

Faculty of Science Course Syllabus (Section A)
Department of Mathematics and Statistics
MATH 1215 - Calculus for the Life and Social Sciences
Fall 2021

Dalhousie University sits on the ancestral and unceded territory of the Mi'kmaq nation. We are all Treaty people.

1 General Information

Course Description: Rates of change are at the heart of Calculus. By examining how a quantity changes instantaneously, we can model, say, the amount of medicine in the body over time, or the spread of misinformation.

MATH 1215 is designed to provide some basic mathematical tools required for the life and social sciences. The main topics from differential and integral Calculus will be covered (including rates of change, differentiation, Taylor polynomials, the Fundamental Theorem of Calculus, integration, and basic ordinary differential equations) and have an emphasis on modelling systems from the life and social sciences.

The course material is taught during the lectures and tutorial classes. You will either have class 4 times per week (MWF + your tutorial class) or 3 times per week (TR + your tutorial class). Although called a “tutorial”, it is classtime with initially some review of background material, and after a couple weeks will cover new content.

Prerequisites: Nova Scotia Mathematics 11 and 12 or pre-calculus is highly recommended.

Exclusions: MATH 1000 and MATH 1280.

Textbook: Calculus for the Life Sciences: Modelling the dynamics of life, 2nd Cnd. ed. by F. Adler and M. Lorvić.

Calculators: Calculators are not permitted during the midterm and final exam. Answers may be left unsimplified.

2 Instructors & in-person course delivery details

| Section | Time | Location | Instructor | email | office |
|---------|-----------------|--------------|--------------------|------------------------|-----------|
| 1 | MWF 11:35-12:25 | LSC C242 | Dr. David Iron | david.iron@dal.ca | Chase 322 |
| 2 | MWF 09:35-10:25 | MCCAIN AUD-1 | Dr. Sarah Chisholm | sachisho@dal.ca | Chase 122 |
| 3 | MWF 11:35-12:25 | DUNN 135 | Dr. Sarah Chisholm | sachisho@dal.ca | Chase 122 |
| 4 | TR 11:35-12:55 | MCCAIN AUD-1 | Leila Mohammadi | leila.mohammadi@dal.ca | Chase 328 |

In addition to your Lecture section, you will have one tutorial class per week – please see the academic timetable for these days, times, and locations.

3 Self-assessment

All students should take the Mathematics Self-Assessment prior to the start of the semester. If you have not yet done so, please complete the assessment as soon as possible. <https://www.dal.ca/faculty/science/math-stats/programs/undergraduate-studies/first-year-math.html> If your score is below 50% you will be encouraged to register in MATH 1215 L03 and T05, a smaller class reserved for students with less background preparation.

4 Student Support

There are many ways to seek help in this course. There are office hours with instructors (see the course Brightspace page for details), support from Teaching Assistants in the MATH/STAT Learning Centre, and other classmates.

The MATH/STAT Learning Centre is located in Chase 119. It opens on Sept. 7 and is open Monday through Friday from 11:30am - 4:30pm until Dec. 19. There is also remote support on Tuesdays and Thursdays from 6:30-7:30pm. Register for the Brightspace “course” at <https://www.dal.ca/faculty/science/math-stats/about/learning-centre.html> to access the online support.

5 Course Assessment

Homework Homework assignments typically follow each class (lectures and tutorials) and are found on the course Brightspace page via WeBWorK. The problems extend class content and suggested textbook problems. This is an opportunity to think about problems more deeply, beyond our first inspection in class, as you investigate more challenging problems.

There is an opportunity to highlight the mathematical contributions made by people from Black, Indigenous, and People of Color (BIPOC) communities in this class. By writing a short biography about a mathematician of your choosing to post on the course Brightspace page (300 word limit), you can drop 3 low homework scores.

Group Projects There are two projects that provide the opportunity to work through an application of the theory in this course to a real-life situation, with other students. Group sizes are 2 or 3 people and all group members must contribute equally.

