you have missed some key idea, and should therefore consult with me as soon as possible. Keep all solutions as they are an excellent source of review material for assignments and exams.

5. The notes contain answers to all exercises, and detailed solutions to even-numbered exercises (except the challenging two-asterisk exercises). Again, these solutions are not simply reading material. They should be consulted once you have finished an exercise and you wish to compare your method of solution with mine. Additionally, if you spend a reasonable amount of time attempting an exercise, but get nowhere, then take a brief glance at my solution to get yourself started, and then continue on your own.

**Exercises:** It is not my practice to suggest exercises from the notes. You should do as many exercises from the notes and tutorial problems in the time that you have available. It is a rule of thumb that you should spend 3 hours outside class per week for each hour of lectures; in other words, 9 hours per week on this course. It should be noted that exercises with no asterisk \* are considered routine problems. Difficulty with these exercises indicates a definite lack of understanding of associated material and help should be sought. Exercises with a single star are more difficult; they may require more intensive calculations or some creative thinking. Exercises with two asterisks are challenging and should be attempted only when other exercises have been mastered.

**Tutorials:** Each Friday tutorial problems for the following week will be posted on the course web page. You are to attempt to solve the problems **before** the tutorial. The teaching assistant will help you with difficulties that you encounter with the tutorial problems.

**Evaluation:** There are three components contributing to the final grade in the course.

**Quizzes** Five quizzes in the tutorials on September 27, October 11, October 25, November 22, and December 6 count 20% of the mark in the course. Quizzes begin at the start of the tutorial.

1. The best four of five quizzes each count 5%.
2. If a student does not take a quiz for any avoidable reason, his/her mark for that quiz will be zero. If a student misses a quiz for a valid reason, he/she must inform his/her instructor within 48 hours of the scheduled quiz.

3. If a student misses 2 quizzes for VALID reasons, each taken quiz will be worth 5% and the final exam will count 55%.
4. If a student misses 3 quizzes for ANY reason, he/she will receive an F in the course. Such students are encouraged to discuss the situation with their faculty advisor well in advance of the end of the course in order to come up with a plan of action.

**Midterm** The midterm, counting 30% of the mark in the course will be conducted October 28 from 5:45 to 7:00 pm in rooms that will be announced in class. In addition, the material for which you will be responsible will also be announced in class. If you miss the midterm and can provide an acceptable reason for doing so, you will be given the opportunity to write a make-up midterm. You will need to fill out a self-declaration form (available on the university web page) within 48 hours of the scheduled midterm, and submit it to your instructor.

**Final Exam** A two-hour final exam counting 50% is scheduled by Student Records. It covers the entire course, with material after the midterm weighted more heavily than material prior to the midterm.

**Notes, books, calculators or other computing devices are not allowed for the midterm or the final exam.**

**Grading:** The following can be used as a guide in changing numerical grades to letter grades. It is only a guide, however, as fluctuations in grade lines may occur.

Numerical Grade	Letter Grade
91-100	A+
83-90	A
78-82	B+
72 -77	B
66-71	C+
60-65	C
51-59	D
0-59	F

**Voluntary Withdrawal Date:** Voluntary withdrawal date is November 19, 2014.

## **Academic Dishonesty:**

The Department of Mathematics, the Faculty of Science and the University of Manitoba all regard acts of academic dishonesty in quizzes, tests, examinations or assignments as serious offences and may assess a variety of penalties depending on the nature of the offence.

Acts of academic dishonesty include bringing unauthorized materials into a test or exam, copying from another student, plagiarism and examination personation. Students are advised to read Academic Integrity and Examinations: Personations in the General Academic Regulations and Requirements of the current Undergraduate Calendar. Note, in particular, that cell phones and pagers are explicitly listed as unauthorized materials, and hence may not be present during tests or examinations.

