Teaching Dossier

Mitra Mansouri

November 8, 2024

Contents

1 Introduction

1.1 Brief Biography

I am an experienced mathematics educator with a PhD in Mathematics, specializing in Lie superalgebras and supersymmetric spaces. I have taught a variety of undergraduate courses at the University of Ottawa. As a part-time professor, I taught MAT 1339 - Introduction of Calculus and Vectors and MAT 1318 - Functions, engaging over 300 students and honing my ability to effectively communicate mathematical concepts. My teaching approach focuses on active learning, student engagement, and the integration of technology to enhance student understanding and participation.

In addition to my teaching experience, I have demonstrated potential for scholarly research through my involvement in projects in Algebra during my PhD studies. I am also well-versed in experiential learning and online course delivery, having designed and implemented online learning activities as part of my coursework and practicum experiences. My academic background includes a strong foundation in mathematics, as well as experience teaching and supporting students from diverse backgrounds.

I am excited about the opportunity to apply my teaching skills and expertise to support programs in the Mathematical sciences and beyond. I am committed to fostering an inclusive learning environment and helping students succeed in their academic and professional pursuits.

2 Teaching Philosophy

My teaching philosophy is deeply rooted in my journey as both a student and an educator. Beginning my teaching career in 2015 as a high school teacher, I discovered a passion for fostering student growth and facilitating learning experiences. Over the years, I have found immense fulfillment in connecting with students and guiding them towards achieving their academic aspirations. As I transitioned into higher education and took on roles as a teaching assistant and part-time lecturer, I recognized the profound impact that effective teaching can have on students' lives. Interacting with students from diverse backgrounds and witnessing their intellectual development reinforced my commitment to pursuing a career in university-level teaching.

My teaching philosophy is centered on creating an interactive and inclusive learning environment. I believe that fostering student engagement through interactive problem-solving and technology is essential for effective learning. The following principles guide my teaching:

2.1 Inclusive and Supportive Learning Environment

Creating an inclusive classroom is a fundamental aspect of my teaching. I strive to build an environment where all students feel comfortable expressing their ideas and asking questions. My exposure to diverse educational settings during my MSc studies, where I was taught by professors from various cultural backgrounds, greatly influenced my approach. The different teaching styles and the inclusive learning environments I encountered helped me navigate my studies successfully.

Recognizing that each student is unique, I incorporate diverse teaching methods to meet individual learning needs. I believe learning is most effective in a welcoming and supportive atmosphere that encourages active participation and builds confidence. I prioritize establishing strong relationships with my students, helping them feel confident in asking questions and engaging with the material.

In Canada's multicultural educational setting, with students from various cultural and linguistic backgrounds, it is vital to provide an inclusive environment where everyone feels empowered to express themselves, ask questions, and contribute to discussions. This approach is key to fostering academic success and excellence.

Additionally, I make myself available for one-on-one discussions and provide guidance to students who need extra support. I firmly believe that every student can succeed with the right encouragement and resources.

2.2 Active Learning and Student Engagement

My teaching experiences have focused on active learning activities. I like to engage students and receive feedback during and after the class. My teaching style is student-focused that creates more opportunities for student participation. In my lectures, I provide a blank pre-typed format of lecture notes that students can fill in during the sessions. This allows them to engage with the material actively as I explain and solve examples live on a tablet, projecting my screen. This approach helps students visualize the problem-solving process and encourages participation.

I frequently ask questions and challenge students with bonus questions to stimulate critical thinking and maintain their interest in the subject. These strategies ensure that students are not passive listeners but active participants in the learning process.

2.3 Formative and summative learning (Assessment for Learning and Assessment of learning)

Every student of mine is sure to hear the 4Ps: Passion, Practice, Patience and Perseverance. I teach my students the need to learn actively, think and understand what they learn. Understanding the concepts in mathematics is key but not enough. Students need to build a love for the subject, practice many examples, and this may need some level of patience and perseverance to get through. I include hands-on exercises during my class session, and also allow students to discuss their ideas in groups. This does not just offer me the opportunity to dispel the notion that mathematics is done alone, but also offers me the opportunity to ensure that students learn to work with people of different backgrounds which create an inclusive classroom. I give my students exercises, midterms examinations and several practice problems to enforce their understanding of the concepts I teach them. I also believe assessment should be cumulative and final exams should not carry too much weight in my classes so far as this is consistent with the policy of the University.

2.4 Clear communication of lesson objective

Clearly communicating the objective of each lesson has been a key aspect of my teaching practice. Before each class, I share the lesson objectives with my students. For example, I provide them with a pre-typed outline of the lesson objectives a day in advance. This allows students to know exactly what will be covered and gives them a note they can print and use to follow along during the lecture.

These notes also include a summary of previous lessons, which I use to review and help students recall key concepts before introducing new material. At the end of each lesson, I provide a summary of the main ideas covered and a study guide to help reinforce their understanding.

2.5 Use of Technology in Teaching

I am committed to integrating technology into my teaching to enhance student learning experiences and foster engagement. In addition to traditional classroom instruction, I have experience designing and implementing online learning activities using platforms such as Brightspace, allowing for interactive and personalized learning experiences.

In large classes, I use *Mobius* for assignments, which provides students with varied versions of the same type of problem. This not only promotes fairness but also gives students the opportunity to practice more effectively. Mobius also automates the grading process, allowing me to focus on providing quality feedback rather than spending extensive time on grading.

Furthermore, I incorporate graphing software into my lessons, encouraging students to utilize these tools for graph-related tasks.

2.6 Teaching Tailored to Meet Individual Student Needs

In my experience, students have a wide range of learning styles, levels of cognitive development, attitudes, family backgrounds, and prior knowledge. These factors play a significant role in shaping my teaching approach. I make a deliberate effort to get to know my students as early as possible, as understanding their individual needs allows me to tailor my teaching accordingly.

I place great emphasis on being available for informal discussions, as I firmly believe that a good teacher builds strong relationships with students, believes in their potential, and knows they can succeed with the right support. A good teacher engages students, encourages collaboration, and demonstrates multiple approaches to problem-solving.

In my classes, I aim to show genuine care for each student. Providing one-on-one support and adapting my teaching to accommodate different learning styles has proven to be highly effective. I also encourage the use of small group work and personal interactions to help clarify technical concepts. By responding promptly to student inquiries and offering quality feedback, I ensure that each student's needs are met, helping them achieve their full potential.

3   Teaching Experience

3.1   Courses Taught at the University of Ottawa

- **MAT1339 - Introduction to Calculus and Vectors (Fall 2023)**
  Taught over 300 students, focusing on the following: Instantaneous rate of change as a limit, derivatives of polynomials using limits, derivatives of sums, products, the chain rule, derivatives of rational, trigonometric, exponential, logarithmic, and radical functions. Applications to finding maxima and minima and graph sketching. Concavity and points of inflection, the second derivative. Optimization in models involving polynomial, rational, and exponential functions. Vectors in two and three dimensions. Cartesian, polar and geometric forms. Algebraic operations on vectors, dot product, cross product. Applications to projections, area of parallelograms, volume of parallelepipeds. Scalar and vector parametric form of equations of lines and planes in two and three dimensions. Intersections of lines and planes. Solution of up to three equations in three unknowns by elimination or substitution. Geometric interpretation of the solutions. The course syllabus can be found in Section 7.1.

- **MAT1318 - Foundations of Mathematics (Fall 2024)**
  There were about 90 student enrolled in this course. The course description is as follows: Polynomial and rational functions: factoring, the remainder theorem, families of polynomials with specified zeros, odd and even polynomial functions. Logarithms and exponentials to various bases, their laws. Trigonometric functions: radian measure, values of primary trigonometric ratios, compound angle formulae, trigonometric identities. Solving equations and inequalities involving absolute values, polynomial, rational, logarithmic, exponential and trigonometric functions. Their graphs. Operations on functions: point-wise addition and multiplication, composition; inverse functions. Average and instantaneous rate of change, approximating instantaneous rate of change, secants and tangents to graphs. Applications to graphing and finding maxima and minima of functions. Using functions to model, interpolate, and extrapolate data. A detailed course syllabus can be found in Section 8.1.

3.2   Other Teaching and Tutoring Roles

- **Staff Member: uOttawa Mathematics Help Center**
  I have been a regular staff member at the Mathematics Help Center since 2021, providing students with support in solving mathematical problems and preparing for exams.

- **Teaching Assistant: University of Ottawa** I have served as a teaching assistant for several courses at the University of Ottawa, supporting the instruction of various mathematics topics. My responsibilities included preparing and facilitating group discussions, proctoring exams, grading assignments and midterms, and entering grades into Brightspace. The class sizes typically ranged from 40 to 50 students.

  - **Calculus I**: Fall 2020, Winter 2020
  - **Calculus II**: Summer 2020, Summer 2021, Winter 2023
  - **Mathematical Methods II**: Winter 2020, Winter 2021
  - **Introduction to Linear Algebra**: Fall 2020, Summer 2021, Fall 2021, Winter 2022

- **Calculus for Life Sciences I**: Fall 2022
- **Ordinary Differential Equations and Numerical Methods**: Fall 2019
- **Applied Linear Algebra**: Fall 2019
- **Private Tutor**
  I have privately tutored students in both high school and university-level mathematics, helping them improve their understanding of complex topics and preparing them for exams.

3.3   Courses Taught at Azad University of Boroujen, Iran

- **Calculus III for Engineers** Taught over 100 students, focusing on the following: Extrema of functions of several variables. Multiple integration and applications. Vector fields and their derivatives. Curves. Vector differential operators. Line integrals. Surfaces and surface integrals. Theorems of Stokes, Gauss, etc.

4   Use of Technology in Teaching

There are several technologies that are valuable in my teaching, each offering unique benefits for engagement, assessment, collaboration, and visualization. In the following, I have mentioned some of these technologies and their specific advantages.

- **Brightspace and Online Resources:** I upload the syllabus, lecture notes, assignments, assignment solutions, midterm solutions, suggested exercises, practice tests, and additional resources to Brightspace, providing students with consistent access to all course materials at any time. This structure allows students to review and study at their own pace, fostering self-directed learning and reinforcing classroom instruction. Additionally, having all resources centralized on Brightspace supports students in keeping track of deadlines, preparing for assessments, and reducing the need for repeated requests for materials.

- **Mobius for Assignments and Assessments:** I use Mobius to assign and grade homework, particularly in large classes where manual grading would be time-consuming. Mobius provides personalized versions of each assignment, enhancing academic integrity by reducing opportunities for direct copying. Furthermore, the immediate feedback offered by Mobius helps students identify areas of improvement in real-time, promoting iterative learning and encouraging a proactive approach to mastering complex topics.

- **Screen Sharing and Interactive Teaching:** I conduct lectures using a tablet, where I solve problems live in front of the class while projecting my screen. This setup enables students to engage directly with the problem-solving process and ask questions as they arise, making the experience interactive and dynamic. Additionally, using a tablet allows me to maintain eye contact with students, fostering a more connected and engaging classroom atmosphere. This method is especially beneficial for visual learners, as it combines live demonstrations with real-time explanations, helping students retain concepts more effectively.

- **Desmos and GeoGebra for Graphing and Visualization:** Desmos and GeoGebra are powerful online graphing tools that allow students to explore functions, equations, and geometric shapes interactively. These tools enable dynamic visualization, which helps students understand complex mathematical concepts, like transformations, derivatives, integrals, and geometric proofs, by seeing them in action. Integrating these tools can make abstract concepts more concrete, especially for visual and kinesthetic learners.

- **Lecture Capture Tools (e.g., Panopto, Zoom Recording):** Lecture capture tools allow me to record live lectures for students to review later. This can be incredibly helpful for students who need additional time to process complex material or for those who missed a class. Recorded lectures with annotations or embedded questions can enhance students' learning experiences and improve retention.

