



FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS

2022 Winter Term 2

January - April, 2023

Introduction to Ordinary Differential Equations (3 credits)

MATH 225

The Faculty of Science acknowledges that the land on which we are situated is the unceded territory of the Syilx (Okanagan) People

*Math 225 is an in-person course, with all of the benefits of that mode of delivery. Lecture time will be used for learning new content, doing exercises, and for Q&A with the instructor and peers. Lectures will be streamed, so that any students who are feeling unwell can still join the course virtually. I will handle questions from the chat as I am able, but my first priority will be for the in-person students. Lectures will **not** be recorded.*

*Math 225 Tutorials are in-person **only**. Tutorials will be used for group work assignments, which are to be done on paper and handed in at the end of tutorial. These assignments will be marked by TAs. Half of these group work assignments will focus on topics related to Climate Change, as solving this problem is the most important task faced by humanity at the moment, and differential equations have a role!*

Two lectures during the term are reserved for guest lectures by climate science experts (bring your questions!), following which students will submit a written reflection for marking by the instructor.

Your Instructor

- Professor Rebecca Tyson
- Web: <https://cmps-people.ok.ubc.ca/rtyson>
- Email: Math 225 questions will only be accepted via Canvas mail.
- Office Hours: 1 1/2 hours per week, generally Mondays 2pm-3:30pm

Here is a little [autobiography](#) I wrote for a newsletter a few years ago. It will tell you a little about my winding career path and how I ended up here at UBCO!

An Important Reminder

I can show you the material, but I cannot learn it for you.

Location of Lectures and Tutorials



The physical location of the class and course tutorials are listed on the Student Service Centre website.

Email Correspondence

The best way to contact me is to **attend lectures and office hours**. If that is impossible, however, I will respond to brief, politely-worded emails, sent via Canvas mail, within 2 business days, where possible. I will not respond at all to queries that could be answered by reading this course outline. If you have a question requiring a detailed or sustained response, please request an appointment to see me and put "appointment request" in the subject line. If you have special needs or you are struggling at any point in the course, please keep in contact with me so I can offer help and support.

Textbook

The textbook for the course is either

- Fundamentals of Differential Equations by Nagle, Saff, and Snyder (Pearson publishing), 9th Edition
- OR
- Fundamentals of Differential Equations and Boundary Value Problems by Nagle, Saff, and Snyder (Pearson publishing), 7th Edition

You may use the e-text or hardcopy. The solutions manual is completely optional.

Course Description (calendar - the more congenial course description is in Course Overview, Content, and Objectives below)

MATH 225 (3) Introduction to Differential Equations

First-order equations, initial value problems, existence and uniqueness theorems, second-order linear equations, superposition of solutions, independence, general solutions, non-homogeneous equations, phaseplane analysis, numerical methods, matrix methods for linear systems, and applications of differential equations to the physical, biological, and social sciences. [3-0-1]

Prerequisite: MATH 101.

Corequisite: MATH 221 is recommended.

Course Format

This course will be delivered in-person with live-streaming of lectures to accommodate students who occasionally need to stay at home.

Course Overview, Content and Objectives

Differential Equations are a lot of fun! In Math 225 you will learn the tools to set up and solve a wide variety of ordinary differential equations. In this way you will learn a great deal about expressing real-life systems in mathematical language and about finding meaningful solutions. In this course, the concepts are as important as the calculations, and the assessment questions will reflect this. The text has been selected for its clarity, and especially for its attention to motivating the problems we address in the course.

One of the exciting aspects of Math 225 this year, is the relevance of this course to understanding models of diseases like COVID-19. We will therefore spend some time learning about disease models, and understanding the mathematical basis of concepts that are being talked about regularly in the media: The reproductive number,



flattening the curve, epidemic wave, peak size, and final size. Time permitting, we will also discuss the effect of spatial movement on disease progression in the population.

