Math*2270 – Applied Differential Equations – Fall 2023

UNIVERSITY of GUELPH

(Revised: August 25, 2023)

---

1 Instructional Support

1.1 Instructor

[redacted]

Office Hours: To be determined; likely two hours per week face-to-face, and one hour per week virtual (through Zoom).

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

1.2 Teaching Assistants

Lab TAs:

[redacted]

---

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 and Lab Manual (Available through Courselink)

These are our primary resources for the course, made available online from the start, free of charge. Feel free to print these out if you wish, and bring them to classes and lab (either in paper or electronic form). Your lab TA will go through the lab notes to cover various applications of DEs, though that material will depend on the concepts introduced in the course notes in class.

2.3 Recommended Resources

For extra examples, feel free to check out my Youtube series for this course! None of the examples we cover in the course are exactly the same, so these videos are best viewed as a chance to revisit concepts from class and lab, for some optional extra practice. Be aware that this is not necessary; and that we now cover a few additional topics in some more depth in class that is not found in the videos.

2.4 Additional Resources

Lecture Information:

Lecture material will be delivered in person and will follow the course notes. Completed course notes will be uploaded promptly (typically before the end of the day) to Courselink, if you are unable to come to class.

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! Up to one bonus mark applied to your course grade may be given, at a TA's/my discretion, for an especially polished/precise correct answer to another student's question.

- Send me an email [redacted]. 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

Tests (20% each):

Friday, October 20	Friday, November 10
6:00 – 7:15 pm or 7:45 – 9 pm	6:00 – 7:15 pm or 7:45 – 9 pm
Locations TBA	Locations TBA

Tests will generally be focused on topics from recent sections of the course notes. Applications will be tested in lab, so tests will focus more on theory and calculations. You will be allowed to create a study sheet that you may bring to these tests, and calculators are allowed. Phones, however, must be turned off and put away. Collaboration is not allowed for these tests.

Lab Tests (Two tests at 7.5% apiece):
In each week following the midterm tests, there will be a lab test that focuses on the applications that you have covered so far. These lab tests are open book and you may work with a partner IF you wish, but this is not necessary. You must attend the lab that is in your schedule to ensure that there is space for everyone!

Lab Test 1: Week of October 23 - October 27
Lab Test 2: Week of November 13 - November 17

MyLab Refresher Quizzes (Optional 10%):
A number of quizzes, mostly focusing on essential concepts from functions, calculus, and linear algebra, will be available through an online quiz system. Details on how to access this system will be made available during the first couple of lectures. There is a fee to access this service (approximately $50), and thus I have chosen to make it entirely optional. These

quizzes are worth up to 10% of your grade, and will be open through the semester, until your final exam, for as many attempts as you wish. Use them as you see fit to polish up on your derivatives, integration skills, and so forth!

An alternative grading scheme is available**,** designed for those of you who choose not to use this service. All other components of the course will increase in their weight very slightly according to an alternative scheme:

Midterm Tests: 20% each -> 22.5% each
Lab Tests: 7.5% each -> 8.5% each
Final Exam: 35% -> 38%

All students will have their grade calculated using both the regular and alternative schemes, and the better result will stand as the final grade. You do not have to indicate which you would prefer; this will happen automatically.

Final Exam (35%):
Monday, December 4, 8:30 am

Location TBA

The exam will be face-to-face and will be cumulative, and will cover material from both lectures and labs. Similar to tests, you will be allowed to create a study sheet that you may bring to the exam, and calculators are allowed. Phones, however, must be turned off and put away; collaboration of any kind is not allowed.

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).

---

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!

5 Teaching and Learning Activities

5.1 Timetable

Lectures:

[redacted]

Labs:
Please see Webadvisor for the list of lab sections.

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

Lectures 1-3	Introduction to DEs	Section 1	Learning Obj. 1,2,3
4-11	Solutions to First-Order DEs	Section 2	LOs 1,2,3
12-13	Introduction to Higher-Order DEs	Section 4	LOs 1,2
14-16	Solution Techniques for Higher-Order DEs	Section 5	LOs 1,2,3
17-21	Solution Methods for Nonhomogeneous DEs	Section 6	LOs 1,2,3
22-27	Laplace Transforms	Section 8	LOs 1,2,4,5
28-30	Power Series Solutions to DEs	Section 9	LOs 1,2,4
31-33	Solving Linear Systems of DEs	Section 10	LOs 1,2,3
34-36	Introduction to Fourier Series	Section 11	LOs 1,2,4

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

Lab 1	Greetings + Integration Review	N/A
Lab 2	More Integration Review, Position/Velocity/Acceleration	N/A
Lab 3	Orthogonal Trajectories, Introduction to Growth Models	LOs 2,5
Lab 4	More on Growth Models	LOs 2,3,5
Lab 5	No Lab (Thanksgiving Week)	N/A
Lab 6	Mixing Problems	LOs 2,5
Lab 7	Lab Test 1	N/A
Lab 8	Simple Circuits	LOs 2,3,5
Lab 9	Introduction to Vibrations	LOs 1,2,3,5
Lab 10	Lab Test 2	N/A
Lab 11	More on Damped and Forced Vibrations	LOs 1,2,3,5
Lab 12	No Lab (Last week of class)	N/A

5.4 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.

5.5 Other Important Dates

Thursday, September 7: Classes commence
Monday, October 9: Thanksgiving Day (no classes scheduled)
Tuesday, October 10: 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

---

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.