5 Professional Development

5.1 Workshops Attended

I have attended several workshops to continuously improve my teaching practices. Some of these workshops include:

- **Integrating Technology in Large Classrooms** (2022)
- **Inclusive Pedagogy and Active Learning Strategies** (2023)
- **Assessment Strategies for Online Learning** (2023)

6 Evidence of Teaching Effectiveness

6.1 Professor, MAT1339 C00 Introduction to Calculus and Vectors

Detailed feedbacks of the formal course evaluation done by the University can be found in Appendix A. Here are Some Selected Student Feedback for MAT1339 C00 Introduction to Calculus and Vectors.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: Thank you professor Mansouri for always answering questions in class and taking the time to re–answer them when students don't understand.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: Overall, this course was very good despite being a challenging course. The professor is highly knowledgable in calculus physics and engineering, and can provide various levels of education.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: Great professor. I found her confusing at times (which may be expected in a math course) due to her teaching style and sometimes could not hear her clearly despite sitting in the front. I know she has the best interest for her students as she always encourages us to send her emails if there was something we did not understand which is nice. But I can't say I had the best time in her class as I would always have to relearn the topic again myself at home. She is very nice though! A note of constructive criticism: for lectures in the future, instead of just reading the lecture notes and solving the examples given, try explaining the lecture notes and key takeaways from the topic to remember, as well as go into depth explaining various (different cases of) examples instead of just 2 and moving on.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: I had a great experience taking MAT1339, Introduction to Calculus and Vectors, with Professor Mitra Mansouri. She is an excellent teacher who combines clarity with enthusiasm to make complex mathematical concepts accessible. The course materials were well–organized, and the lectures were engaging, which helped me to better understand calculus and vectors. I liked how Professor Mansouri explained abstract ideas with real–world applications, which made learning more enjoyable and practical. The interactive exercises and practical examples also helped solidify my understanding of challenging topics. Moreover, Professor Mansouri was always responsive to questions and willing to provide extra support outside of class time, which made the learning environment positive and supportive. I particularly appreciated the use of technology, such as interactive software and online resources, which enriched the overall learning experience. To enhance the course further, I suggest incorporating more opportunities for collaborative problem–solving sessions or real–world case studies to provide practical insights into the applications of calculus and vectors. Overall, Professor Mitra Mansouri's dedication to creating a conducive learning environment, along with her excellent teaching skills, greatly contributed to my success in this course.

- The professor was good, she managed to help pull students along through a heavy course and lead students to finding the answers.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: Compared to other MAT1339 courses at Uottawa Ive taken, I liked this one the best. The professor

clearly explains concepts and answers students questions. My biggest issue with this class was that the midterms were more different than the reviews than I would have expected. I felt that the exams were hard to study for as I never really knew what would be on them. I also found that the review questions were typically easier than those on the tests or mobious assignments.

- - Mitra Mansouri: Professor Mitra Mansouri is a great teacher. She goes over materials thoroughly and always checks in with the class during lectures to make sure everyone understands the topics. She does not hesitate to go over subjects which helps students. Overall I think the class was great, however there is too much material to cover in the course and not enough time. The final exam is too soon considering how much time students need to process difficult courses like math.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: She was an excellent professor and she cares about her students. All the instructions were clear and her methods of teaching are exceptional.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: The teacher is great she makes sure you understand the concept and she explains really well.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: The professor is excellent, she can explain all the hard concepts very well and always asks us if we have understood what she has taught at the end of each lecture.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: I liked how went through the questions in class and didn't waste time on things that were not that important and explained things well. Something that can be improved on is the lecture on natural logarithms wasn't that clear.

- MAT1339 C00 Introduction to Calculus and Vectors - Mitra Mansouri: I enjoyed this class immensely. The instructor's clear explanations made complex concepts understandable. The supportive environment fostered effective learning. A highly enriching course that enhanced my understanding in math.

Some Selected Student Feedback from https://www.ratemyprofessors.com/professor/2962509:

- 10/10 recommend for any class she may be teaching

- An excellent professor who clearly explains problems using effective examples.

- Very good doctor helps understand the subject inside and outside of the classroom and if you study the lectures and past midterm your good to go

6.2 Teaching Assistant, MAT1341 A01 Introduction to Linear Algebra

- Takes time to explain the questions thoroughly. Is good at simplifying hard–to–understand subjects.

- Goes through the material slowly. Exlplains each question from various angles.

7 Sample syllabus and course materials (MAT 1339)

7.1 Syllabus

Syllabus: MAT1339C Introduction to Calculus and Vectors (Fall 2023)

INSTRUCTOR: Mitra Mansouri   *****EMAIL**   mmansou2@uottawa.ca

*Please use your official University of Ottawa and write "MAT1339" in subject line of all emails to me.

DESCRIPTION OF THE COURSE   Instantaneous rate of change as a limit, derivatives of polynomials using limits, derivatives of sums, products, the chain rule, derivatives of rational, trigonometric, exponential, logarithmic, and radical functions. Applications to finding maxima and minima and graph sketching. Concavity and points of inflection, the second derivative. Optimization in models involving polynomial, rational, and exponential functions. Vectors in two and three dimensions. Cartesian, polar and geometric forms. Algebraic operations on vectors, dot product, cross product. Applications to projections, area of parallelograms, volume of parallelepipeds. Scalar and vector parametric form of equations of lines and planes in two and three dimensions. Intersections of lines and planes. Solution of up to three equations in three unknowns by elimination or substitution. Geometric interpretation of the solutions.

Prerequisite: Ontario 4U Functions (MHF4U) or MAT 1318 or equivalent. The courses MAT 1339, Ontario 4U Calculus and Vectors (MCV4U) or any equivalent cannot be combined for units.

COURSE INFORMATION

LECTURES:

LEC	Monday	5:30 – 6:50 pm (EDT)	100 Louis Pasteur (CRX) C240
LEC	Wednesday	5:30 – 6:50 pm (EDT)	100 Louis Pasteur (CRX) C240

DGDs! This is your Discussion Group, led by a graduate student TA. Prepare by doing the posted exercises, and use your time well by asking questions! You are registered to **one** of the following DGD sections:

DGD C01	Tuesday	8:30 am – 9:50 am (EDT)	60 University (SMD) 224
DGD C02	Tuesday	4:00 pm – 5:20 pm (EDT)	125 University (MNT) 203
DGD C03	Tuesday	8:30 am – 9:50 am (EDT)	161 Louis Pasteur (CBY) B012

OFFICE HOURS! Whenever you need concepts clarified or would like to discuss the course, please drop in to my Office Hours:

Office hours	Wednesdays	1:30 – 3:00 pm (EDT)	150 Louis Pasteur (STM) 666

STAY UP-TO-DATE WITH BRIGHTSPACE! The course webpage is on **Brightspace (Virtual Campus)** of the University of Ottawa. Announcements, lecture notes, tests and more will be posted there. You will need to check Brightspace regularly.

TEXTBOOK! *Calculus and Vectors 12 (Erdman, Ferguson, Lenjosek, Speijer), ISBN : 9780070126596*

MATH HELP CENTRE!   In addition to the DGDs, lectures, and professor's office hours, you can get help via the Math Help Centre which is located in STEM Complex, room 207 from September 18 until December 15: Monday to Wednesday: 10:00-7:00, Thursday: 10:00-5:00 and Friday 10:00-3:00. The Math Help Center is closed during the Study break: October 23-27. It is strongly recommended that students come with clear and specific questions. Explaining a whole section of a course is not in the mandate of the center. For more details, go to
https://www.uottawa.ca/faculty-science/student-life-services/help-centres

ACCESSIBILITY: The University of Ottawa is committed to ensure that persons with disabilities have equal access to its services and events. If you are in need of accommodation during this course due

to a disability, please consult with Access Services as soon as possible:
https://www.uottawa.ca/study/academic-support/accommodation-services-available

How you will be evaluated

Möbius homework worth 10%

There will be online 4 assignments worth a total of 10% (2.5% each) on the following dates:

Assignment 1 — Start Date: Sunday, September 17. Due Date: Wednesday, September 27.

Assignment 2 — Start Date: Thursday, September 28. Due Date: Sunday, October 8.

Assignment 3 — Start Date: Sunday, November 5. Due Date: Saturday, November 18.

Assignment 4 — Start Date: Monday, November 26. Due Date: Friday, December 8.

2 Tests worth 20% each

The tests will be written during the lecture on the following two dates:

Test 1 — Wednesday, October 11th, from 5:30 PM until 6:50 PM (EDT)

Test 2 — Wednesday, November 22nd, from 5:30 PM until 6:50 PM (EDT)

Final Exam worth 50%

There will be a cumulative 3-hour final exam, scheduled during the Exam Period (Dec. 10–22, 2021). The final exam schedule will be posted around reading week.

Additional Course Evaluation Policies:

- If your mark on the Final Exam is lower than 40%, then you will fail the course (F), regardless of your other marks.

- If your mark on the Final Exam is higher than your Möbius homework component, and/or your grade on any one or more of the Tests, then the weight of all such assessments will be transferred to the weight of the final exam (whenever it is to your advantage).

- If you missed a test by a valid reason with appropriate proof, the weight will be moved to the final exam. No makeup tests will be arranged.

- Checking the Test/Assignment/Quiz/Exam Grades: It is your responsibility to make sure that your marks recorded correctly by visiting Brightspace.

Mobius

All assignments will be completed using Mobius. You need to buy license, which is valid for one year. The website with a list of FAQ is:
https://mysite.science.uottawa.ca/bdionne/teaching/Mobius

Important dates for MAT1339C

Wednesday, **September 6**	first LEC
Tuesday, **September 12**	first DGD
Sunday, **September 17**	Möbius Assignment 1 start
Wednesday, **September 27**	Möbius Assignment 1 due
Thursday, **September 28**	Möbius Assignment 2 start
Sunday, **October 8**	Möbius Assignment 2 due
Monday, **October 9**	Thanksgiving – no lectures
Wednesday, **October 11**	**TEST 1** (20%) from 5:30 PM until 6:50 PM (EDT)
October 23–29	reading week break
Sunday, **November 5**	Möbius Assignment 3 start
Saturday, **November 18**	Möbius Assignment 3 due
Wednesday, **November 22**	**TEST 2** (20%) from 5:30 PM until 6:50 PM (EDT)
Monday, **November 26**	Möbius Assignment 4 start
Tuesday, **December 5**	last DGD
Wednesday, **December 6**	last LEC
Friday, **December 8**	Möbius Assignment 4 due
December 9–22, 2023	final exam period

You can see the important academic dates via the website:

https://www.uottawa.ca/current-students/important-academic-dates-deadlines

Rough Course Schedule

This is the planned course schedule. The Tests and homework dates are fixed. The subjects covered on any given day may drift a little depending on class interest

- Sept. 6 and 11 : Introduction; Rate of change; Precalculus Review.

- Sept. 13 and 18: Limits and Continuity (most of chapter 1 of textbook).

- Sept. 20 and 25: Derivatives (Polynomials, Chain rule and Quotient Rule (chapter 2 of textbook)).

- Sept. 27 and Oct. 2: Derivatives: Applications to Curve Sketching (part of chapter 3 of textbook). More curve sketching. Applications to Optimization Problems (remainder of chapter 3 of textbook).

- Oct. 4: Test 1 Review.

- Oct. 11: Test 1 covers Lectures from Sept. 6 to Oct. 4

- Oct. 16 and 18: Derivatives: Inverse Functions; Exponential, Logarithmic and Other Spe- cial Functions; Start of trigonometric functions (most of chapter 5 of textbook; some of chapter 4).

- Oct. 30 and Nov. 1: Derivatives: Trigonometric Functions (remainder of chapter 4 of textbook). Vectors: Vectors: Introduction and Basic Properties (start of chapter 6

of textbook).

- Nov. 6 and 8: Lines and Planes (half of chapter 8 of textbook).

- Nov. 13 and 15: Vectors: Dot and Cross Products (chapter 7 of textbook).

- Nov. 20: Test 2 Review.

- Nov. 22: Test 2 covers Lectures from Oct 16. to Nov. 20.

- Nov. 27 and 29: Intersections of Lines and Planes (remainder of chapter 8 of textbook).

- Dec. 4 and 6: Final Exam Review.

University of Ottawa Services and Policies

Academic Integrity. Academic integrity means being responsible for the quality of your work, preparing it honestly, and respecting the intellectual community you are part of as a student. Every member of the University community has the moral obligation to learn and share knowledge with honesty and integrity. For more information, please see http://www.uottawa.ca/vice-president-academic/academic-integrity

Academic Fraud. Academic fraud refers to "an act by a student that may result in false academic evaluation of that student or another student". Plagiarism and all forms of cheating are taken very seriously at the University of Ottawa. Please take the time to see   https://www.uottawa.ca/about-us/policies-regulations/academic-regulations/a-4-academic-integrity-academic-misconduct

Accessibility. The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs. The University of Ottawa is committed to ensure that persons with disabilities have equal access to its services and events.

