MATH 221: MATRIX ALGEBRA, SECTION 102
2022, WINTER TERM 1

ABOUT THIS DOCUMENT

This is a PDF syllabus for Section 102 of Math 221. It is based on the syllabus on the Canvas website for the course, as it was on September 1 2022.

While we try to make both documents accurate, there may be mistakes and inconsistencies between them. The Canvas website will be updated more frequently, and if there is some difference between this syllabus and that one, assume the Canvas website is correct.

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.

LECTURES, TIMES AND LOCATIONS

Table 1: Times, locations and instructors of lectures

Section	Time	Place	Instructor	Instructor Contact
101	TuTh 9:30-11	CEME 1202	Prof. Sujatha	sujatha@math.ubc.ca
102	MWF 10-11	CHEM C124	Dr. Ben Williams	tbjw@math.ubc.ca
103	MWF 1-2	HENN 200	Dr. Anirudh Asuri Mukundan	anirudh.mukundan@math.ubc.ca
104	MWF 1-2	LSK 200	Dr. Keqin Liu	kliu@math.ubc.ca
105	MWF 1-2	DMP 301	Dr. Wenzhao Chen	chenwzhao@math.ubc.ca
106	MWF 3-4	BUCH A103	Dr. Keqin Liu	kliu@math.ubc.ca

Instructors in math courses have no control over registration. For registration questions, refer to `https://www.math.ubc.ca/undergraduate/advising-and-resources/registration-issues`.

OFFICE HOURS

Office hours are subject to change. You can attend the office hours of any instructor, not just your own.

Office hours will be posted here later.

You may also be able to make an appointment to meet your instructor at some other time.

TEXTBOOK

The textbook for this course is the online textbook Interactive Linear Algebra: UBC Edition.

Note that you can download a pdf version of the textbook from the linked website.

The textbook is based on Interactive Linear Algebra by Dan Margalit and Joe Rabinoff. Most of the chapters are the same, but the initial topics have been reordered.

Some years ago, this course was taught using Linear Algebra and Its Applications (4th edition) by David Lay. Most of the material is the same, so you might benefit from having a used copy of this book (or of the 5th edition) but it is not the official textbook for this version of Math 221.

ASSESSMENT AND GRADE

For Section 102, see here: https://canvas.ubc.ca/courses/103695.

In this course, there will be weekly WeBWorK assignments and MATLAB assignments every two weeks. The homework will count for 15% of the course grade. There will be some in-class participation, worth 5% of the grade. There will be two midterms and a final exam.

The midterms and the final exam are in-person exams.

At the end of the term, we will calculate your score based on one of these three formulas:

- 15% for each midterm and 50% for the final,
- 15% for one midterm and 65% for the final,
- 80% for the final.

We will automatically use whichever calculation is best for you.

In the case of regular assignments, (MATLAB, WeBWorK) we will automatically drop one (MATLAB) or two (WeBWorK) of your lowest-scoring submissions. This is the default "first concession". If you need more concession than this, consult the section titled "Concessions" below.

Table 2: Overall grade calculation)

Type	Number	Points each	Total points
WeBWorK homework	10 best of 12	1	10
MATLAB assignments	5 best of 6	1	5
In class participation	Answer 75% of questions		5
Midterms	0, 1 or 2 best of 2	15	0, 15 or 30
Final	1 best of 1	55, 70 or 85	50, 65 or 80
Total			**100**

MIDTERMS

There will be two midterms, in weeks 6 and 10 of the term. They will be in-person exams, on the UBC campus. Both will be 90 minutes long. The provisional timetable is this (for students not registered with CfA):

- Midterm 1 will take place on Wednesday 12 October, at 7pm.
- Midterm 2 will take place on Tuesday 8 November, at 7pm.

If you cannot take one of the midterms, don't panic. You do not have to take the midterms—the weight will be automatically be moved to the final, as part of the overall rules for grade calculation. We do not intend to provide alternate midterms.

FINAL

There will be a final exam, in the final exam period. It is an in-person exam.

 You can fail the final and still pass the course (although, since the final is a lot of points, this is hard to do).

HOMEWORK

WebWork. Homework assignments in this course will mostly take the form of automated WebWork assignments. They will be posted online each week (starting in week 2), and will be due on the Monday of the following week (this will be adjusted for Midterm 2). Please note the following items:

(1) For most questions, you may attempt each question up to 5 times.

(2) The questions are generated randomly, and the numbers may be different for each student.

(3) You are encouraged to discuss these problems with other students in this course, either on the Piazza website or independently.

(4) If you think there is a mistake in the question, contact the instructor on WeBWorK (but for math help, look on Piazza)

(5) 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.

(6) Your lowest two WebWork grades out of 12 will be dropped in the final course calculation.

MATLAB. There will be 6 MATLAB assignments. They will also be due on Mondays, starting on 26 September, and then every two weeks. If you submit multiple attempts, only the last-submitted attempt will be graded. We will drop the lowest score for each student. You may submit each assignment up to three days late, with a late penalty of 10% per day.

iCLICKER PARTICIPATION

There will be iClicker questions throughout the term. To get full credit for this portion, you need to answer 75% of these questions. It does not matter if you get the answers right: you just have to answer the questions.