Midterm Test The midterm test is on Friday, October 22, from 6:30-8:30pm. Location TBA.

Final Exam The final exam is 3 hours long. The date and time for this exam is set by the registrar during the official Dalhousie exam period from Dec. 9 until Dec. 19, 2021. If you plan to depart from campus at the end of the semester, please make your plans after the registrar has announced the exam schedule, or plan to leave after December 19. Unfortunately, there are no opportunities to write the exam early.

Course score: We use the maximum of the following possible combinations for you –

Homework 15% + Projects 20% + Midterm Test 25% + Final Exam 40%

Homework 10% + Projects 20% + Midterm Test 25% + Final Exam 45%

Homework 15% + Projects 15% + Midterm Test 25% + Final Exam 45%

Homework 15% + Projects 20% + Midterm Test 20% + Final Exam 45%

The grading scheme for this course will follow the standard scale set by Dalhousie University. https://www.dal.ca/campus_life/academic-support/grades-and-student-records/grade-scale-and-definitions.html

6 Growth mindset vs. fixed mindset

There is evidence ¹ that shows that your frame of mind can greatly affect your success. In particular, if you have a growth mindset (you believe that with practice your abilities can improve) you are often more successful than if you have a fixed mindset (you believe that you can either do or not do something). We invite you to take a growth mindset to mathematics: with regular practice, you will improve your skills.

7 Important Dates

September 20 Project 1 is available online

October 4 (MWF classes) Project 1 is due in class

October 5 (TR classes) Project 1 is due in class

October 22 Midterm Test

November 4 Project 2 is available online

November 25 (TR classes) Project 2 is due in class

November 26 (MWF classes) Project 2 is due in class

December 9-19 Exam period

8 Course topics and approximate schedule

week 1 Discrete dynamical systems - §3.1-3.4

week 2 Rates of change, Limits, Trig. Functions - §4.1-4.3, 2.3

week 3 Continuity, Differentiation, Exponential Functions - §4.4-4.5, 5.1, 2.2

week 4 More derivatives, Implicit derivatives, Logarithmic Functions - §5.2-5.3, 5.5, 2.2

week 5 Trig. derivatives, Related Rates, Second derivatives, Linear Approximation - §5.4, 5.5, 5.6, 5.7

week 6 Max/Min, Midterm Exam Review, Graphing - §6.1, 6.5

week 7 l'Hôpital's rule, Taylor Polynomials - §6.4, 5.7

week 8 Equilibria & derivatives, Logistic Equation, Differential equations - §6.7, 6.8, 7.1

week 9 Euler's Method, Antiderivatives, Definite Integrals, Riemann Sums - §7.1-7.4

¹Dweck, C. S. (2006). Mindset: The new psychology of success. Random House.

week 10 FTOC, Substitution, Autonomous Differential Equations - §7.3-7.5, 8.1-8.3

week 11 Integration by Parts, Separable Differential Equations, Systems of Differential Equations - §7.5, 8.4, 8.5

week 12 Integration by Taylor Polynomials, Final Exam Review - §7.5, 8.4

9 Student Accommodations

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic under the Nova Scotia Human Rights Act. Students who require academic accommodation for either classroom participation or the writing of tests, quizzes and exams should make their request to the Office of Student Accessibility & Accommodation (OSAA) prior to or at the outset of each academic term. Please visit https://www.dal.ca/campus_life/academic-support/accessibility.html for more information and to obtain Form A - Request for Accommodation. A note taker may be required to assist a classmate. There is an honorarium provided for the note taker of \$75-100/course/term. If you are interested, please contact OSAA at access@dal.ca or 494-2836 for more information. Lectures and tutorials will not be recorded, but please speak with your instructor if you would like to use your own recording device in class.