Access Services. The University of Ottawa accommodates students with disabilities through Access Services, a division of the Student Academics Success Service (SASS). SASS is a *free* network of services and programs designed to give you the tools and information you need to succeed. Delivered by professionals and fellow students who care about your success and your well-being, the programs and services of SASS complement your classroom learning and support you in achieving your academic and professional goals. Please note that there are deadlines for registering with Access Services. For more information, please visit https://sass.uottawa.ca/en/access/

Sexual Violence, Harassment, and Cyber-bullying.
The University of Ottawa will not tolerate any act of sexual violence. This includes acts such as rape and sexual harassment, as well as misconduct that take place without consent, which includes cyberbullying. The University, as well as various employee and student groups, offers a variety of services and resources to ensure that all uOttawa community members have access to confidential support an information, and to procedures for reporting an incident or filing a complaint. For more information, see
https://www.uottawa.ca/about-us/policies-regulations/policy-67b-prevention-sexual-violence

7.2 Sample lesson

In each class session, I begin by thoroughly reviewing the key concepts and foundational skills covered in the previous lesson, ensuring that all students feel confident and ready to build upon this knowledge. This review phase serves not only as a refresher but as an opportunity to clarify any lingering questions and reinforce the material in a new context. Following this, I introduce the objectives and central themes of the upcoming lecture, providing students with a clear perspective on how the new content builds on what they've learned. I emphasize the connections between these topics to foster an integrated understanding, allowing students to see each lesson as part of a cohesive learning journey.

Derivative of Exponential and Logarithmic Functions

Topic	Description
Review of Exponential Functions	Basic properties, graphs, and applications
Review of Logarithmic Functions	Basic properties, graphs, and applications
Main Topic: Title of Main Topic Here	Introduction to main topic concepts
Applications	Real-world applications of today's topic
Practice Problems	Solving problems to reinforce concepts
Summary and Q&A	Recap of main points and open questions

Table 1: Outline for Today's Lecture

Review of Exponential Functions

An exponential function is defined as:

$$y = f(x) = a^x, \quad a > 0, a \neq 1.$$

- Domain: x can be any real number

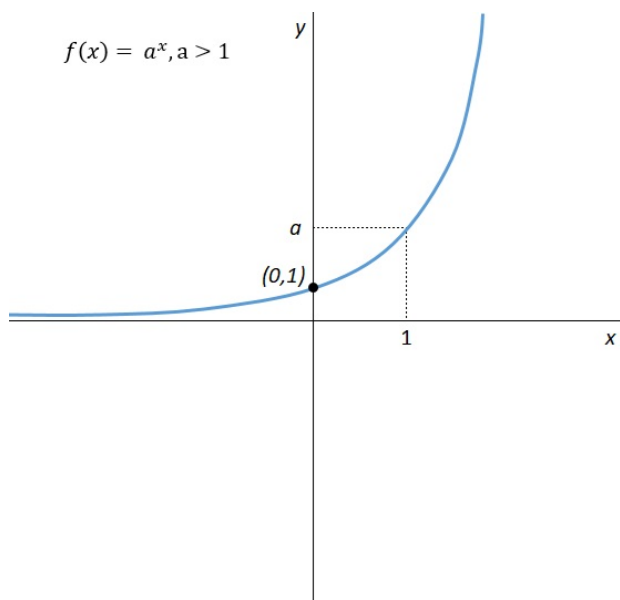- Exponential growth: $a > 1, \quad \lim_{x \to -\infty} a^x = 0, \quad \lim_{x \to \infty} a^x = \infty$

Figure 1: Graph of $f(x) = a^x$ for $a > 1$

- Exponential decay: $0 < a < 1$, $\quad \lim_{x \to -\infty} a^x = \infty$, $\quad \lim_{x \to \infty} a^x = 0$
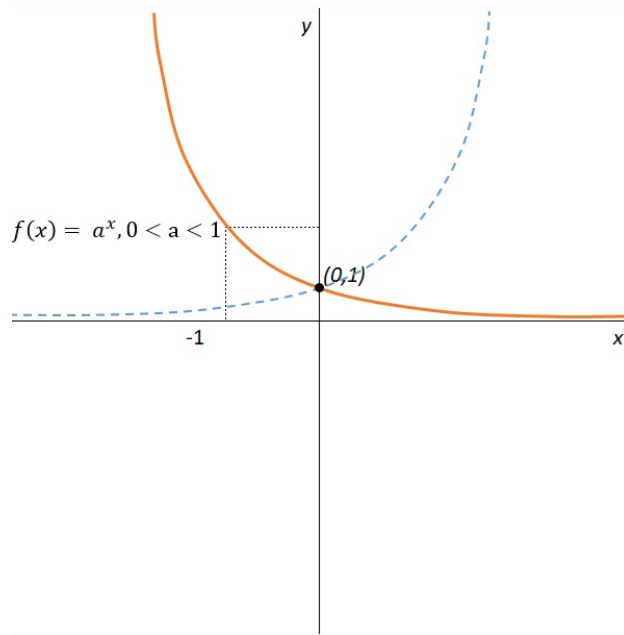

Figure 2: Graph of $f(x) = a^x$ for $0 < a < 1$

Laws of exponents:

$$a^{x+y} = a^x a^y, \quad a^{x-y} = \frac{a^x}{a^y}, \quad (a^x)^y = a^{xy}, \quad a^x b^x = (ab)^x.$$

Example 1: Sketch the graph of $y = 3^x + 5$ and $y = 3^{-x} + 5$.
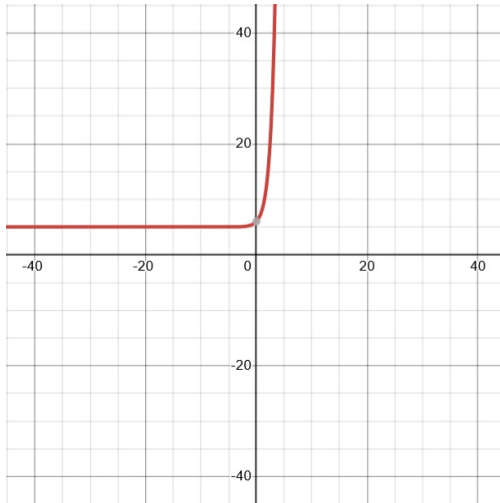
(a) Graph of $f(x) = 3^x + 5$
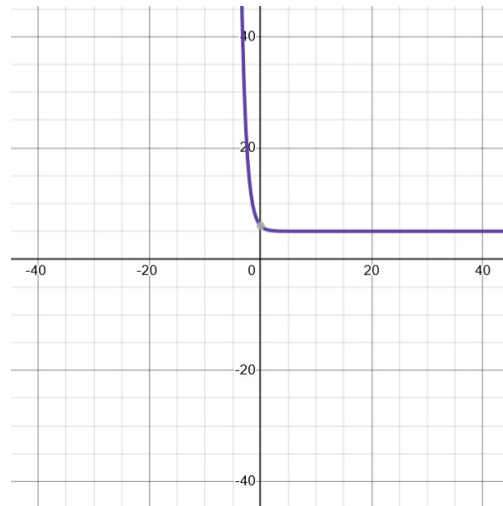
(b) Graph of $f(x) = 3^{-x} + 5$

Review of Logarithmic Functions

The natural logarithm function and its properties are discussed in this subsection. The logarithmic function with base a is defined as follows:

$$y = \log_a x.$$

which is the inverse function of $y = a^x$. The natural logarithmic function, $y = \ln x$, has the domain $x > 0$.

Properties of the Natural Logarithm

Let $B, C > 0$. The properties of the natural logarithm are as follows:

1. $\ln(BC) = \ln B + \ln C$,

2. $\ln\left(\frac{B}{C}\right) = \ln B - \ln C$,

3. $\ln(B^n) = n \ln B$,

4. $\ln(e^x) = x$, $\quad \ln e = 1$,

5. $e^{\ln B} = B$,

6. $\ln 1 = 0$.

Example: Solve for x:
$$\ln(x) + \ln(x - 8) = \ln 9.$$

Solution

$$\ln(x) + \ln(x - 8) = \ln x(x - 8) = \ln(x^2 - 8x) = \ln 9.$$

Therefore,

$$(x^2 - 8x) = 9 \quad \Longrightarrow \quad x^2 - 8x - 9 = 0 \quad \Longrightarrow \quad (x - 9)(x + 1) = 0,$$

and since the domain of $\ln(x)$ is $x > 0$, the only answer of this equation is $x = 9$.

Example: A bacterial culture starts with 500 bacteria and triples in size every 4 hours.

(a) How many bacteria are there after t hours?

(b) How long will it take for the population to reach 600?

Solution

(a) Let $P(t)$ represent the number of bacteria after t hours. Then:

$$P(0) = 500, \quad P(t) = 500 \cdot 3^{t/4}.$$

(b) To find when the population reaches 600:

$$600 = 500 \cdot 3^{t/4},$$

$$\frac{6}{5} = 3^{t/4},$$

$$\ln\left(\frac{6}{5}\right) = \frac{t}{4} \ln 3,$$

$$t = \frac{4 \ln\left(\frac{6}{5}\right)}{\ln 3}.$$

Derivatives of Exponential and Logarithmic Functions

Derivative of Exponential Functions

The derivative of an exponential function is given as follows.

Example:

$$\frac{d}{dx}(e^x) = e^x.$$

Example: Show that $e^x \geq 1 + x$ for $x \geq 0$.

Proof. Let $f(x) = e^x - (1 + x)$. Then

$$f'(x) = e^x - 1 \geq 0 \quad \text{when } x \geq 0.$$

Thus, $f(x)$ is increasing when $x \geq 0$. Note that $f(0) = 0$, so $f(x) \geq 0$ for $x \geq 0$.

Example: At what point(s) on the curve $y = (x^2 + 2x - 3)e^x$ is the tangent line horizontal?

Solution: Let

$$y = (x^2 + 2x - 3)e^x.$$

To find when $y' = 0$, we solve for x, implying that $x = 1$ or $x = -3$.

Example 86. The catenary is the theoretical shape of a hanging flexible chain or cable when supported at its ends, acted upon by a uniform gravitational force (its own weight), and in equilibrium. Let

$$y = 30\left(e^{x/60} + e^{-x/60}\right), \quad -30 < x < 30.$$

Find the lowest point.

Solution: Rewrite y as:

$$y = 30\left(e^{x/60} - e^{-x/60}\right).$$

Setting $y' = 0$, we find $x = 0$. By the first-derivative test, the minimum point is $(0, 60)$.

Derivative of Logarithmic Functions

The derivatives of logarithmic functions are as follows:

- $\frac{d}{dx}(\ln x) = \frac{1}{x}$,

- $\frac{d}{dx}(\ln f(x)) = \frac{f'(x)}{f(x)}$,

- $\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$,

- $\frac{d}{dx}(\log_a f(x)) = \frac{f'(x)}{f(x) \ln a}$,

- $\frac{d}{dx}(a^x) = a^x \ln a$.

Change of Base Formula

$$\log_a b = \frac{\ln b}{\ln a}.$$

Example 87. Differentiate $\ln(x^2 + 1)$.

Solution: Let $y = \ln(x^2 + 1)$, then

$$\frac{dy}{dx} = \frac{2x}{x^2 + 1}.$$

7.3 Final Test

In this section, I have attached the final exam for the MAT1339 course, administered to students on December 9, 2023, with an average grade of 75 percent.

Université d'Ottawa · University of Ottawa

Faculté des sciences
Mathématiques et de statistique

Faculty of Science
Mathematics and Statistics

MAT 1339 Introduction to Calculus and Vectors
Deferred Final Exam
9 December 2024
Instructor: Mitra Mansouri

Duration: 180 minutes

Instructions. *You must sign below to confirm that you have read, understand, and will follow them.*

- You have 180 minutes to complete this exam.

- Cellular phones, smart watches , unauthorized electronic devices, or course notes are not allowed during this exam. Phones and devices must be turned off and put away in your bag. Do not keep them in your possession, such as in your pockets. If caught with such a device or document, the following may occur: academic fraud allegations will be filed which may result in you obtaining a 0 (zero) for the exam. By signing below, you acknowledge that you have ensured that you are complying with the above statement.

