Math*2270 – Applied Differential Equations – Fall 2022

(Revised: August 29, 2022)

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1 Instructional Support

1.1 Instructor

Dr. Matt Demers mdemers@uoguelph.ca
Office Hours:
Face-to-Face: Mondays 11 am – 12 noon, THRN 1425
Virtual: Thursdays 5 – 7 pm, through Zoom

Also feel free to get in touch to make an appointment with me, or chat with me after class!

1.2 Teaching Assistants

TAs:

Rebecca Fong	fongr@uoguelph.ca
Kevin Kasa	kkasa@uoguelph.ca
Yahuza Bello	ybello@uoguelph.ca
Jay Vijaykumar Papaiya	jpapaiya@uoguelph.ca
Kasra Ghasemi	kghasemi@uoguelph.ca
Rahul Vinubhai Kumbhani	rkumbhan@uoguelph.ca
Rutva Dharmesh Patel	rutvadha@uoguelph.ca
Avneet Singh	singh12@uoguelph.ca

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2 Learning Resources

2.1 Course Website

Completed course notes, news, announcements, and grades will be regularly posted to the Math*2270 Courselink page.

2.2 Required Resources

Math*2270 - Applied Differential Equations – Course Manual (Available through Courselink)

This is our primary resource for the course. This will be released free of charge, through Courselink, chapter by chapter as we progress through the course.

2.3 Recommended Resources

Not applicable.

2.4 Additional Resources

Lecture Information:

Lecture material will be delivered via an asynchronous (previously recorded) format, accessible through Youtube. Links to these videos will be provided regularly through Courselink, at a recommended pace; nevertheless, all of the videos will be available through my Youtube channel so you have the ability to study ahead as necessary. Treat these as though they are a pre-cursor to each in-person lecture. Make a schedule to watch videos several times per week. It is not advisable to procrastinate, and then "binge-watch" a large number of videos at once! Much of the material in this course takes time to learn, digest, and practice.

In-person lectures are designed to review, reinforce, and then extend concepts presented in the videos. In most lectures, I will summarize what you should already have been introduced to in the videos, and then we will concentrate on examples, common mistakes, friendly advice, and most importantly a variety of problems and examples, including some interesting extensions.

Past Tests and More:

Assignments and tests from recent offerings of the course will be posted online with full solutions available. This is an opportunity for you to see and work on extra problems that are at the level I expect from you. *This does not in any way, however, imply that the assignments and tests of this semester will be or should be identical to or similar to those of previous years.* I may also post extra resources or provide links from time to time if I create something or come across something that I believe might be helpful to you. Anything like this would be posted to the Courselink site, so again, check it every day!

2.5 Communication & Email Policy

Please feel free to ask any questions during or just after the live lectures. Do not feel intimidated about contributing, because active learning is much more effective than just copying down notes! There are other options for help too:

- Your lab TA may be able to help you with questions you may have.
- Drop in to my posted office hours. Don't ever hesitate to join, even if you think you are behind in your studying. Getting you caught back up is **exactly** what those

opportunities are there for!

- Use the discussion forums available to you on Courselink. It is possible that a classmate will know the solution and will be able to help you, and it will be useful to have classmates to collaborate with. Myself and a TA will be monitoring the boards to help answer questions in case a classmate is unable to jump in with a response first. Remember: It is GREAT practice to help and explain one concepts to one another!

- Send me an email (mdemers@uoguelph.ca). If you do this, it would be extremely helpful for you to *attach a picture of your work*, so I can easily see where you might be stuck and be able to help you more quickly. I will always aim to respond within a day, and quicker whenever I can.

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3 ASSESSMENT

3.1 Dates and Distribution

Warmup: (10%; or 0% if your Warmup grade is lower than your Final Exam grade)
Friday, September 23 during class time

The Warmup is short test, focusing on essential concepts from calculus and linear algebra. You will have 40 minutes to write it. The Warmup is a *closed book* test and you will not be allowed any resources except something to write with. The Warmup is designed to measure your readiness for the rest of the course, so aim high on this!

Lab Assignments: (15%**)
Released every weekend, starting September 10-11, these must be submitted during your designated lab time in the following week to your TA. TAs will only be grading their own sections; so make sure you attend the proper lab section! Submission instructions will be announced in the first week in class and on Courselink.

**Lab assignments are worth 15% of your grade, evenly split among your labs. *Late lab submissions will not be accepted; but any unsubmitted labs will have their weight transferred automatically to the final exam.*

Lab assignments will not be given during the last week of class, or during the weeks of either of the midterm tests.

