

University of Manitoba
Department of Mathematics, Faculty of Science
September–December 2014

Course Number and Title: MATH 3130 Linear Spaces for Physicists

Number of Credit Hours: 3

Pre-requisites: MATH 2750, or MATH 2720 and Physics 2490

Class Times and Location: Monday, Wednesday, Friday, 12:30-1:20 in MH-418

Instructor information: D. Trim, Office MH410A, Telephone 474-8760,

Email- Donald.Trim@umanitoba.ca

Office hours: Monday, Wednesday, Friday 9:30-12:30

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, I am willing to 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. It is my practice to read my email first thing each morning (and sometimes at other times during the day). I will endeavour to answer any inquiries within 24 hours.

Web Page: The web page for the course can be found at home.cc.umanitoba.ca/~dtrim/

Follow the links to this course.

Web Page for Old Tests and Exams: www.math.umanitoba.ca/courses

Past examinations are for practice only. There is no guarantee that your examinations in this course will be similar to examinations from previous years.

Calendar Description of Course:

Review of linear algebra (MATH 1300), vector spaces, linear transformations, eigenvalues and eigenvectors, inner product spaces, additional topics as time permits.

A more Detailed Description of the Course:

Vector spaces and subspaces, linear independence of vectors, bases and dimension of a space; linear transformations and linear operators, their associated matrices, kernels, ranges and inverses, 1-1 and onto transformations; eigenvalues and eigenvectors; inner product spaces, adjoint, Hermitian, orthogonal, and unitary operators; applications of linear algebra to various problems in physics and engineering.

Goals: The course has five main goals:

1. understand when a sets of vectors constitutes a vector space
2. understand what it means for a set of vectors to be linearly independent
3. understand what it means for a set of vectors to be a basis for a vector space and components of a vector relative to a basis
4. know what the dimension of a space means
5. understand the concept of linear transformation and operator
6. know how matrices are associated with linear transformations
7. be able to discuss into, onto and 1-1 transformations
8. know the meaning of kernel, range, and inverse of a transformation
9. understand eigenvalues and eigenvectors of operators
10. understand the concept of real and complex inner product spaces
11. understand adjoint, Hermitian, orthogonal, and unitary operators
12. apply linear algebra in various applications of physics and engineering

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

1. use the definition of a vector space to decide whether a set of entities constitutes a vector space, or a subspace of a vector space
2. determine whether a set of vectors is linearly dependent or independent
3. determine whether a set of vectors is a basis for a vector space or subspace and find components of vectors relative to the basis
4. determine the dimension of a space or subspace
5. determine whether a transformation or operator is linear
6. find the matrix associated with a linear transformation
7. decide whether a transformation is into, onto, or 1-1
8. determine bases for the kernel and range of a transformation, and find its inverse
9. calculate eigenvalues and eigenvectors of operators
10. determine whether a bilinear function is an inner product in a real or complex inner product
11. determine whether an operator is Hermitian, orthogonal, or unitary
12. Apply eigenvalues and eigenvectors to simplify problems in physics and engineering

Notes: Notes for the course can be found on the course web page. There may not be sufficient time to cover all sections of notes. Information about which sections are required material will be given in lectures.

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

1. Three assignments each worth 5%.
2. A 50 minute midterm to be conducted in class worth 25%.
3. A three hour examination scheduled by Student Records counts for the remaining 60% of the final grade.

The midterm and final exam will be open-book.

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
90-100	A+
80-89	A
74-79	B+
68 -73	B
61-67	C+
55-60	C
50-54	D
0-49	F

Voluntary Withdrawal Date: Voluntary withdrawal date is **November 12, 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 section 7 (Academic Integrity) and section 4.2.8 (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.

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 (most of us struggle with new ideas in mathematics)
- be open to suggestions (they 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. 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.

- 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 and solutions manual; these should guide you on how to write solutions to problems on tests.
- be honest. Test and examination 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.