- This is a closed-book exam. Only Faculty-approved calculators (models: Texas Instruments TI-30* and TI-34*, Casio FX-260* and Casio FX-300*) are permitted.

- The exam consists of 14 questions on 14 pages. Page 15 is the formula sheet. Be sure to read carefully and follow the instructions for the individual problems. To receive full marks, your solution must be correct, complete, and show all relevant details.

- Questions 1 through 3 are multiple choice. **Record your answers to the multiple choice questions in the boxes provided**. There are no partial marks for multiple choice questions

- Questions 4 through 14 are long answer, with number of points as indicated. You must show your work, your work must be legible and well justified.

- For rough work or additional work space, you may use the back pages. Do not use scrap paper of your own.

- Use proper mathematical notation and terminology.

- You may ask for clarification.

Last name:_____   First name:_____

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Max	2	2	2	2	4	4	5	2	3	10	6	4	4	4	
Marks															

1. Consider the function **[2 pts]**

$$f(x) = \begin{cases} \frac{x^2-1}{x+1} & \text{if} \quad x < 1 \\ x^3 + k & \text{if} \quad x \geqslant 1 \end{cases}$$

Find the value of k such that f is continuous at $x = 1$.

   A. 1 **B.** 2 **C.** 3

   D. 4 **E.** -1 **F.** None of the above

Your Answer: [   ]

2. What is the slope of the tangent line of the curve $f(x) = e^{2x} + \sin(\frac{\pi}{6})$ at $x = 5$. **[2 pts]**

   A. $2e^{10}$ **B.** $2e^5$ **C.** e^{10}

   D. e^{-10} **E.** $10e^5$ **F.** None of the above

Your Answer: [   ]

3. Let $f(x) = \ln(e^{x+2}) - 2$.**[2 pts]** What is the average rate of change for f between $x = 3$ and $x = 5$?

   A. 6 **B.** 1 **C.** 2

   D. 4 **E.** 9 **F.** 12

Your Answer: [   ]

Long-answer questions: You must show your work, your work must be legible and well-justified,

4. Let **[2 pts]**

$$f(x) = \frac{x^2 + 1}{x^2 - 3x - 10}.$$

State the equation of any vertical asymptotes and horizontal asymptotes.

5. Use intervals to express the domain of the following functions.**[4 pts]**

$(a): f(x) = \dfrac{\sqrt{5+x}}{x^2 - x - 2}$

$(b): g(x) = \ln\left(\dfrac{x^2}{x^2 - 9}\right) + e^x$

6. Use appropriate algebraic techniques and find the following limits. **[4 pts]** Leave the answer as a fraction and show your work!

$(a): \displaystyle\lim_{x \to -3} \dfrac{(1+x)^2 - 4}{x + 3}$

$(b): \displaystyle\lim_{x \to 0} \dfrac{\sqrt{4+x} - 2}{x}$

7. Let $f(x) = x^3 + 9x^2 - 21x + 6$.

   - (a) find the critical number of $f(x)$. **[2 pts]**

   - (b) Classify each critical number (that is, determine whether it is a local maximum,**[1 pts]** local minimum, or neither). Record your findings in an organized table as we did in the lecture.

   - (c) Find the interval(s) on which the**[2 pts]** function f is increasing and interval(s) on which the function f is decreasing.

8. Let $f(x) = x^4 - 2x^3 - 12x^2 + 3$.**[2 pts]** Find the inflection point(s) of this function and use intervals to determine where this function is concave down and concave up. Show all your work. Record your findings in an organized table as we did in the lecture.

9. Sketch the function $f(x) = x^3 - 6x^2 + 10$. **[3 pts]**Your sketch must indicate the following informations: local maximum, local minimum, inflection points in the form $(x, f(x))$. The increase/decrase of the function and when the function is concave up/concave down. (Note that you don't need to find the $x-$intercepts)

10. Determine each of the following derivatives. **[10 pts]***You may use any technique we*

have seen so far in the course. You do not need to simplify your answers.

(a) $f(x) = \dfrac{3x^4}{\sqrt{5x+6}}$

(b) $f(x) = (x^2+3)^{-\frac{3}{2}}(4x-3)^2$

(c) $f(x) = \ln(x^2+3x+1) + 5e^{x^2+2x}$

(d) $f(x) = 8\cos(3x+1) + \tan(3x+1)$

(e) $f(x) = \log_5(x^2+5) + \sin(\cos(5x+1))$

11. Let $\vec{u} = [3, -4]$, $\vec{v} = [6, 8]$, and $\vec{w} = [-4, 3]$.

- (a) Let θ be the angle between the vectors $\vec{u}$ and $\vec{v}$. Find the value of $\cos(\theta)$.**[2 pts]**

- (b) Find a unit vector in the same direction as the vector $\vec{u}$.**[1 pts]**

- (c) Determine if $\vec{v}$ and $\vec{w}$ are orthogonal or not.**[1 pts]**

- (d) Find the projection of $\vec{v}$ on $\vec{u}$. That is, find $\mathrm{Proj}_{\vec{u}}\vec{v}$.**[2 pts]**

12. Let $\vec{u} = [-2, 4, 6]$, $\vec{v} = [3, 5, -2]$.

- Find the area of the parallelogram defined by the vectors $\vec{u}$ and $\vec{v}$.**[2 pts]**

- Find the values of a such that $(a, 8, 12)$ and $\vec{u}$ are collinear.**[2 pts]**

13. Answer to the following questions.

- Give the parametric equations of the line in $\mathbb{R}^3$ that **[2 pts]** passes through the points $P = (2, 1, -1)$ and $Q = (6, -5, 2)$.

- Give the vector equation of the line in $\mathbb{R}^3$ **[2 pts]** (the space) that passes by the point $P(2, 3, 1)$ and that is parallel to the line L with parametric equation

$$L : \begin{cases} x = 1 + 2t \\ y = 3 - 2t \\ z = 5 - t \end{cases}$$

14. Consider the plane Π that is perpendicular to the line

$$[x, y, z] = [1, 2, -3] + t[3, 5, -3],$$

and contains the point $P = (4, -2, 3)$.

- (a) Write a scalar equation of the plane Π.**[2 pts]**

- (b) Write a vector equation of the plane Π.**[2 pts]**

8 Sample syllabus and course materials (MAT 1318)

8.1 Syllabus

Syllabus: MAT1318 Functions (Fall 2024)

INSTRUCTOR: Mitra Mansouri   ***EMAIL   mmansou2@uottawa.ca

*Please use your official University of Ottawa and write "MAT1318" in subject line of all emails to me.

DESCRIPTION OF THE COURSE   Polynomial and rational functions: factoring, the remainder theorem, families of polynomials with specified zeros, odd and even polynomial functions. Logarithms and exponentials to various bases, their laws. Trigonometric functions: radian measure, values of primary trigonometric ratios, compound angle formulae, trigonometric identities. Solving equations and inequalities involving absolute values, polynomial, rational, logarithmic, exponential and trigonometric functions. Their graphs. Operations on functions: point-wise addition and multiplication, composition; inverse functions. Average and instantaneous rate of change, approximating instantaneous rate of change, secants and tangents to graphs. Applications to graphing and finding maxima and minima of functions. Using functions to model, interpolate, and extrapolate data.

MAT1318 may be taken for upgrading purposes as an admission requirement. In all cases, credits for this course do not count as part of any program requirements. S/NS grading scheme.

Prerequisite: Ontario grade 11 Functions (MCR3U) or the equivalent. The courses MAT 1318, Ontario 4U Advanced Functions (MHF4U) or any equivalent cannot be combined for units.

COURSE INFORMATION

LECTURES:

LEC	Monday	10:00 – 11:20 AM (EDT)	129 Louis Pasteur (LPR) 155
LEC	Wednesday	8:30 – 9:50 pm (EDT)	120 University (FSS) 1030

OFFICE HOURS! Whenever you need concepts clarified or would like to discuss the course, please drop in to my Office Hours:

Office hours	Wednesdays	10:00 – 11:30 AM (EDT)	150 Louis Pasteur (STM) 668

STAY UP-TO-DATE WITH BRIGHTSPACE! The course webpage is on **Brightspace (Virtual Campus)** of the University of Ottawa. Announcements, lecture notes, tests and more will be posted there. You will need to check Brightspace regularly.

TEXTBOOK! *Mathematics for Calculus, 7th ed. by James Stewart, Lothar Redlin, and Saleem Watson.*

MATH HELP CENTRE! In addition to the lectures, and professor's office hours, you can get help via the Math Help Centre which is located in STEM Complex, room 207 from September 18: Monday to Wednesday: 10:00-7:00, Thursday: 10:00-5:00 and Friday 10:00-3:00. The Math Help Center is closed during the Study break: October 13-19. It is strongly recommended that students come with clear and specific questions. Explaining a whole section of a course is not in the mandate of the center. For more details, go to
https://www.uottawa.ca/faculty-science/student-life-services/help-centres

ACCESSIBILITY: The University of Ottawa is committed to ensure that persons with disabilities have equal access to its services and events. If you are in need of accommodation during this course due to a disability, please consult with Access Services as soon as possible:
https://www.uottawa.ca/study/academic-support/accommodation-services-available

How you will be evaluated

Assignments worth 15% There will be online 3 assignments worth a total of 15% (5% each).

2 Tests worth 15% each The tests will be written during the lecture on the following two dates:

    Test 1 Wednesday, October 9th, from 8:30 AM until 9:50 AM (EDT)

    Test 2 Wednesday, November 13th, from 8:30 AM until 9:50 AM (EDT)

Final Exam worth 55% There will be a cumulative 3-hour final exam, scheduled during the Exam Period (Dec. 5–18, 2024). The final exam schedule will be posted around reading week.

Additional Course Evaluation Policies:

- If your mark on the Final Exam is lower than 40%, then you will fail the course (F), regardless of your other marks.

- If your mark on the Final Exam is higher than your homework component, and/or your grade on any one or more of the Tests, then the weight of all such assessments will be transferred to the weight of the final exam (whenever it is to your advantage).

- If you missed a test by a valid reason with appropriate proof, the weight will be moved to the final exam. No makeup tests will be arranged.

- Checking the Test/Assignment/Quiz/Exam Grades: It is your responsibility to make sure that your marks recorded correctly by visiting Brightspace.

University of Ottawa Services and Policies

Academic Integrity. Academic integrity means being responsible for the quality of your work, preparing it honestly, and respecting the intellectual community you are part of as a student. Every member of the University community has the moral obligation to learn and share knowledge with honesty and integrity. For more information, please see http://www.uottawa.ca/vice-president-academic/academic-integrity

Academic Fraud. Academic fraud refers to "an act by a student that may result in false academic evaluation of that student or another student". Plagiarism and all forms of cheating are taken very seriously at the University of Ottawa. Please take the time to see https://www.uottawa.ca/about-us/policies-regulations/academic-regulations/a-4-academic-integrity-academic-misconduct

Accessibility. The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs. The University

of Ottawa is committed to ensure that persons with disabilities have equal access to its services and events.

Access Services. The University of Ottawa accommodates students with disabilities through Access Services, a division of the Student Academics Success Service (SASS). SASS is a *free* network of services and programs designed to give you the tools and information you need to succeed. Delivered by professionals and fellow students who care about your success and your well-being, the programs and services of SASS complement your classroom learning and support you in achieving your academic and professional goals. Please note that there are deadlines for registering with Access Services. For more information, please visit https://sass.uottawa.ca/en/access/

Sexual Violence, Harassment, and Cyber-bullying.
The University of Ottawa will not tolerate any act of sexual violence. This includes acts such as rape and sexual harassment, as well as misconduct that take place without consent, which includes cyberbullying. The University, as well as various employee and student groups, offers a variety of services and resources to ensure that all uOttawa community members have access to confidential support an information, and to procedures for reporting an incident or filing a complaint. For more information, see
https://www.uottawa.ca/about-us/policies-regulations/policy-67b-prevention-sexual-violence

8.2 Sample lesson

In each class session, I begin by thoroughly reviewing the key concepts and foundational skills covered in the previous lesson, ensuring that all students feel confident and ready to build upon this knowledge. This review phase serves not only as a refresher but as an opportunity to clarify any lingering questions and reinforce the material in a new context. Following this, I introduce the objectives and central themes of the upcoming lecture, providing students with a clear perspective on how the new content builds on what they've learned. I emphasize the connections between these topics to foster an integrated understanding, allowing students to see each lesson as part of a cohesive learning journey. The following section provides a sample lecture, demonstrating my approach to engaging students with new material while reinforcing previous concepts. This lecture is designed to exemplify my teaching philosophy, which prioritizes clarity, coherence, and active participation. Through structured review, purposeful introductions, and interactive examples, I aim to create an environment where students feel equipped and motivated to deepen their understanding. In addition, I incorporate various tools to clarify concepts for my students. For example, when teaching function transformations, I utilize online graphing tools to enhance students' understanding and engagement with the material.