Tests (20% each)**:**
Saturday, October 15
10:00 – 11:30 am
Locations TBA

Friday, November 11
6:00 – 7:30 pm

Final Exam (35%; or 45% if your Final Exam grade is higher than your Warmup grade):
Thursday, December 8 at 8:30 am

Location TBA

The tests and exam will be face-to-face and open-book; you may use any resources except for phones (or any screens).

The final exam will be cumulative. Be prepared for material from over the entire course.

3.2 Course Grading Policies

Missed Assessments and Tests:
If you know in advance that you will be unable to attend any tests due to medical, psychological, compassionate, or other reasons, please email me with at least two weeks of notice. If you do, I will try my best to come to an agreement to reweight the test to other components of the course, or provide an alternative assessment, depending on your situation. See below for details and consult the undergraduate calendar for information on regulations and procedures for Academic Consideration:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations:
If you are unable to meet an in-course requirement due to religious obligations, please email me within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade:
You must receive a final grade of 50% or greater in order to pass this course.

Illness:
Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g. final exam or major assignment).

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4 Aims, Objectives & Graduate Attributes

4.1 Calendar Description

Solution of differential equations which arise from problems in engineering. Linear equations of first and higher order; systems of linear equations; Laplace transforms; series solutions of second-order equations; Fourier series and introduction to partial differential equations.
Prerequisite(s): One of IPS*1510, MATH*1210, or MATH*2080
Corequisite(s): Engg*2400 (for Engineering Students)

4.2 Course Aims

This course is taught with the view to combine a sound and accurate exposition of the elementary theory of differential equations with considerable emphasis on methods of solution that have proved useful in a wide variety of applications in science and engineering. A primary objective of this course is to motivate the ideas and results of ordinary differential equations for use in modeling of engineering systems. An introduction to partial differential equations is given to prepare the student for study of transport phenomena involving fluid mechanics, heat transfer and mass transfer.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Discern between partial differential equations (PDEs) and ordinary differential equations (ODEs/DEs); linear and non-linear DEs; homogeneous and nonhomogeneous DEs; first and higher-order DEs; and specific types of first-order DEs.
2. Solve particular types of DEs using a variety of common methods, understanding that a given problem could be solved using many different approaches.
3. Explain qualitative aspects of solutions to ODEs, including equilibrium points and the long-term behaviour of solution curves.
4. Effectively use and deeply understand mathematical tools including Laplace transforms, Taylor series and Fourier series, and how they might be used to solve ODEs or PDEs.
5. Translate word problems in various applications into mathematical language before solving them.

4.4 Graduate Attributes (for Engineering)

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2, 3, 4, 5	Labs, Tests, Exam
2. Problem Analysis	1, 2, 3, 4, 5	Labs, Tests, Exam
3. Investigation	-	-
4. Design	-	-
5. Use of Engineering Tools	-	-
6. Communication	1, 2, 3, 4, 5	Labs, Tests, Exam
7. Individual and Teamwork	1, 2, 3, 4, 5	Labs
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

As your instructor, I pledge to:

1. Deliver course material in a professional way that facilitates learning for a variety of students and learning styles.

2. Respond to you. This includes, as time permits, questions during or after lectures, during office hours, or through email. You are more than welcome to contact me at any time through these means if you have questions or concerns about the course or new concepts.

3. Evaluate you fairly, providing prompt feedback on your performance and justification for any grades you are given. I must provide academic consideration, where appropriate, as described in Section 3.

4.6 Students' Learning Responsibilities

As a member of this class, you are expected to:

1. Take advantage of the learning opportunities provided during lectures, labs, and through Courselink.
2. Treat others with dignity whenever you address them. There are a large number of people enrolled in this class from all walks of life and of all skill levels. Your understanding and respect of this diversity is extremely important!
3. Genuinely try all homework in a timely manner and make the effort of attempting optional practice questions, especially if you have faced some trouble with math courses in the past.
4. Seek help if you have tried the homework and are still having difficulty with the course content. This means using the Courselink forums to get help from your peers, contacting me through email or in office hours (*not* just at the last minute!) and possibly considering other resources as I recommend them to you.
5. Check all of your posted grades with tests that have been returned to you, to verify that the correct mark has been recorded. If not, then for tests, get in touch with me right away in person or through email, and we will figure things out. For lab assignments, contact your TA and they will do the same.
6. Notify me, as described in Section 3, in the case that there are academic conflicts that are known in advance. If illness, work, or extra-curricular activities are causing you to struggle, you are advised to keep me up-to-date on your progress, so that I can be more helpful to you.

4.7 Relationships with other Courses & Labs

MATH*1160/ENGG*1500; MATH*1200+1210 or IPS*1500+1510. These courses provide the fundamental tools required for the new concepts and methods introduced in MATH*2270.

