Math 415: Applied Linear Algebra

http://www.math.msu.edu/~seal/teaching/su13/

Summer 2013

Michigan State University[a]

TWF 12:40–14:30 Wells Hall A116

Instructor: David Seal (seal@math.msu.edu)

[a]Note: there are many hyperlinks hidden in this document!

1 Contact and Meeting Information

1.1 Meeting times

Course meets three days a week (**TWF**) for *two hours:* **12:40–14:30** in **Wells Hall A116**. We will have a five minute break halfway through each lecture.

It is your responsibility to learn the material presented in lecture. If you must miss a lecture for any reason, find notes from a classmate in order to make up the missing material. My suggestion is to do your best not to miss class, especially given that this is a fast paced, intensive summer course.

1.2 Office Hours

I live in **Wells Hall C330**. I guarantee my presence there every **Thursday** from **12:40–14:30**. Meetings outside of this time can be scheduled by appointment.

In addition, I maintain an "open door" policy, meaning that you are always welcome to stop by. If I am available, I will make time to meet with you, however, in order to guarantee a meeting, it is advisable to first make an appointment.

2 Course Overview

Math 415 is a second semester Linear Algebra course designed for undergraduate and graduate students working on scientific, engineering, statistics, and mathematics majors. This subject is arguably the most ubiquitous of all mathematics topics covered in a complete undergraduate education. Its presence is felt in theoretical mathematics, applied mathematics, science, and engineering.

2.1 Pre-requisites

Please visit the Registrar's website (https://www.reg.msu.edu) for a formal definition of what's required to enroll in this course.

2.1.1 Pre-requisites: Linear Algebra

You should have a working knowledge of basic Linear Algebra (e.g. MTH 309 or 314) in order to enroll in this course. An *incomplete* list of material that you should be familiar with includes the following:

1. Matrix and vector operations (e.g. multiplication and addition).
2. Gaussian elimination.
3. Matrix inversion (e.g. given A, use Gaussian elimination to find A^{-1}).
4. Determinants.
5. Finding Eigenvalues and Eigenvectors for small linear systems.

This course will provide extra practice with these techniques, but it will be assumed that you've at least heard these words before.

2.1.2 Pre-requisites: Differential Equation

Although the formal requirements ask for a working knowledge of differential equations (e.g. MTH 340), a solid knowledge of the linear differential equations material presented at the calculus level should suffice for this course. We'll study the more complicated systems version of those problems (c.f. §§5.2–5.3 from the textbook), as well as some linear recurrance relations.

2.2 Goals

The purpose of this course is to lay a solid foundation that can be used to investigate specialized topics. To this end, while we develop this foundation, we'll try to provide small samples of where Linear Algebra can be used in the applied mathematics community.

2.2.1 Textbook

Required textbook: Lorenzo Sadun, *Applied Linear Algebra: The Decoupling Principle,* 2^{nd} *edition.* Available on reserve in the library, from the Bookstore, or from a private seller such as Schuler Books or Amazon.
Recommended textbooks:

- Otto Bretscher, *Linear Algebra with applications*
- G. Strang, *Linear Algebra and its applications*
- G. Nagy, *Linear Algebra.* (Course notes that Prof. Nagy has used in the past for teaching this course. Available for free from http://math.msu.edu/ gnagy/teaching/la.pdf.)

2.2.2 Course plan

We will cover Chapters 1–7 plus selected topics along the way. This includes, but is not limited to,

1. Generalized vector spaces, bases, linear operators, and Eigenvalues.
2. Applications of Linear Algebra: systems of linear differential equations, stability, Markov chains, ...
3. Inner product spaces and least squares fitting.
4. Adjoints, Hermitian Operators, and Unitary Operators.
5. Fourier Series and the Discrete Fourier Transform (DFT).

3 Important Dates

Every day is important, some more than others. For a list of the more important dates, consider the following:

- Tuesday, July 2^{nd} - classes begin.
- Tuesday, July 30^{th} - Midterm exam.
- Wednesday, August 14^{th} - Final exam and last day of class.

Given the shortened clock, there will be absolutely no "make-up" exams offered. Do not register if you will be unavailable to take the final (and midterm) exam.

4 Evaluation

End of semester grades will be based on quizzes, midterms and final exam score. *You must pass the final in order to pass this course.* For each of the two exams, you will be permitted one sheet of notes.

There are two methods by which grades will be assigned:

	Quizzes	Midterm	Final Exam
Method 1	-	40%	60%
Method 2	20%	30%	50%

I will take the larger of these two grades, and I reserve the right to drop the lowest quiz score if needed. I do not recommend skipping the quizzes and relying solely on Method 1.

5 Keys to Success

Mathematics is the art of problem solving, and therefore in order to master this, you have to *solve problems*. Feel free to work out additional exercises from the textbook and other texts!

- Attend **Lecture**. Take complete notes in class: all of the supplemental material will be presented in lecture.
- Visit **Office Hours**.
- Read the textbook.
- Do *all* of the assigned **homework**. Start working on the assigned problems as soon as they're assigned.
- Study for the **quizzes.**
- Take the **midterm** and **final**!

6 Academic Honesty and Integrity

Don't cheat.[1]

[1] Visit MSU's policy on "Student's Rights and Responsibilities" or "Graduate Students Rights and Responsibilities" for a full discussion.