1. Review of Previous Concepts: Average Rate of Change and Transformations of Functions

The average rate of change of a function $y = f(x)$ over an interval $[a, b]$ is given by:

$$\text{Average rate of change} = \frac{f(b) - f(a)}{b - a}$$

Transformations adjust the graph of a function in various ways. Here are the key types:

- **Vertical Shifting:** The graph of $y = f(x) + c$ shifts $y = f(x)$ up by c units. If $y = f(x) - c$, the shift is down by c units.

- **Horizontal Shifting:** The graph of $y = f(x - c)$ shifts $y = f(x)$ right by c units, while $y = f(x + c)$ shifts it left by c units.

- **Reflections:** The graph of $y = -f(x)$ reflects $y = f(x)$ over the x-axis, and $y = f(-x)$ reflects it over the y-axis.

- **Vertical Stretching and Shrinking:** $y = cf(x)$ stretches $y = f(x)$ vertically by c if $c > 1$; if $0 < c < 1$, it shrinks vertically by c.

- **Horizontal Stretching and Shrinking:** $y = f(cx)$ shrinks $y = f(x)$ horizontally by $\frac{1}{c}$ if $c > 1$ and stretches it horizontally by $\frac{1}{c}$ if $0 < c < 1$.
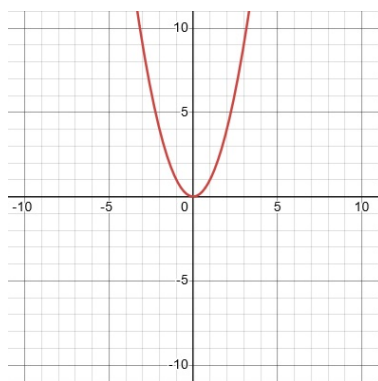
Example 1: Determine the type of transformation applied to $f(x) = x^2$ for the following functions:

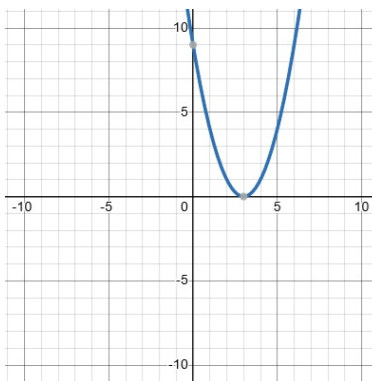a) $g(x) = x^2 + 3$: *Vertical shift up by 3 units.*

b) $h(x) = (x - 2)^2$: *Horizontal shift right by 2 units.*

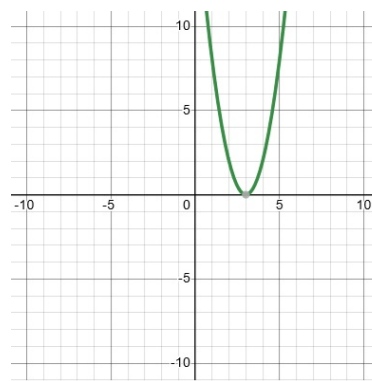**Example 2:** Sketch the graph of the following function:
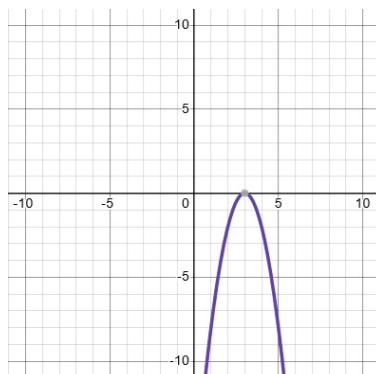
$$f(x) = -2(x - 3)^2 + 1$$
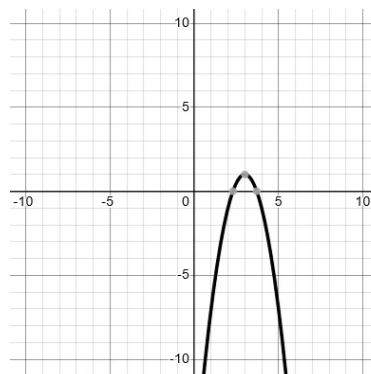

(c) x^2

(d) $(x - 3)^2$

(e) $2(x - 3)^2$

(f) $-2(x - 3)^2$

(g) $2(x - 3)^2 + 1$

Figure 3: Transformations of the function $f(x) = x^2$

3. Even and Odd Functions

A function $f(x)$ is:

- **Even** if $f(-x) = f(x)$ for all x in its domain.

- **Odd** if $f(-x) = -f(x)$ for all x in its domain.

Example 2: Determine if the following functions are even, odd, or neither:

a) $f(x) = x^5 + x$: *Odd function, since $f(-x) = -f(x)$.*

b) $g(x) = 1 - x^4$: *Even function, since $g(-x) = g(x)$.*

4. Sums, Differences, Products, and Quotients of Functions

For functions f and g with domains A and B, respectively:

$$(f + g)(x) = f(x) + g(x) \quad \text{Domain: } A \cap B$$

$$(fg)(x) = f(x) \cdot g(x) \quad \text{Domain: } A \cap B$$

$$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)} \quad \text{Domain: } \{x \in A \cap B \mid g(x) \neq 0\}$$

Example 3: Let $f(x) = \frac{1}{x^2}$ with domain A and $g(x) = x$ with domain B. Find $(f + g)(4)$, $(f - g)(4)$, $(fg)(4)$, and $\frac{f}{g}(4)$.

- *Solution:*

$$(f + g)(4) = f(4) + g(4) = \frac{1}{16} + 4 = \frac{65}{16}$$

$$(f - g)(4) = f(4) - g(4) = \frac{1}{16} - 4 = -\frac{63}{16}$$

$$(fg)(x) = \frac{1}{x^2} \cdot x = \frac{1}{x}$$

$$\frac{f}{g}(x) = \frac{\frac{1}{x^2}}{x} = \frac{1}{x^3}$$

5. Composition of Functions

The composition of two functions f and g, written $f \circ g$, is defined as:

$$(f \circ g)(x) = f(g(x))$$

Example 4: Given $f(x) = x + 2$, $g(x) = \sqrt{x - 8}$, and $h(x) = x^2 - 1$, find $f \circ g$, $g \circ f$, $g \circ g$, and $g \circ h$ along with their domains.

- *Solution for $f \circ g$:*
$$(f \circ g)(x) = f(\sqrt{x - 8}) = \sqrt{x - 8} + 2$$

Domain: $x \geq 8$

- *Solution for* $g \circ f$:

$$(g \circ f)(x) = g(x + 2) = \sqrt{x + 2 - 8} = \sqrt{x - 6}$$

Domain: $x \geq 6$

- *Solution for* $g \circ g$:

$$(g \circ g)(x) = g(\sqrt{x - 8}) = \sqrt{\sqrt{x - 8} - 8}$$

Domain: $x \geq 64$

- *Solution for* $g \circ h$:

$$(g \circ h)(x) = g(x^2 - 1) = \sqrt{x^2 - 1 - 8} = \sqrt{x^2 - 9}$$

Domain: $x \leq -3$ or $x \geq 3$

One-to-One Functions

A function f is **one-to-one** (injective) if it assigns a unique output for each input and does not repeat any values. Mathematically, $f(x_1) = f(x_2)$ implies that $x_1 = x_2$.

Horizontal Line Test

A function is one-to-one if every horizontal line intersects its graph at most once. This is called the **Horizontal Line Test**.

Example 1: Determine if the function $f(x) = x^3 + x$ is one-to-one. **Solution:** We use the Horizontal Line Test:
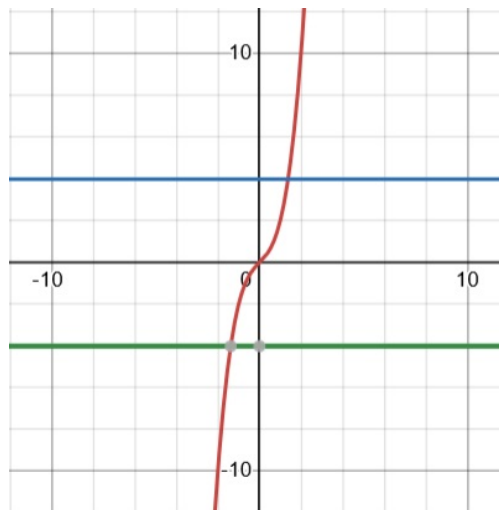

Figure 4: Graph of $f(x) = x^3 + x$

Thus, we can observe that each horizontal line intersects the graph at most once, indicating that the function $f(x)$ is one-to-one.

Inverse Functions

If f is a one-to-one function with domain A and range B, there exists an **inverse function** f^{-1} that "reverses" f. For $y = f(x)$, the inverse function $f^{-1}(y) = x$ satisfies:

$$f(f^{-1}(y)) = y \quad \text{and} \quad f^{-1}(f(x)) = x$$

Steps to Find an Inverse Function

1. Write $y = f(x)$.
2. Solve for x in terms of y.
3. Interchange x and y, and then write $y = f^{-1}(x)$.

Example 2: Find the inverse of $f(x) = 2x + 3$.

- *Solution:*

$$y = 2x + 3$$
$$y - 3 = 2x$$
$$x = \frac{y - 3}{2}$$

Switching x and y, we get:

$$f^{-1}(x) = \frac{x - 3}{2}$$

Verifying Inverses

To verify that f and f^{-1} are inverses, check if $f(f^{-1}(x)) = x$ and $f^{-1}(f(x)) = x$.

Example 3: Verify that $f(x) = 2x + 3$ and $f^{-1}(x) = \frac{x-3}{2}$ are inverses.

- *Solution:*

$$f(f^{-1}(x)) = f\left(\frac{x - 3}{2}\right) = 2 \cdot \frac{x - 3}{2} + 3 = x - 3 + 3 = x,$$
$$f^{-1}(f(x)) = f^{-1}(2x + 3) = \frac{2x + 3 - 3}{2} = x.$$

Since both conditions hold, f and f^{-1} are indeed inverses.

Conclusion

This lecture reinforced transformations, explored compositions, and developed skills in analyzing complex functions. These foundational concepts are essential for advanced topics we will cover in future sessions. we defined one-to-one functions and inverse functions, explored methods for determining if a function is one-to-one, and practiced finding and verifying inverse functions. These skills are foundational for understanding complex function behavior in further studies.

9 Midterm test

In this section, I have attached the second midterm test for the MAT1318 course, administered to students on October 11, 2024.

Université d'Ottawa · University of Ottawa

Faculté des sciences
Mathématiques et de statistique

Faculty of Science
Mathematics and Statistics

MAT 1318 Functions
2nd Midterm Exam
13 Nov 2024
Instructor: Mitra Mansouri

Duration: 75 minutes

Instructions. *You must sign below to confirm that you have read, understand, and will follow them.*

- You have 75 minutes to complete this exam.

- You are allowed to bring **one two-sided formula sheet** for the exam. Please ensure that all necessary formulas and notes fit onto a single sheet of paper, written or printed on both sides.

- This is a closed book exam. Except for Faculty-approved calculators (models: Texas Instruments TI-30* and TI-34*, Casio FX-260* and Casio FX-300*), no electronics, no notes, cell phones, smartwatches or related devices of any kind are permitted. All such devices, including cell phones, **must be stored in your bag under your desk**.

- The exam consists of 8 questions on 7 pages. Be sure to read carefully and follow the instructions for the individual problems. To receive full marks, your solution must be correct, complete, and show all relevant details.

- Questions 1 through 3 are multiple choice. **Record your answers to the multiple choice questions in the boxes provided**. There are no partial marks for multiple choice questions

- Questions 4 through 8 are long answer, with number of points as indicated. You must show your work, your work must be legible and well justified.