Math 225 content is also a window into real modelling of processes in the natural world. The most important problem facing humanity right now is climate change, and so we are going to spend time in this course learning about climate change, and climate change models formulated as ODEs. Most of this learning will occur through group work exercises during tutorials.

There is a great deal of basic material to cover in the few weeks we have available! Staying current with the asynchronous content and homework, and attending the synchronous components will be essential to doing well in the course.

Learning Outcomes

By the end of this course, students will be able to:

- *Interpret and Create* direction fields and phase lines
- *Solve* linear, separable, and exact first order differential equations
- *Solve* linear second order differential equations with constant coefficients and interpret the meaning of the equation and solutions analytically
- *Interpret* nonlinear second order differential equations and predict solution behaviour
- *Develop* and, where possible, solve simple compartmental models, including disease models of SIR-type
- *Use* Laplace transforms to solve ODEs with discontinuous coefficients or forcing
- *Work effectively in groups* for problem-solving and solution presentation
- *Understand* the use of ODEs in modelling infectious disease dynamics and climate change.

Assessment

Assessment will be based on take-home homework assignments, in-class and in-tutorial group work assignments, midterms and a final exam. Group work and homework assignments are to be handed in online via Canvas. The Final Exam will be held during the final exam period. More details about the final exam appear below. Your final course mark will be computed according to one of the two weightings below. The weighting that gives you the best mark will be used.

Item	Description	Weight 1	Weight 2
Group Work	Worksheets completed in small groups during class or tutorial. <i>Lowest two marks dropped.</i>	10%	5%
Homework Assignments	Take-home homework assignments, due on Mondays by 10pm . You are welcome to discuss the homework problems with classmates, but you must hand in your own work. Due dates appear in the agenda. <i>Lowest mark dropped.</i>	20%	5%
Midterms	Midterms will be written during class time. The Midterm dates are Feb 6th and Mar 20th . Each	20%	10%



	midterm will be a two-stage test.		
Final Exam*	Written, during the final exam period. *Note: You must obtain at least 50% on the final exam in order to pass the course. If you fail the final exam, your course mark will be at most 45%.	50%	80%

The final grade assigned will be the best of the two formulas above, and conversion to a letter grade will be done according to the standardized grading system outlined in the UBC Okanagan Calendar.

Course Schedule

Please see the course agenda.

Late Policy

Late homework or group work assignments are not accepted. No exceptions. Instead, the lowest homework assignment mark and the lowest two group work assignment marks are dropped.

Final Examinations:

The final exam will be a comprehensive individual closed-book test held during the final examination period at the end of the term. The specific date, time, and location of the exam for this course will be announced later in the term. **Failure to write the final examination at the scheduled time without a legitimate excuse will result in an automatic failing grade for the course.** Whether the exam is in-person or online, invigilators must be able to see your face, and the paper or tablet on which you are writing.

Out of Time Final Exam: Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 24-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a family member. Unforeseen events include (but may not be limited to) ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job. Further information on Academic Concession can be found under Policies and Regulation in the Okanagan Academic Calendar <http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0>.

Calculators

A scientific calculator is required.

Technical Support Resources for Students

The Student Learning Hub's technical support can be found at <https://students.ok.ubc.ca/academic-success/learning-hub/tech-support-for-online-learning/>

Aboriginal Programs and services



The primary goal of the Aboriginal Programs and Services is to provide culturally appropriate services and support to First Nation, Metis and Inuit students.

UNC 212

<http://students.ok.ubc.ca/aboriginal/welcome.html>

International Program and Services

International Program and services (IPS) provides advising, transition services and programs for international students, and IPS works to foster an intercultural campus community where differences are embraced and respected and adapting is multidirectional.

UNC 227

<http://students.ok.ubc.ca/international/welcome.html>

Grading Practices

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to University, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record. For more information, please go to the following web page: <http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014>.

Academic Integrity

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

Specific Format for Online Tests: The examinations in this course are all closed-book, i.e., you **do not** have access to any of the course materials, including your notes, during the exam. Proper studying will be necessary if you wish to succeed.

