**SYLLABUS FOR MATH 221, WINTER TERM 1, ALL SECTIONS**

This document is adapted from the course canvas website: `https://canvas.ubc.ca/courses/45348`.

This document was accurate on 28 August 2019. The information on the course website is more up-to-date than this document.

## 1. Sections and Instructors

| Number | Time | Place | Instructor |
|---|---|---|---|
| 101 | TuTh 9:30-11 | Math 100 | Antonio Alfieri |
| 102 | MWF 10-11 | LSK 201 | Dan Coombs |
| 103 | MWF 1-2 | Math 100 | Ben Williams |
| 104 | MWF 1-2 | LSK 201 | Jishnu Ray |
| 106 | MWF 3-4 | MATX 1100 | Markus Lange |

All instructors can be contacted through the Canvas website.

## 2. Office Hours

You may prefer to attend the office hours of your own instructor, but all office hours are available to all students. The times of office hours will be made available on the website.

## 3. Description

Math 221: Matrix Algebra is an introductory course in linear algebra.

Linear algebra is a fundamental and extremely important topic in mathematics. Many other branches of mathematics are concerned with reducing more complicated questions to problems in linear algebra. For instance, calculus tries to reduce questions about curves and surfaces (or higher dimensional shapes) to ones about their tangent lines or tangent planes. These lines and planes are concepts in linear algebra. This course is a study of linear maps. We will learn what they are, how to manipulate them as well as tools (determinants, eigenvectors/eigenvalues, diagonalization) to visualize them better. Along the way we will also touch on various applications.

## 4. Assessment

4.1. **WebWork.** Homework assignments in this course will mostly take the form of automated WebWork assignments. These will be worth a total of 12% of the course grade.

They will be posted online each week, and will be due on the Thursday of the following week. Please note the following items: You may attempt each question as often as you like until you solve the problem. There is no penalty for a wrong answer. This is to help you correct your own mistakes, and to get instant feedback on your attempts. The questions are generated randomly, and the numbers are different for each student. Please try to do the problems by yourself, and without the use of other calculators or software, unless otherwise instructed.

Since calculators and software are not allowed in the exams, you should practice working without them. If you really get stuck, you can request help by clicking the email instructor button. It may take some time to get a response, so please don't wait till the last minute.

The deadlines are enforced by the system, and it will shut down automatically when time is up, so give yourself plenty of extra time in case of difficulties. Your lowest WebWork grade will be dropped in the final course calculation.

4.2. **MATLAB.** There will be 6 MATLAB assignments. They will also be due on Thursdays. We will award 5% of the course grade for these, by making each one worth 1% and dropping the lowest score for each student.

4.3. **Clickers.** We will incorporate interactive answering of questions into lecture using clickers. These will be worth a small amount of the final grade, 3%, all of which is for participation.

4.4. **Exams.** There will be two midterm exams and a final exam in this course. The times of the exams will be announced later. Both midterms will cover material covered in lecture up to the last lecture of the previous week.

4.5. **Final Grade Calculation.** Your final grade will be calculated as whichever is better for you of the two options

- 20% from the homework and class participation (clickers), (15+15)% from the two midterms, 50% from the final exam;
- 20% from the homework and class participation (clickers), 15% from one of the midterms, 65% from the final exam.

If you must miss a midterm, you will be graded according to the second formula above. No make-up midterms will be given.

We reserve the right to scale all course grades (for all students and all sections at once) in order to adjust for the difficulty of the final exam relative to previous years.

## 5. TEXTBOOK

The textbook for this course is Linear algebra and its applications by David Lay. The 3rd edition (customised for UBC) is the specific edition the department issues to instructors, although if you have another edition, that is fine. The custom UBC edition is taken from *Linear algebra and its applications* (4th edition) by David Lay. Used copies of this book or the 5th edition can be easily obtained and are not expensive.

## 6. TOPICS TO BE COVERED

Here is a preliminary list of the topics to be covered on a weekly basis. The references are to the third (UBC) edition of the book.

| Week | Chapter | Titles |
|---|---|---|
| 1 | 1.1, 1.2 | Systems of Linear Equations, Row Reduction and Echelon Forms |
| 2 | 1.2, 1.3, 1.4 | Row Reduction and Echelon Forms, Vector Equations, The Matrix Equation $A\vec{x} = \vec{b}$ |
| 3 | 1.5, 1.6, 1.7 | Solution Sets of Linear Systems, Linear Independence |
| 4 | 1.8, 1.9 | Introduction to Linear Transformations, the Matrix of a Linear Transformation |
| 5 | 2.1, 2.2 | Matrix Operations, the Inverse of a Matrix |
| 6 | 2.2, 2.3 | The Inverse of a Matrix (cont), Characterizations of Invertible Matrices |
| 7 | 2.5, 2.6 | Subspaces of $\mathbf{R}^n$, Dimension and Rank |
| 8 | 2.6, 3.1, 3.2 | Dimension and Rank (cont), Introduction to Determinants, Properties of Determinants |
| 9 | 4.1, 4.2 | Eigenvectors and Eigenvalues, the Characteristic Equation |
| 10 | 4.3, 4.4, 4.6 | Diagonalization, Discrete Dynamical Systems |
| 11 | 5.1, 5.2 | Inner Product, Length, Orthogonality, Orthogonal Sets |
| 12 | 5.3, 5.4 | Orthogonal Projections, the Gram–Schmidt process |
| 13 | 5.5, 5.6 | Least-Squares Problems, Applications to Linear Models |

**Notes.** Complex numbers are outside the scope of this course, so only real-number eigenvalues are covered.

## 7. Materials

Lecture notes will be provided as lectures are given. Other than this, required or recommended items consist of:

- The recommended book is any edition of Linear Algebra and its Applications by David Lay. The UBC bookstore sells an edition of this for $86 (before tax), but we recommend you get a used copy of the 4th or 5th edition, which should be less than $40.
- Some kind of iClicker device. You can either use a physical iClicker+ (or better) device. This can currently be bought for $60 new online (or less, if used). You may already own such a device, however. You can also use a smartphone with an iClicker Reef app on a smartphone. Currently this costs $16 for a 6-month subscription.

## 8. Expectation and learning goals

A page describing learning goals, broken down by section, appears on the website. In order to get a B-grade or better in this course, you should meet these goals and be able to apply what you have learned accurately in straightforward problems. To get an A-grade in the course, you should meet these goals, be able to apply what you have learned quickly and accurately and in more complicated problems.

## 9. Where to look for help, and other advice

For problems of a non-personal nature, please use the Piazza software (there is a link to this from the Canvas website). This is the best way to have a question answered quickly. For problems with the material or homework, the UBC Math Learning Centre will also be happy to help you. They offer a drop-in service starting from the second week of term: `https://www.math.ubc.ca/~MLC/`

Visit the MATLAB Help Centre to get help with your MATLAB assignments. You can also attend the office hours of your instructor or of any other instructor for Math 221.

For enrolment problems, talk to the math office.

For all other problems, contact your instructor.

## 10. UNIVERSITY VALUES AND POLICIES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available at `https://senate.ubc.ca/policies-resources-support-student-success`