- For rough work or additional work space, you may use the back pages. Do not use scrap paper of your own.

- Use proper mathematical notation and terminology.

- You may ask for clarification.

Last name:_____   First name:_____

Student number:_____   Signature:_____

Question	1	2	3	4	5	6	7	8	Total
Max	1	1	1	4	3	2	4	4	20
Marks									

1. Find the distance between two points $A(1,2)$ and $B(-3,5)$. **[1 pts]**

$$\textbf{A. } 3 \qquad \textbf{B. } 4 \qquad \textbf{C. } 5$$
$$\textbf{D. } 6 \qquad \textbf{E. } 7 \qquad \textbf{F. } 8$$

Your Answer:

2. Let $f(x) = x^2 - 1$. What is the average rate of change for f between $x = 3$ and $x = 5$? **[1 pts]**

$$\textbf{A. } 6 \qquad \textbf{B. } 8 \qquad \textbf{C. } 5$$
$$\textbf{D. } 4 \qquad \textbf{E. } 9 \qquad \textbf{F. } 12$$

Your Answer:

3. Consider the functions **[1 pts]**

$$f(x) = x^2 + 2, \quad g(x) = \sqrt{x} - 3$$

Find the composition function $g \circ f$.

A. $x + \sqrt{2} - 3$ **B.** $\sqrt{x^2} + 5$ **C.** $\sqrt{x^2 + 2} - 3$

D. $(\sqrt{x} - 3)^2 + 2$ **E.** $x - 1$ **F.** None of the above

Your Answer:

Long-answer questions: You must show your work, your work must be legible and well-justified,

4. For each of the following functions, find the x-intercepts and y-intercepts.
   [4 pts] $(a) \quad f(x) = x^2 + 5x + 6$

   $(a) \quad f(x) = |x + 2| - 5$

5. Determine the type of symmetry for each of the following functions: symmetry with respect to the x-axis, y-axis, or the origin. Show your work.**[3 pts]**

$(a): y = x^2 + 3x^{10} - 4$

$(b): y = x^9 - 4x^3 - 9$

$(c): y = x^9 - 4x^3$

6. Solve the following inequality graphically!**[2 pts]**

$(a): |x| \leqslant x + 2$

7. For each of the following graphs, find the intervals of **increase** and **decrease**, as well as the **local maxima and minima.[4 pts]**
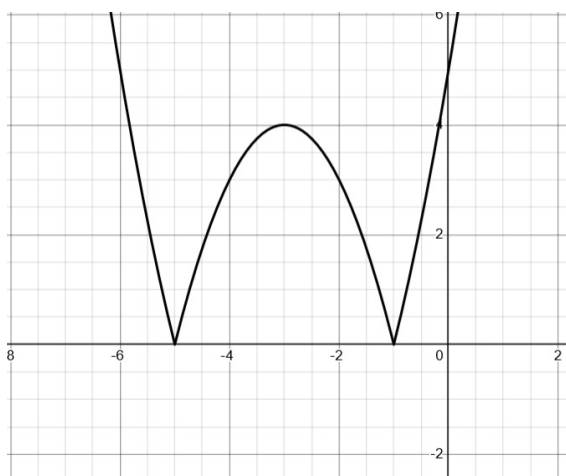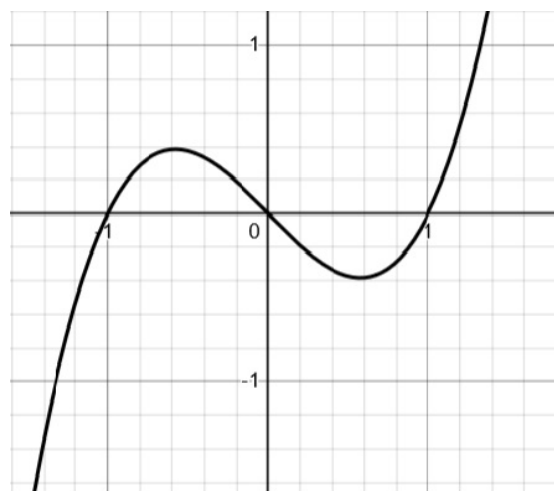

Figure 5: Graph 1

Figure 6: Graph 2

8. (a) Let $f(x) = \sqrt{x}$. By transforming the function $f(x)$, sketch the grapf of the function $g(x) = 5 - \sqrt{x-2}$**[2 pts]**

(b) Let $f(x) = \frac{1}{x}$. By transforming the function $f(x)$, sketch the grapf of the function $g(x) = 2\frac{1}{x-1}$**[2 pts]**

10 Future Teaching Goals

In the future, I aim to further integrate technology into my teaching to enhance student engagement and learning outcomes. This includes developing online resources such as video tutorials, interactive quizzes, and adaptive learning platforms that offer personalized support. I also plan to implement more collaborative, group-based learning activities that foster teamwork, critical thinking, and communication skills. In addition, I will incorporate experiential learning techniques, such as real-world problem-solving and case studies, to make mathematical concepts more relevant and accessible. Promoting inclusivity remains a priority, and I will continue refining my teaching practices to ensure that students from all backgrounds feel supported. I also aim to expand my use of formative assessments, providing timely feedback to guide student progress. Finally, I am committed to my own professional development by attending workshops and exploring new teaching strategies to continuously improve the learning experience for my students.

11 Conclusion

As an educator, my goal is to create a dynamic and supportive learning environment where students feel empowered to succeed. Through the integration of technology and active learning strategies, I strive to make complex mathematical concepts accessible and engaging for all students.

Appendix A: Teaching Evaluations

INFORMAL EVALUATION: MEMBERS OF CUPE 2626

For every appointment there shall be an informal evaluation based on criteria relevant to the Unit in which the appointment is held and relevant to the nature of the duties required by the appointment (16.3). The informal evaluation cannot take place earlier than the mid-point of the appointment and shall be conducted by the Employee's immediate Supervisor (16.5.1).

1.	**Employee's Surname:** Mansouri	**Given Name:** Mitra	**Empl. No.:**
2.			

1.	**Employee's Surname:** Mansouri	**Given Name:** Mitra	**Empl. No.:**

2. Nature of the appointment and work being evaluated *(e.g. teaching assistant for ABC 1000; corrector for DEF 2000; research assistant for project on gerontology):*   TA for MAT 1327A (DGDs)

3. Date work began: Sept 1, 2022   Date of the Evaluation: Nov 30, 2022

4. Please check the appropriate box. You may add comments if you choose a) or b); you **must** add specific information in the *Comments* section if you choose c) or d).

a) The performance is excellent, that is, all the requirements are being met and the quality of the performance exceeds expectations.	✔
b) The performance is satisfactory, that is, all the requirements are being met and the quality of the performance meets expectations.	
c) The performance is satisfactory, but one or more minor deficiencies exist and should be corrected *(complete the Comments section below).*	
d) The performance is seriously deficient, and a formal evaluation is requested *(complete the Comments section below).*	

5.   Comments

Sorry I didn't get a chance to attend your DGD. I have been very happy with your responsiveness and the students have said only good things. Thanks for a good term!

(Additional comments, if any, should be appended on a separate sheet).

Pursuant to 16.5.3 of the CUPE collective agreement, I have "given a copy of this informal evaluation" to the employee, and I have given the employee "an opportunity to discuss the results" with me before having the evaluation placed in the employee's file.

Name of the immediate supervisor (please print):   Andrew Wagner

Signature of the immediate supervisor: *[signature]*   **Date:**   Nov 30, 2022

Please return a copy of this evaluation to   Alex Jablonski   **so that it may be included in the employee's personal file.**

INFORMAL EVALUATION: MEMBERS OF CUPE 2626

For every appointment there shall be an informal evaluation based on criteria relevant to the Unit in which the appointment is held and relevant to the nature of the duties required by the appointment (16.3). The informal evaluation cannot take place earlier than the mid-point of the appointment and shall be conducted by the Employee's immediate Supervisor (16.5.1).

1.	**Employee's Surname:** Given Name: Empl. No.:	
2.	Nature of the appointment and work being evaluated *(e.g. teaching assistant for ABC 1000; corrector for DEF 2000; research assistant for project on gerontology):*	
3.	**Date work began:** Date of the Evaluation:	
4.	Please check the appropriate box. You may add comments if you choose a) or b); you **must** add specific information in the *Comments* section if you choose c) or d).	
	a) The performance is excellent, that is, all the requirements are being met and the quality of the performance exceeds expectations.	
	b) The performance is satisfactory, that is, all the requirements are being met and the quality of the performance meets expectations.	
	c) The performance is satisfactory, but one or more minor deficiencies exist and should be corrected *(complete the Comments section below).*	
	d) The performance is seriously deficient, and a formal evaluation is requested *(complete the Comments section below).*	
5.	**Comments**

(Additional comments, if any, should be appended on a separate sheet). | |

Pursuant to 16.5.3 of the CUPE collective agreement, I have "given a copy of this informal evaluation" to the employee, and I have given the employee "an opportunity to discuss the results" with me before having the evaluation placed in the employee's file.

Name of the immediate supervisor (please print):

Signature of the immediate supervisor: *Pegah*   **Date:**

Please return a copy of this evaluation to   **so that it may be included in th   employee's personal file.**

ÉVALUATION OFFICIEUSE : MEMBRES DU SCFP 2626

Une évaluation officieuse accompagne chaque nomination, fondée sur des critères propres à l'unité où s'exerce cette nomination et propres à la nature des fonctions qu'elle exige [16.3]. Le superviseur immédiat de l'employé effectue l'évaluation officieuse, qui a lieu au plus tôt à mi-contrat. Un employé exerçant des fonctions de supervision délègue à son superviseur immédiat la responsabilité d'effectuer l'évaluation [16.5.1].

1.	**Nom de famille de l'employé :**	**Prénom :**	**N^o d'employé :**
2.	Le genre de nomination et le travail qui sont évalués *[ex. assistant d'enseignement pour ABC 1000; correcteur pour DEF 2000; assistant de recherche pour projet sur gérontologie]* :		
3.	**Date de début du travail :**	**Date de l'évaluation :**	
4.	Veuillez cocher la case appropriée. Vous pouvez ajouter des commentaires si vous choisissez a) ou b); vous **devez** ajouter des renseignements spécifiques à la section *Commentaires* si vous choisissez c) ou d).		

a) Le rendement est excellent, c'est-à-dire que toute les exigences sont satisfaites et que la qualité du rendement dépasse les attentes.		
b) Le rendement est satisfaisant, c'est-à-dire que toutes les exigences sont satisfaites et que la qualité du rendement répond aux attentes.		
c) Le rendement est satisfaisant, mais il comporte une ou plusieurs faiblesses mineures que l'employé devra corriger *[veuillez remplir la section Commentaires ci-dessous]*.		
d) Le rendement comporte de graves faiblesses et une évaluation officielle est par conséquent requise *[veuillez remplir la section Commentaires ci-dessous]*.		

5.	**Commentaires**
	[Les renseignements supplémentaires, s'il y a lieu, doivent être annexés sur une feuille séparée].

Selon le 16.5.3 de la convention collective du SCFP, j'ai remis à l'employé "une copie de l'évaluation officieuse" et il "a eu la possibilité de discuter des résultats" avec moi avant que l'évaluation ait été déposée au dossier de l'employé.

Nom du superviseur immédiat [en majuscules] :

Signature du superviseur immédiat :   **Date :**

Une copie de cette évaluation doit être envoyée à Mayada El Maalouf afin qu'elle soit déposée au dossier personnel de l'employé.

