

Mathematics 221

Matrix Algebra

2020 Winter Term 1 (Sept.–Dec. 2020) – Section 001

Note. All times displayed below are in Pacific Standard Time (PST).

General Information

Lectures: Tue: 8 – 9:30 AM and Fri: 3:30 – 5 PM. (Lectures will be recorded!)

Instructor: Dr. Paul Tsopméné

Office: FIP 324

Office hours: Mon, Wed: 1:00 – 2:30 PM, or by email, or by appointment.

Email: paul.tsopmene@ubc.ca

Lab: Every student must be registered in one of the lab sections. You should know your lab section number and the name of your TA.

Canvas: Zoom links, lecture videos, practice problems, and important dates will be posted on the canvas course page. It is your responsibility to check announcements and important dates frequently. Log in at <https://canvas.ubc.ca>

Textbook: *Linear Algebra and Its Applications* by David C. Lay, Steven R. Lay and Judi J. McDonald, 5th edition, Pearson.

Calculators: The use of a scientific calculator (non-graphing, non-programmable) is permitted.

Prerequisites: One of MATH 100, MATH 116.

Corequisites: One of MATH 101, MATH 142.

Course Description

MATH 221 covers the following topics.

- **Linear Equations in Linear Algebra:** Systems of Linear Equations, Row Reduction and Echelon Forms, Vector Equations, The Matrix Equation $Ax = b$, Solution Sets of Linear Equations, Applications of Linear Systems, Linear Independence, Linear Transformations.

- **Matrix Algebra:** Matrix Operations, The Inverse of a Matrix, Characterizations of Invertible Matrices, Subspaces of \mathbb{R}^n , Dimension and Rank.
- **Determinants:** Introduction to Determinants, Properties of Determinants.
- **Eigenvalues and Eigenvectors:** Eigenvectors and Eigenvalues, The Characteristic Equation, Diagonalization.
- **Orthogonality and Least Squares:** Inner Product, Length, and Orthogonality, Orthogonal Sets, Orthogonal Projections, The Gram–Schmidt Process, Least-Squares Problems.

Course Objectives

To enable the student to

- understand the fundamental objects, concepts, and computations of matrix algebra;
- apply these concepts to analyzing, modeling and solving a variety of problems.

Evaluation

The final grade will be based on Assignments (20%), Midterms (30%) and Final Exam(50%) as shown below.

Description	Weights	Dates	Duration
Assignments	20 %	See below	See below
Midterm 1	15%	Friday Oct. 9	60 minutes
Midterm 2	15%	Friday Nov. 20	60 minutes
Final Exam	50%	TBA	3 hours

- **Assignments.** There will be 7 assignments that will be posted on Fridays. The **due date** will be on the next **Friday at 11:59 PM.**

Assign- ment #	Assignment Topics	Will be posted on	Due dates
1	Syst. of Linear Equations, Row Reductions, Vect. Equations	Sept. 18	Sept. 25
2	Solution Sets, Applications of Linear Systems	Sept. 25	Oct. 2
3	Matrix Operations, Invertible Matrices	Oct. 16	Oct. 23
4	Subspaces of \mathbb{R}^n , Dimension and Rank	Oct. 23	Oct. 30
5	Determinants	Oct. 30	Nov. 6
6	Eigenvectors, Eigenvalues	Nov. 6	Nov. 13
7	Diagonalization, Orthogonal Projections	Nov. 27	Dec. 4

- **Practice Problems.** There will be additional practice problems that will be typed and posted each week. While completion of these problems is essential for your success in this course, you do not hand them in for grading.
- **Midterms.** There will be **two midterm exams** (60 minutes each), which are scheduled for the dates shown above. These will be written during the class time. **No make up midterms will be given. If a test is missed for a valid reason (e.g. medical or compassionate reasons, with documentation), the final exam will be weighted more heavily to compensate.**

Midterm 1 Topics	Midterm 2 Topics	Final Exam Topics
Systems of Linear Equations	Matrix Operations	Midterm 1 Topics
Row Reductions	Invertible Matrices	Midterm 2 Topics
Vector Equations	Subspaces of \mathbb{R}^n	Orthogonality
Solution Sets of Linear Systems	Dimension and Rank	Gram-Schmidt Process
Applications of Linear Systems	Determinants	Least-Squares Problems
Linear Independence	Eigenvectors and Eigenvalues	
Linear Transformations	Diagonalization	

- **Final Exam.** There is a three-hour comprehensive final exam during the final examination period from Dec. 7 – 22. **Failure to write the final exam at the scheduled time OR failure to attain a mark of at least 35% on the exam may result in a failing grade for the course.**
- **Submission Policy.** Once you are done with your assignment or midterm or final exam, you **MUST upload a single file** (preferably a PDF file) of your work on Canvas. For example, if your work consists of 10 pictures, you must first merge them into a single file and then submit the latter.

Lecture Outline

Lecture #	Description	Date
	No classes	Sept. 8
1	Systems of Linear Equations	Sept. 11
2	Row Reduction and Echelon Forms	Sept. 15
3	Vector Equations	Sept. 18
	Assignment # 1	
4	Equation $Ax = b$ and Solution Sets	Sept. 22
5	Applications of Linear Systems	Sept. 25
	Assignment # 2	
6	Linear Independence	Sept. 29
7	Linear Transformations	Oct. 2
8	Matrix Operations	Oct. 6
	Midterm # 1	Oct. 9
9	The Inverse of a Matrix	Oct. 13
10	Characterizations of Invertible Matrices	Oct. 16
	Assignment # 3	
11	Subspaces of \mathbb{R}^n	Oct. 20
12	Dimension and Rank	Oct. 23
	Assignment # 4	
13	Introduction to Determinants	Oct. 27
14	Properties of Determinants	Oct. 30
	Assignment # 5	
15	Eigenvectors and Eigenvalues	Nov. 3
16	The Characteristic Equation	Nov. 6
	Assignment # 6	
17	Diagonalization	Nov. 10

	Midterm Break	Nov. 12 – 13
18	Inner Product, Length, and Orthogonality	Nov. 17
	Midterm # 2	Nov. 20
19	Orthogonal Sets	Nov. 24
20	Orthogonal Projections	Nov. 27
	Assignment # 7	
21	The Gram-Schmidt Process	Dec. 1
22	Least-Squares Problems	Dec. 4

Useful Information

- **Math and Science Centre.** This is a good place to go if you need help other than at the time of a tutorial session:
<https://students.ok.ubc.ca/academic-success/learning-hub/math-science-tutoring/>
- **Supplementary Learning (SL).** SL sessions will be held and you are encouraged to attend. More information can be found at
<https://students.ok.ubc.ca/academic-success/learning-hub/supplemental-learning/>
 This will also be announced in class during the first week.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President’s Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the policies and procedures, may be found at:

<http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0>

If you have any questions about how academic integrity applies to this course, please consult with your professor. A current version of the above integrity statement can be found as a

.pdf in the following link:

<http://web.ubc.ca/okanagan/ikbarberschool/facultystaff/forms.html>

Disability Services

If you require disability-related accommodations to meet the course objectives, please contact the Coordinator of Disability Resources located in the Student Development and Advising area of the student services building. For more information about Disability Resources or academic accommodations, please visit the website at www.ubc.ca/okanagan/students/drc/welcome.html.

Equity, Human Rights, Discrimination and Harassment

UBC Okanagan is a place where every student, staff and faculty member should be able to study and work in an environment that is free from human rights based discrimination and harassment. If you require assistance related to an issue of equity, discrimination or harassment, please contact the Equity Office. www.ubc.ca/okanagan/equity