10 Learning Objectives

- To enhance your mathematical tool kit to help model problems in the world around you.
- To develop an understanding of applications of dynamical systems, equilibria, and stability in science.
- To encourage you to regularly ask “why, why, why?”
- To enhance your mathematical intuition and develop your curiosity.
- To build upon your logical reasoning, and both critical and analytical thinking.
- To grow your fluency in mathematics so that you can identify injustices in the world and move towards change.

11 Course Policies related to Academic Integrity

You are strongly encouraged to collaborate with other students when working on homework and studying for your exams. When you submit your homework online, this done independently so that you assess your own learning.

12 Homework Schedule

There are a total of 28 homework assignments (roughly 3 per weekly – note the week of Oct. 12-15 is particularly busy when there are 4 assignments due). They are arranged in order by deadline (not by homework number, for example, or by the opening date). Each homework topic is assigned on the day the topic is covered in class and you will have about 4 days to complete the homework. (Some sections will be a little bit ahead, due to holidays, and so some homework topics may open up just before you learn them in your section.)

The “Open on” date begins at 9am of that day and the “Due date” is by 11:59pm on that day.

| Homework # | Topic | Opens on | Due date |
|------------|------------------------------|----------|----------|
| 1 | Review | Sept. 7 | Sept. 13 |
| 2 | Equilibria | Sept. 9 | Sept. 15 |
| 3 | Rates of Change | Sept. 14 | Sept. 20 |
| 4 | Limits | Sept. 16 | Sept. 22 |
| 5 | Infinite Limits | Sept. 16 | Sept. 24 |
| 6 | Continuity | Sept. 21 | Sept. 27 |
| 7 | Definition of the Derivative | Sept. 23 | Sept. 29 |
| 8 | Derivative Rules | Sept. 23 | Oct. 1 |
| 9 | Product & Quotient Rules | Sept. 28 | Oct. 4 |
| 10 | Chain Rule | Oct. 1 | Oct. 8 |

*Note that some of the deadlines get whacky from here on in, now that you have homework that follows tutorial classes (which fall on different days of the week, depending on which tutorial class you are in), starting with homework 11 & 12 and again with 23 & 24. This table is intentionally broken into two pieces so that you are aware of this!

| Homework # | Topic | Opens on | Due date |
|------------|-----------------------------------|----------|----------|
| 12 | Implicit Differentiation | Oct. 4 | Oct. 12 |
| 11* | Trig. Derivative Rules* | Oct. 4 | Oct. 13 |
| 13 | Related Rates | Oct. 6 | Oct. 14 |
| 14 | Second Derivative | Oct. 8 | Oct. 15 |
| 15 | Linear Approximation | Oct. 12 | Oct. 18 |
| 16 | Extreme Values | Oct. 14 | Oct. 20 |
| 17 | Graphing | Oct. 19 | Oct. 25 |
| 18 | l'Hôpital's Rule | Oct. 25 | Oct. 29 |
| 19 | Differential Equations | Oct. 25 | Nov. 3 |
| 20 | Taylor Polynomials | Oct. 28 | Nov. 4 |
| 21 | Antiderivatives | Nov. 1 | Nov. 17 |
| 22 | Euler's Method | Nov. 4 | Nov. 18 |
| 24 | Riemann Sums | Nov. 16 | Nov. 22 |
| 23* | Substitution* | Nov. 15 | Nov. 24 |
| 25 | Fundamental Theorem of Calculus | Nov. 18 | Nov. 25 |
| 26 | Integration by Parts | Nov. 22 | Dec. 1 |
| 27 | Autonomous Differential Equations | Nov. 25 | Dec. 2 |
| 28 | Separable Differential Equations | Nov. 29 | Dec. 6 |

13 Course Policies on missed or late academic requirements

In the event that you are absent for three days or fewer resulting in missed or late academic requirements, you will be required to submit a Student Declaration of Absence Form to your instructor, see: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html

We understand that circumstances can arise that can interfere with completing your course work. We will drop your two lowest homework scores to function as a buffer for all.