Math*2270 – Applied Differential Equations – Fall 2020

(Revised: September 8, 2020)

Disclaimer: Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website https://news.uoguelph.ca/2019-novel-coronavirus-information/
The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

---

1 Instructional Support

1.1 Instructor

Dr. Matt Demers mdemers@uoguelph.ca

One-on-One (Skype) Office Hours: By request – just send me an email and we can find a time that works!

Group (Zoom) Office Hours:
Tuesdays, 10:30 am – 12 noon Wednesdays, 1:30 – 3:00 pm

1.2 Teaching Assistants

Graders:

Prabhjot Kaur	pkaur@uoguelph.ca
Hannah May	hmay@uoguelph.ca
Mohammadreza Mohaghegh	mohaghem@uoguelph.ca
Ibrahim Nouzil	inouzil@uoguelph.ca

Elite Four (Office Hours to be announced on Courselink shortly):

Quade Butler	qbutler@uoguelph.ca
Camille Leclerc	cleclerc@uoguelph.ca
Isaac Spotts	ispotts@uoguelph.ca
Brent Van de Walker	bvandewa@uoguelph.ca

2 LEARNING RESOURCES

2.1 Course Website

Completed course notes, news, announcements, and grades will be regularly posted to the Math*2270 Courselink page. Especially given the alternative method of delivery for this semester, it is especially important that you log in and check the page every day.

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:

Lectures will be delivered via an asynchronous (previously recorded) format, accessible through Youtube. Links to these videos will be provided regularly through Courselink. It is extremely important that you treat these as though they were everyday lectures. Make a schedule to watch a video 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.

A live lab will be offered every week, Fridays 1:30 – 2:20, through Zoom. I strongly encourage you to tune in to participate in this! In each lab, I will be going over the material that you should have watched in videos for the week – and then going over problems or concepts that students have usually found to be tricky or troublesome in the past. This will also provide you with a chance to ask questions and interact with me and your classmates directly.

Previous Assignments and Tests:

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.*

Other:

I might post some 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 labs. Do not feel intimidated about contributing during these labs, because active learning is much more effective than just copying down notes! If you can't ask me a question during or after lab, though, there are still options for help:

- Four TAs for the course are designated as our "Elite Four" and will be very regularly available to help you with assignments and test preparation. Get to know them and use their assistance regularly!

- 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. The Elite Four will be checking these forums from time to time, to help answer questions in case a classmate is unable to jump in with a response first.

- 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.

---

3 ASSESSMENT

3.1 Dates and Distribution

Warmup:
Due Monday, September 21 at 5:00 pm
Worth 10% of your grade if this grade is higher than your Exam grade, or 0% otherwise.

The Warmup is an extended assignment, available starting September 11, that will cover topics from high school math, first-year calculus and linear algebra that you should already be familiar with. All problems should be straightforward, and will help you to gauge your readiness for the course. More information will be provided on Courselink and in the first lab.

Lab Assignments:
Every week on Friday, due on the next Monday evenings at 8:00 pm.

Worth 30% of your grade, evenly split among your labs. You may "drop" any one lab for any reason over the whole semester. If on the other hand you submit every lab, your lowest grade among them will be dropped from the calculation of your mark for this component.

A short assignment will be made available through Courselink after each lab, generally pertaining to the material from the lectures of the week before. You may work individually or in groups of up to three. If you do work in a group, the names of all members must be clearly present on your submitted work. *Note: NO lab assignment will be given over Thanksgiving Weekend, or during the very last week of class. An intro assignment, given on September 11 and due on September 18, will be special (more information to come). Stay tuned for more information on labs in Courselink.*

Tests:

Friday, October 2
5:00 – 7:15 pm
Worth 15% of your grade

Friday, October 30
5:00 – 7:15 pm
Worth 15% of your grade

Friday, November 20
5:00 – 7:15 pm
Worth 15% of your grade

Tests will be open-book. For some parts, you will have the opportunity to collaborate with other students. However, you are responsible for understanding the logic behind any written solutions. If the TAs or myself are unclear about your understanding for a provided solution, based on what you have written down, we reserve the right to contact you through email to schedule a friendly and short (~5 minute) virtual meeting to discuss the test. ***Your grade may go up or down based on this discussion!*** Not replying to this email may result in the loss of marks, so keep your eyes open for it.

Final Exam:
Friday, December 11 at 8:30 am
Worth 15% of your grade, if your Warmup grade is better than your Exam grade; *OR*
Worth 25% of your grade, if your Exam grade is better than your Warmup grade.

The final exam will concentrate heavily on the last (untested) material from the course, though there may be a question or two that blend in content from earlier in the course, especially if that material has not been tested yet. Otherwise, the format and policies will be very similar to the other three tests.

3.2 Course Grading Policies

Missed Assessments and Tests:
If you are unable to attend any tests due to medical, psychological, or compassionate

reasons, please email me. We may be able to come to an agreement to reweight the test to other components of the course, or provide an alternative assessment, depending on your situation. If you know in advance that you have a conflict for a test, provide me with at least two weeks of notice. I will try to schedule an alternative writing time *ahead* of the scheduled assessment (but for clarity, I cannot guarantee that such an arrangement will be possible). 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.

Missed Lab Assignments:
With the large number of students in the class, we will not have the ability to grade labs that have been submitted late. Remember that you have the ability to drop any one lab over the semester: Use this flexibility wisely.

---

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 over 500 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!

---

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

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

Labs:
Fridays, 1:30 – 2:20 pm, through WebEx

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 1st-order DEs	Section 3	LOs 1,2,3,5
Lab 6	2nd-Order Homogeneous DEs	Section 5	LOs 1,2
Lab 7	2nd-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 Other Important Dates

Thursday, September 10: First day of classes
Monday, October 12: Thanksgiving Day (no classes scheduled)
Tuesday, October 13: Fall Study Break Day (no classes are scheduled)
Thursday, December 3: Tuesday class schedule is in effect
Friday, December 4: Last day of classes; Monday class schedule is in effect

---

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.
If the laboratory rules are not followed, consequences will include removing student's access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

---

7 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
https://academicintegrity.uoguelph.ca/

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact Student Accessibility Services as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email sas@uoguelph.ca or see the website: https://wellness.uoguelph.ca/accessibility/

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