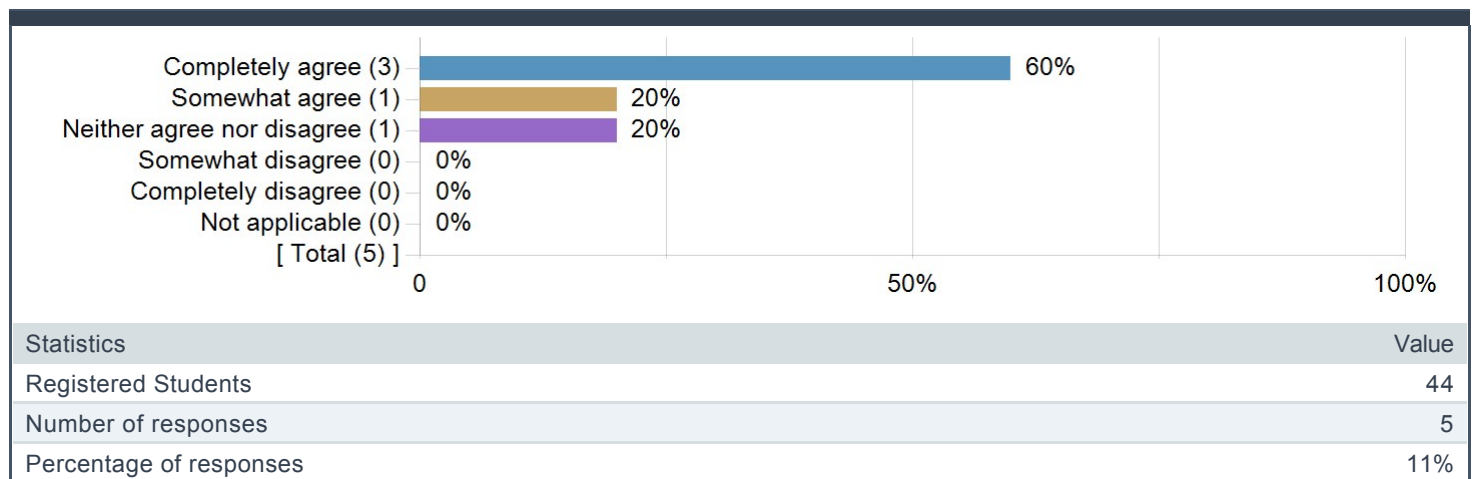**Teaching Assistant Feedback Report**

uOttawa

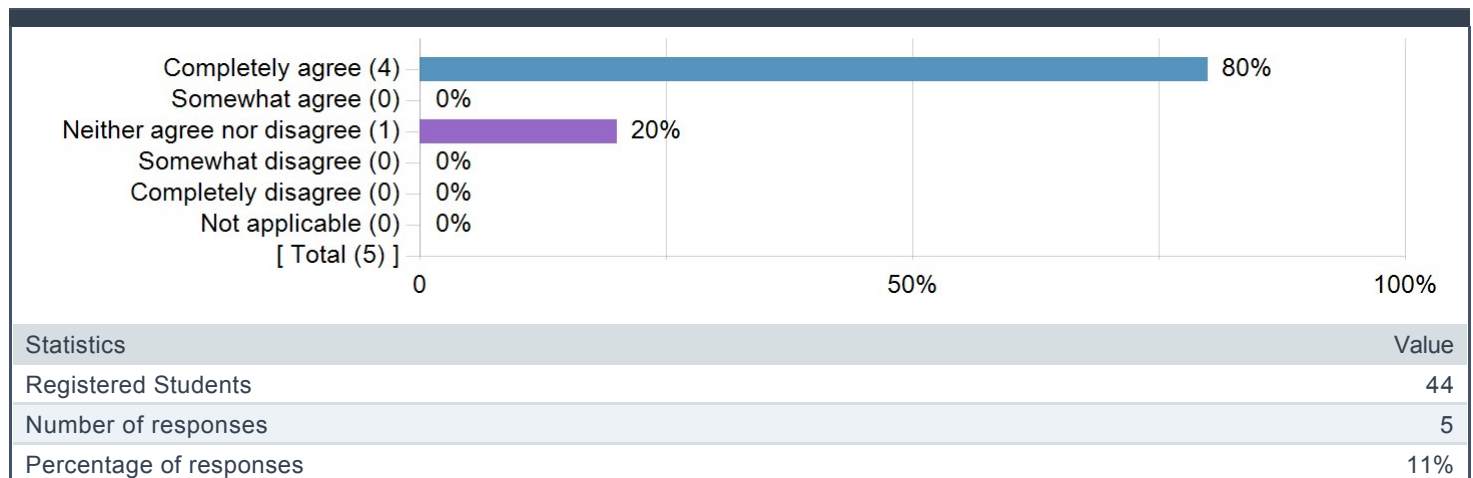- Fall 2021 Term

Teaching Assistant: Mansouri, Mitra

Course/School/Department: MAT1341 A01 Introduction to Linear Algebra / Mathématiques&stats/Maths & Stats

Questions evaluating the teaching assistant

1) The teaching assistant helps me understand the subject matter.

Completely agree (3)	60%
Somewhat agree (1)	20%
Neither agree nor disagree (1)	20%
Somewhat disagree (0)	0%
Completely disagree (0)	0%
Not applicable (0)	0%
[Total (5)]	

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%

2) The teaching assistant hears what students have to say.

Completely agree (4)	80%
Somewhat agree (0)	0%
Neither agree nor disagree (1)	20%
Somewhat disagree (0)	0%
Completely disagree (0)	0%
Not applicable (0)	0%
[Total (5)]	

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%

3) The teaching assistant is always well prepared.

Completely agree (4)	80%
Somewhat agree (0)	0%
Neither agree nor disagree (1)	20%
Somewhat disagree (0)	0%
Completely disagree (0)	0%
Not applicable (0)	0%
[Total (5)]	

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%
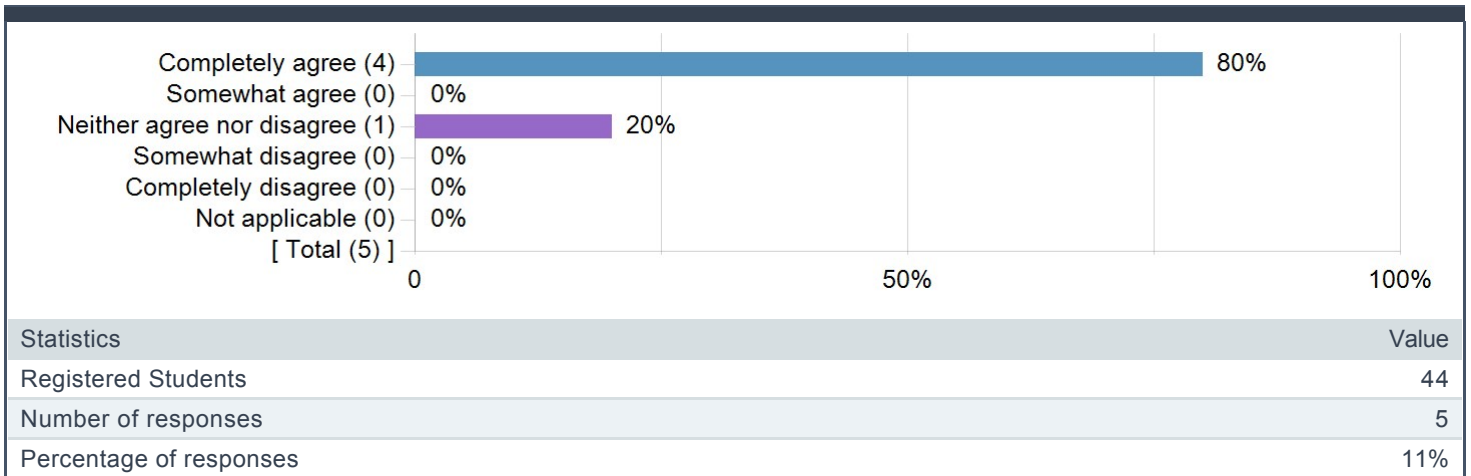
4) I find the explanations given by the teaching assistant to be clear and helpful.

Completely agree (4)	80%
Somewhat agree (0)	0%
Neither agree nor disagree (1)	20%
Somewhat disagree (0)	0%
Completely disagree (0)	0%
Not applicable (0)	0%
[Total (5)]	

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%
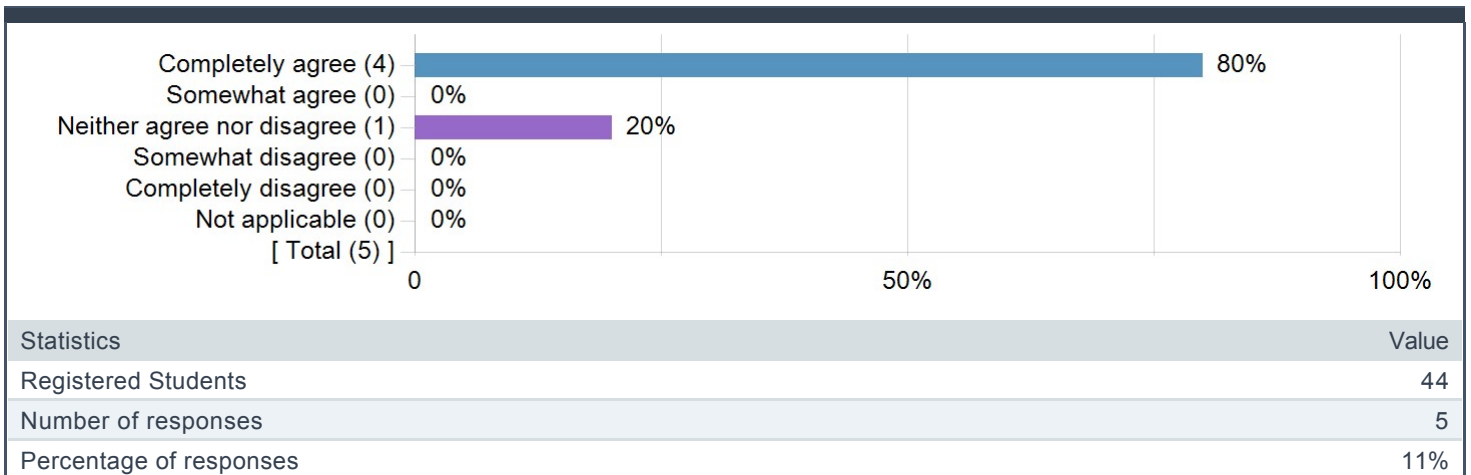
5) The teaching assistant encourages students to participate.

Completely agree (3)	75%
Somewhat agree (0)	0%
Neither agree nor disagree (1)	25%
Somewhat disagree (0)	0%
Completely disagree (0)	0%
Not applicable (0)	0%
[Total (4)]	

Statistics	Value
Registered Students	44
Number of responses	4
Percentage of responses	9%
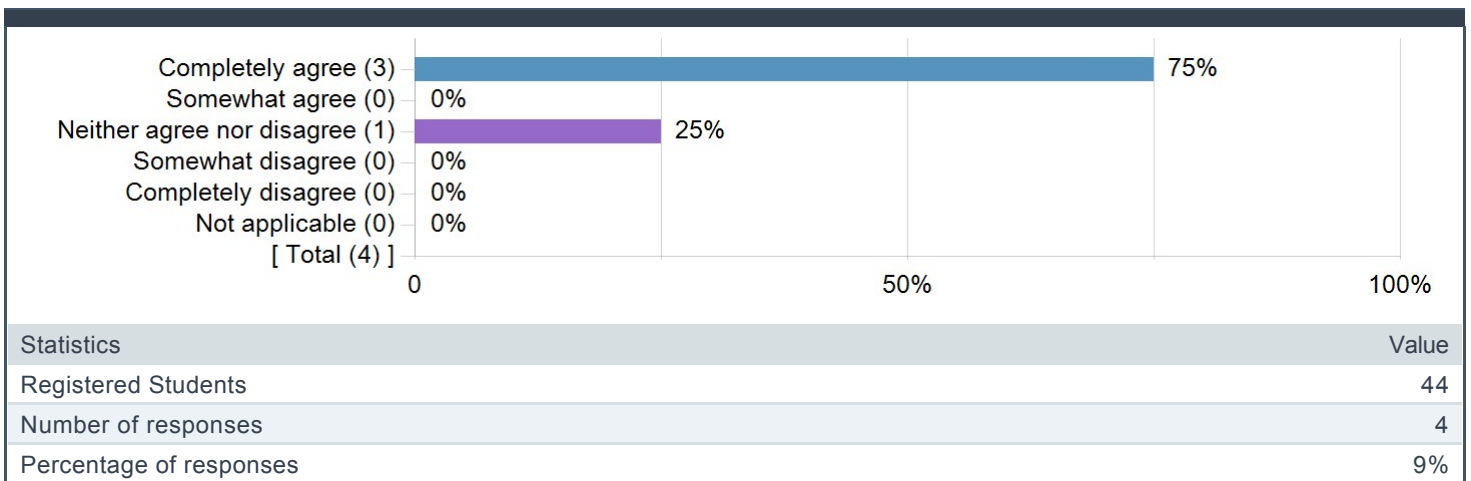
6) The teaching assistant is available during the times indicated in the course syllabus.