Students not answering 75% of the questions will get a scaled proportion of the points. For instance: a student answering 60% of the questions will get 4/5.

TOPICS TO BE COVERED

A list of the topics to be covered on a weekly basis can be found in Table 3.

Note: we may not exactly keep pace with this list of topics. We might end up one lecture ahead or behind. This is especially true in Section 101, which meets on Tuesdays and Thursdays, so has different timing from the other sections.

Week	Section	Titles
1 (6-9 Sep)	1.1, 1.2	Vectors, Vector Equations and Spans
2 (12-16 Sep)	2.1, 2.2, 2.3	Systems of Linear Equations, Row Reduction, Parametric Form
3 (19-23 Sep)	2.4, 3.1, 3.2	Matrix Equations, Solution Sets, Linear Independence
4 (26-30 Sep)	3.2,3.3, 3.4	Linear Independence, Subspaces.
5 (3-7 Oct)	3.5,3.6, 4.1,	Basis and Dimension, Bases as Coordinate Systems, The Rank Theorem.
6 (10-14 Oct)	4.2	Matrix Transformations, One-to-one Transformations, Onto Transformations
7 (17-21 Oct)	4.3, 4.4, 4.5	One-to-one and Onto (continued), Linear Transformations, Matrix Multiplication.
8 (24-28 Oct)	4.6, 5.1, 5.2, 5.3	Matrix Inverses, the Invertible Matrix Theorem, Determinants: Definition, Cofactor Expansions.
9 (31 Oct-4 Nov)	6.1, 6.2, 6.3	Determinants and Volumes, Eigenvalues and Eigenvectors, the Characteristic Polynomial
10 (7, 8 Nov)		
11 (14-18 Nov)	6.4, 6.5	Similarity, Diagonalization, Complex Eigenvalues
12 (21-25 Nov)	6.6, 7.1, 7.2	Dot Products and Orthogonality, Orthogonal Complements
13 (28 Nov-2 Dec)	7.3, 7.4, 7.5	Orthogonal Projection, Orthogonal Sets, the Method of Least Squares
14 (5-7 Dec)		Gram–Schmidt Process, Review.

TABLE 3. Topics to be covered (and approximately when).

MATERIALS

The textbook is fully online (see link above).

You may wish to download a student edition of MATLAB (it takes about 3 GB of space on your computer), but it is not necessary to do this, since you can use MATLAB in the cloud instead. Instructions are on the MATLAB page.

This section will use the iClicker system. If you are in this section, you will need either an iClicker Student account (free) and an internet-enabled device to answer questions on, or a handheld iClicker device.

There are no other required materials.

Other supporting materials, including mini-lectures and learning goals, can be found on the modules page.

EXPECTATION AND LEARNING GOALS

A page describing learning goals, broken down by section, will appear on the Canvas 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.

WHERE TO LOOK FOR HELP, AND OTHER ADVICE

Come to office hours: all listed office hours in this course are open to students from any section.

Post on the course's Piazza page.

There is a team to support MATLAB in this class. For more information, look at the dedicated MATLAB page.

For enrolment problems, use the form here: `https://www.math.ubc.ca/undergraduate/advising-and-resources`

For all other problems, contact your instructor—via UBC email or through this Canvas website.

ACADEMIC INTEGRITY

The usual policy on Academic Honesty and Standards applies. Any kind of academic misconduct is prohibited. In Math 221, this chiefly applies to the midterms and the final, which are subject to the usual rules on misconduct as laid out in the academic calendar, and to the avoidance of plagiarism on homework assignments.

While you may freely discuss your assignments with other people in the class, you must submit your own answers, and not copy someone else's or pretend someone else's work is your own.

CONCESSIONS

UBC's general policy on Academic Concessions is set out here: `http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0`

The syllabus is already flexible about attending lectures, submitting homework and writing midterms. Specifically:

- You do not have to attend lectures or write the midterms. Stay home if you are sick or in quarantine.
- The notes from some lecture sections (certainly section 102) will be posted on this website for everyone (all sections) to read.
- You get to miss up to two WeBWorK submissions and one MATLAB submission without losing marks.
- You can submit MATLAB assignments up to 3 days late, with a point penalty.
- If you can't take a midterm, then the weight of that midterm will be automatically moved to the final.

If you need more concessions than listed above, then use the guidance here:

https://www.math.ubc.ca/general-syllabus-information.

For problems during the term, this means submitting a form to either your instructor, or to the Instructor-in-Charge, Ben Williams (`tbjw@math.ubc.ca`). For problems with the final exam, you will have to contact your faculty (Faculty or Science, Faculty of Arts etc).

Note: We will not grant any extensions on WeBWorK assignments. Instead we may exceptionally allow students to drop more than two WeBWorK submissions.

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 here.