Activities that are NOT allowed during tests, quizzes, or exams:

Transgression of any of the rules below constitutes cheating. Students who cheat will be given a zero for the test on which cheating occurred, and referred to the Dean's Office for Academic Misconduct.

1. You are NOT allowed to discuss questions and answers with your peers or classmates.
2. You are NOT allowed to access help from tutors of any sort (local or online).
3. You are NOT allowed to use software such as Maple, Matlab, or Wolfram Alpha to do the calculations for you.



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A more detailed description of academic integrity, including the University's policies and procedures for dealing with academic misconduct, may be found in the Academic Calendar at <http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0>.

Cooperation vs. Cheating

Working with others on assignments is a good way to learn the material and we encourage it. However, there are limits to the degree of cooperation that we will permit. Any level of cooperation beyond what is permitted is considered cheating. When working on assignments, working together to find a good approach for solving a homework problem is cooperation; listening while someone dictates a solution is cheating. Anything that you hand in must be written by you, from scratch, in your own words and mathematical symbols.

Copyright Disclaimer

Diagrams and figures included in lecture presentations adhere to Copyright Guidelines for UBC Faculty, Staff and Students <http://copyright.ubc.ca/requirements/copyright-guidelines/> and UBC Fair Dealing Requirements for Faculty and Staff <http://copyright.ubc.ca/requirements/fair-dealing/>. Some of these figures and images are subject to copyright and will not be posted to Canvas. All material uploaded to Canvas that contain diagrams and figures are used with permission of the publisher; are in the public domain; are licensed by Creative Commons; meet the permitted terms of use of UBC's library license agreements for electronic items; and/or adhere to the UBC Fair Dealing Requirements for Faculty and Staff. Access to the Canvas course site is limited to students currently registered in this course. Under no circumstance are students permitted to provide any other person with means to access this material. Anyone violating these restrictions may be subject to legal action. Permission to electronically record any course materials must be granted by the instructor. Distribution of this material to a third party is forbidden.

Grievances and Complaints Procedures

A student who has a complaint related to this course should follow the procedures summarized below:

- The student should attempt to resolve the matter with the instructor first.
- In rare circumstances, the student may justifiably feel the need to first talk to someone other than the instructor. Talking to the instructor first, however, is strongly encouraged.
- If the complaint is not resolved to the student's satisfaction, the student should e-mail the Associate Head, Dr. Heinz Bauschke at heinz.bauschke@ubc.ca or the Department Head, Dr. John Braun at john.braun@ubc.ca

Student Services Resources

Academic Integrity Matters (AIM) Program

LIB 237 250.807.9185

email: csc.okanagan@ubc.ca

web: <http://library.ok.ubc.ca/wrs/aim/>

UBC Okanagan Disability Resource Centre

UNC 227A

tel: 250.807.9263

email drc.questions@ubc.ca

web: <http://students.ok.ubc.ca/drc/welcome.html>



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Equity, Human Rights, Discrimination, and Harassment

UNC 227C

tel: 250.807.9291

email: equity.ubco@ubc.ca

web: <http://www.ubc.ca/okanagan/equity/welcome.html>

Health & Wellness

UNC 337

tel: 250.807.9270

web: students.ok.ubc.ca/health-wellness/welcome.html

Early Alert: <https://facultystaff.students.ubc.ca/systems-tools/early-alert>

Sexual Violence Prevention and Response Office (SVPRO)

tel: 250.807.9640

web: svpro.ok.ubc.ca

Independent Investigations Office (IIO)

tel: 604.827.2060.

email: director.of.investigations@ubc.ca

web: <https://investigationsoffice.ubc.ca/>

The Hub

LIB 237

tel: 250.807.9185

web: <https://students.ok.ubc.ca/student-learning-hub/>

SAFEWALK

tel: 250.807.8076.

web: <https://security.ok.ubc.ca/safewalk/>

mobile app: UBC SAFE – Okanagan