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%
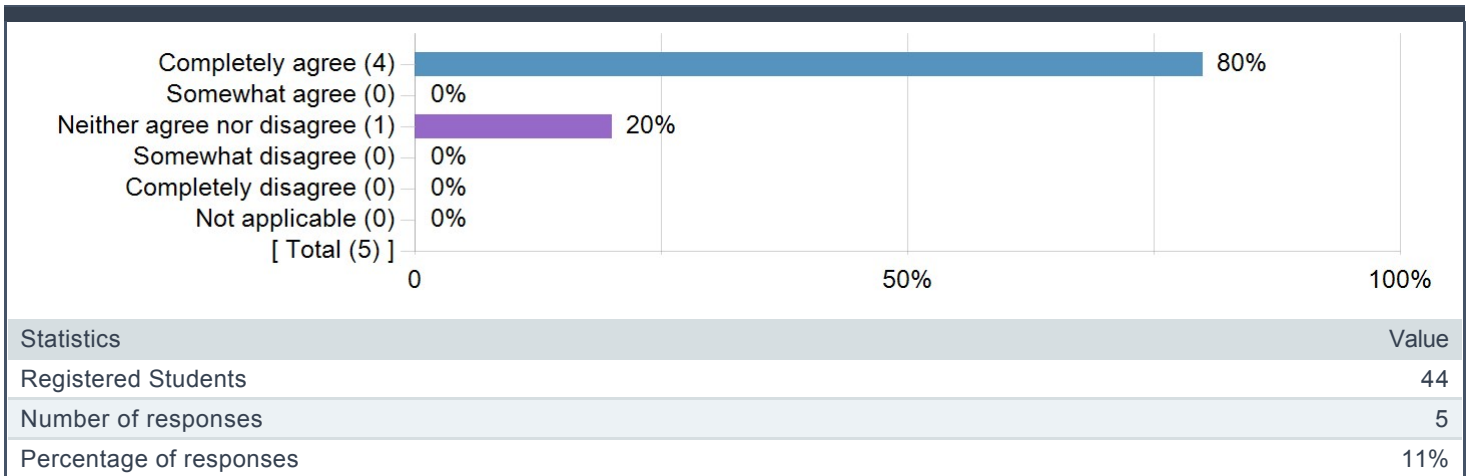
Questions measuring the contribution of teaching assistants to the student experience

7) The group discussions (DGDs) and labs help me connect theory (material learned in class) and practice (how to apply it).

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%
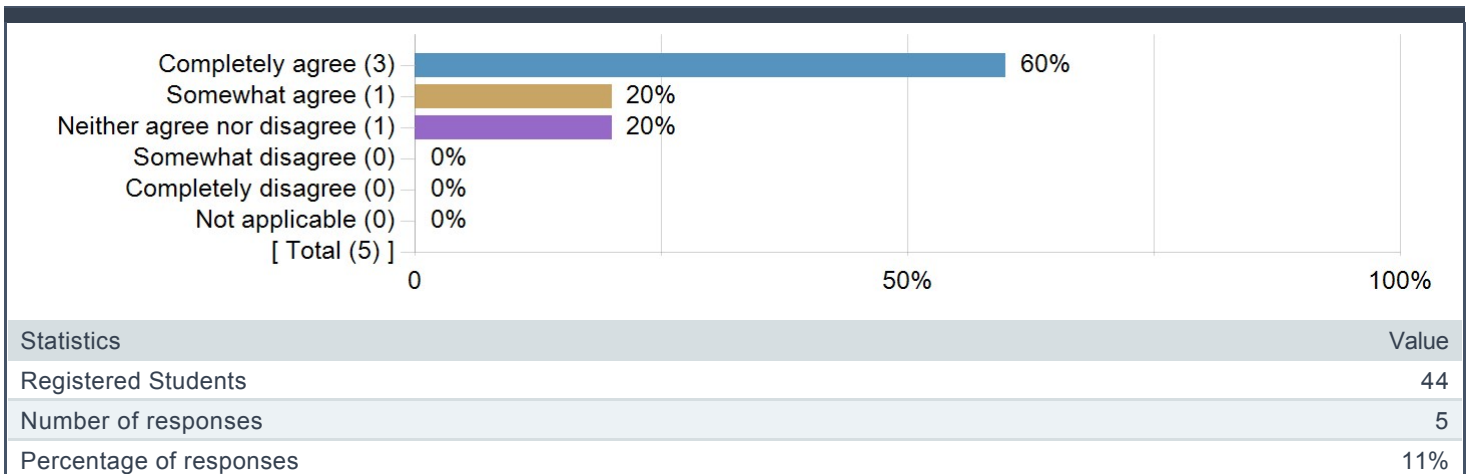
8) The DGDs and labs allow me to clarify certain aspects of the course material or deepen my knowledge of the subject.

Statistics	Value
Registered Students	44
Number of responses	5
Percentage of responses	11%
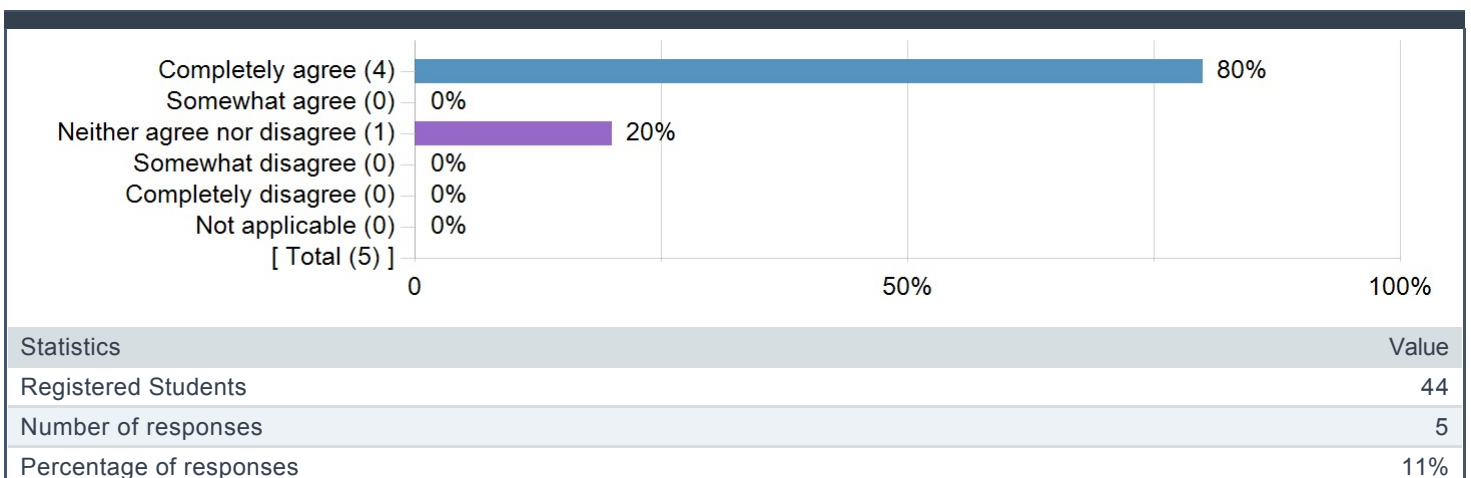
Open-ended questions

Please describe any effective methods the TA uses or characteristics the TA possesses that are particularly helpful for your success in the course.

Comments
Takes time to explain the questions thoroughly. Is good at simplifying hard–to–understand subjects.
Goes through the material slowly. Exlplains each question from various angles.

Please provide any suggestions for improvements the TA could make that would be helpful for your success in the course (the purpose of this questionnaire is to gather constructive feedback).

Comments
None.

Please provide specific examples of what you like most about the DGDs, the labs and your learning experience overall.

Comments
Not bothered by answering quesitons that are supposed to be covered in high schools.

A Report

EVALUATION OF TEACHING BY MEANS OF STUDENT QUESTIONNAIRE

uOttawa

- NON-APUO
- Official Evaluation
- 2023 Fall Term

Professor : Mansouri, Mitra

1) I find the professor well prepared for class

A: Almost always - B: Often - C: Sometimes - D: Rarely - E: Almost never

Course name	STUD. REGD.	NO. OF RESP.	AVG.	A	A %	B	B %	C	C %	D	D %	E	E %
MAT1339 C00 Introduction to Calculus and Vectors (3 cr / CAOTTAWUOC / P)	228	87	4.23	42	48%	27	31%	15	17%	2	2%	1	1%

4) I think the professor conveys the subject matter effectively

A: Almost always - B: Often - C: Sometimes - D: Rarely - E: Almost never

Course name	STUD. REGD.	NO. OF RESP.	AVG.	A	A %	B	B %	C	C %	D	D %	E	E %
MAT1339 C00 Introduction to Calculus and Vectors (3 cr / CAOTTAWUOC / P)	228	87	3.32	19	22%	20	23%	29	33%	8	9%	11	13%

9) I find that the professor as a teacher is

A: Excellent - B: Good - C: Acceptable - D: Poor - E: Very poor

Course name	STUD. REGD.	NO. OF RESP.	AVG.	A	A%	B	B%	C	C%	D	D%	E	E%
MAT1339 C00 Introduction to Calculus and Vectors (3 cr / CAOTTAWUOC / P)	228	87	3.45	22	25%	23	26%	21	24%	14	16%	7	8%

Rating Distribution

Awesome **5**	3
Great **4**	0
Good **3**	0
OK **2**	0
Awful **1**	0

5 / 5

Overall Quality Based on 3 ratings

Mitra Mansouri 🔖

Professor in the **Mathematics department** at **University of Ottawa**

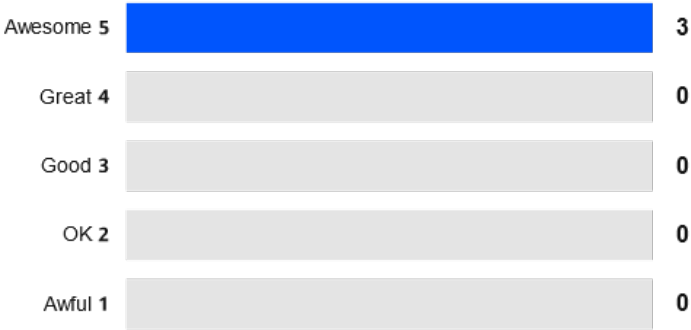## 100%
Would take again

1.3
Level of Difficulty

[Rate]   [Compare]

Help ssor Mansouri

Check out Similar Professors in the Mathematics Department

5.00 Oleksii Volkov   **5.00** Joseph Khoury   **4.90** Robert Hart

Professor Mansouri's Top Tags

AMAZING LECTURES   CARING

ACCESSIBLE OUTSIDE CLASS   **EXTRA CREDIT**

CLEAR GRADING CRITERIA

3 Student Ratings

All courses ⌄

QUALITY

5.0

DIFFICULTY

1.0

1339

Feb 20th, 2024

For Credit: **Yes**   Attendance: **Not Mandatory**   Would Take Again: **Yes**   Grade: **A+**   Textbook: **Yes**

10/10 recommend for any class she may be teaching

AMAZING LECTURES   **CARING**   **ACCESSIBLE OUTSIDE CLASS**

Helpful 👍 0   👎 0

QUALITY

5.0

1339

Feb 2nd, 2024

For Credit: **Yes**   Attendance: **Not Mandatory**   Would Take Again: **Yes**   Grade: **A+**   Textbook: **N/A**

DIFFICULTY

1.0

An excellent professor who clearly explains problems using effective examples.

CLEAR GRADING CRITERIA   CARING   ACCESSIBLE OUTSIDE CLASS

Helpful 👍 0   👎 0

QUALITY

5.0

1339

Jan 31st, 2024

For Credit: **Yes**   Attendance: **Not Mandatory**   Would Take Again: **Yes**   Grade: **A+**   Textbook: **N/A**

DIFFICULTY

2.0

Very good doctor helps understand the subject inside and outside of the classroom and if you study the lectures and past midterm your good to go

EXTRA CREDIT   AMAZING LECTURES   GIVES GOOD FEEDBACK

Helpful 👍 0   👎 0