Follow-On Courses

In the Engineering Program: ENGG*2560, ENGG*2660, ENGG*3260, ENGG*3410, ENGG*3430, ENGG*3470, ENGG*3700, and ENGG*4470. MATH*2270 provides a broad mathematical foundation that any later course involving differential equations will require. Additionally, many applications explored in these later courses are first introduced in **MATH*2270.**

In the Mathematics program: MATH*3100, MATH*3510, and MATH*4270. All of these senior courses involve differential equations and squarely depend upon the concepts introduced in Math*2270!

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:
Asynchronous (lectures will be posted as videos online on a regular basis)

Labs:
Fridays at 9:30 am in ALEX 200 (Section 3)
Fridays at 11:30 am in RICH 2520 (Section 1)
Fridays at 2:30 pm in ROZH 101 (Section 2)

5.2 Video Lecture Schedule – (Please note that the timing may vary slightly)

Lectures 1-2	Introduction to DEs	Section 1	Learning Objectives 1,3	
3-9	Solutions to First-Order DEs		Section 2	LOs 1,2,3
10-12	Applications of First-Order DEs		Section 3	LOs 1,2,3,5
13-14	Introduction to Higher-Order DEs		Section 4	LOs 1,2
15-16	Solution Techniques for Higher-Order DEs		Section 5	LOs 1,2,3
17-20	Solution Methods for Nonhomogeneous DEs		Section 6	LOs 1,2,3
21-22	Vibrations as an Application of 2nd-Order DEs		Section 7	LOs 1,2,3,5
23-28	Laplace Transforms		Section 8	LOs 1,2,4,5
29-31	Power Series Solutions to DEs		Section 9	LOs 1,2,4
32-34	Solving Linear Systems of DEs		Section 10	LOs 1,2,3
35-36	Introduction to Fourier Series		Section 11	LOs 1,2,4

5.3 Design Lab Schedule

Not Applicable.

5.4 Lab Schedule (Again, be warned that the timing or topics may vary slightly)

Lab 0	Greetings + Course Outline	N/A	N/A
Lab 1	Intro to DEs	Section 1	Learning Objectives 1,3
Lab 2	Direction Fields	Section 2	LOs 1,3
Lab 3	Solving Linear, Separable DEs	Section 2	LOs 1,2
Lab 4	Exact DEs, Substitutions (Ungraded)	Section 2	LOs 1,2
Lab 5	Applications of 1^{st}-order DEs	Section 3	LOs 1,2,3,5
Lab 6	2^{nd}-Order Homogeneous DEs	Section 5	LOs 1,2
Lab 7	2^{nd}-Order Nonhomogeneous DEs	Section 6	LOs 1,2
Lab 8	Vibrations	Section 7	LOs 1,2,3,5
Lab 9	Laplace Transforms	Section 8	LOs 1,4
Lab 10	Step Functions	Section 8	LOs 1,2,4,5
Lab 11	Power Series Solutions	Section 9	LOS 1,2,4
Lab 12	**No lab**		

5.5 Drop Date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

5.6 Other Important Dates

Thursday, September 8: Classes commence
Monday, October 10: Thanksgiving Day (no classes scheduled)
Tuesday, October 11: Fall Study Break Day (no classes are scheduled)
Thursday, December 1: Tuesday class schedule is in effect
Friday, December 2: Last day of classes; Monday class schedule is in effect

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6 Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is outlined in the Undergraduate Calendar.

7 ACCESSIBILITY

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: www.uoguelph.ca/sas

8 COVID-19 DISCLAIMER AND SAFETY PROTOCOLS

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via Courselink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, that these guidelines may be updated as required in response to evolving University, Public Health or government directives.

9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: https://www.uoguelph.ca/registrar/calendars

Mental Health Services:

One out of every five students in Canada experiences some sort of mental health issue at some point in their academic career. If you find yourself facing a mental health crisis, or just need to talk to someone, please consider taking advantage of one of the following resources available to University of Guelph students:

Counselling Services: Visit the Counselling Services website (https://wellness.uoguelph.ca/counselling) to get information on resources available to you, both online and in-person. You can also visit them at Health Services (J.T. Powell Building, ext 53244) where they offer individual and group counselling sessions by appointment or walk-in.

Student Support Network: is located in the Wellness & Education Promotion Centre in the J.T. Powell Building and offers confidential, peer-based, drop-in support.

Good2Talk: (1-866-925-5454) is a free, 24/7 student hotline that provides professional counselling and referrals for mental health, addictions and well-being.

Here 24/7: (1-844-437-3247) specializes in assessment, referral and appointment booking and is available 24/7 for crisis support.

You are not alone and you will not be judged for asking for help.