Penalties for violation include being assigned a grade of zero on a test or assignment, being assigned a grade of "F" in a course, compulsory withdrawal from a course or program, suspension from a course/program/faculty or even expulsion from the University. For specific details about the nature of penalties that may be assessed upon conviction of an act of academic dishonesty, students are referred to University Policy 1202 (Student Discipline Bylaw) and to the Department of Mathematics policy concerning minimum penalties for acts of academic dishonesty.

All students are advised to familiarize themselves with the Student Discipline Bylaw, which is printed in its entirety in the Student Guide, and is also available on-line or through the Office of the University Secretary. Minimum penalties assessed by the Department of Mathematics for acts of academic dishonesty are available on the Department of Mathematics web-page.

**Available support services:** The following services are available to students encountering difficulties in adjusting to university life:

- The **Learning Assistance Centre**, located in 201 Tier, offers services that may be helpful to you as you fulfill the requirements of this course, and others. You may meet with a study skills specialist to discuss concerns such as time management, reading and note-taking strategies, as well as test-taking strategies.
- **Student Accessibility Services (SAS)** provides support and advocacy for students with disabilities of all kinds: hearing, learning, injury-related, mental health, medical, physical or visual. Students with temporary disabilities, such as sprains and breaks are also eligible to use SAS services. SAS acts as a liaison between students and faculty as well as support agencies within the province. Phone 474-7423.

- **Student Counselling and Career Centre** offers individual, couple or family counselling in individual and group formats. Phone 474-8592.
- **The English Language Centre** offers workshops and programs in advanced academic and health-sciences English (located in 520, University Centre)

**This is what you can expect of me:**

- make every effort to plan the course and each class so that learning will be maximized
- arrive five minutes early and begin class at precisely the appointed time
- conduct classes, and not give lectures. I will explain this under my expectations of you.
- be patient when you struggle with ideas (struggling reveals that learning is taking place)
- be open to suggestions (Suggestions can often lead to improvements in a course.)
- treat you as adult learners, with related respect
- provide you with plenty of office hours for consultations. I encourage you to see me during office hours as soon as you encounter difficulties. Do not delay.

**This is what I expect of you:**

- be punctual. The first few moments of a class are the most important. There is often a quick review of the main ideas from the last class and how they lead into the present class. General ideas and the “big picture” are often discussed in the first few moments. You are doing yourself a disservice by missing these discussions (as well as perhaps disturbing me and the rest of the class by being tardy).
- participate in class, which includes both speaking up and listening. Learning begins in class but most of it takes place when you study. Learning will begin here only if you contribute to the class; what you put into a class is directly related to what you get out. I will ask you many questions in the course of a class and for many different reasons. Your learning is substantially enhanced if you offer an answer, or at least formulate one. Do not come to class for the sole purpose of taking notes; that does not contribute to your learning. In order to answer many of the questions that I will pose, it is necessary for you to be familiar with what has transpired in recent classes. Try to keep up. Even better would be for you to read ahead. Topics are covered in the order of the notes. If you pre-read material, you will get far more out of class.
- be courteous when others are speaking. Only one person should be speaking at any given time during class. If you repeatedly have conversations with your neighbour while others are discussing course material, I will ask you to leave the room.
- complete all requirements of the course.

- use college-level, mathematical writing, legible and with correct format. There are many worked out examples in the notes; these should guide you on how to write solutions to problems on tests. In addition, the notes contain detailed solutions of even-numbered exercises, a further guide on how to present solutions.
- be honest. Submissions must be your own work.
- have the courage to ask questions in class if something is not clear. If you have a problem, it is quite possible that someone else has the same problem. I will attempt to clear the difficulty immediately. Should I not be able to do so, I may ask you to see me after class for further clarification.
- discuss difficulties that you are having with course material as quickly as possible. The longer you leave a difficulty unresolved, the more unbearable it becomes, and the further and further behind you become. I have plenty of office hours, or you can see me immediately before or after class to set up a special appointment.
- turn off cell phones when entering class.