MATH*2270 – Applied Differential Equations

Section 01/02 - Fall 2024

UNIVERSITY
of GUELPH

(Revised: August 30th, 2024)

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

In-Person Office Hours:

Zoom Office Hours:

Access the meetings through the 'Zoom Office Hours' tab on Courselink.

1.2 Lab Demonstrators

Name	Email	Office Hour
		TBD
		TBD
		TBD
		TBD
		TBD
		TBD

2 LEARNING RESOURCES

2.1 Course Website

Completed course notes, announcements, grades, and other resources 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. Both documents are fill-in-the-blank style manuals that cover lecture and lab material respectively. The course manual will include core concepts, theory, and examples while the lab manual will cover the applications of DEs. Please bring them to classes and labs in paper or electronic form.

2.3 Additional Resources

Lecture 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 Assessments:

Assessments 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 a similar level to what I expect from you. *These were written by a different instructor and thus may be structured differently to those written this semester.*

Past Lecture Videos:

For extra examples, feel free to check out Matt Demers' YouTube series for this course. Keep in mind that the course notes have been modified significantly since the series was created and all examples covered have changed from those included in the series. So, these videos serve as a chance to revisit concepts from class and lab, for some optional extra practice. These videos **do not replace** lectures or labs, and thus are not necessary.

2.4 Communication & Email Policy

Please ask any questions you have during or just after the 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 any questions you may have.

- Attending the posted office hours. Don't ever hesitate to attend, even if you think you are behind in your studying. Getting you caught back up is **exactly** what those are 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. A TA and I 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 concepts to one another! *Up to a 2% bonus may be applied to your final grade for an especially polished/precise correct answer to another student's question and/or continuous contributions to the forums throughout the semester. This will be up to the discretion of the assigned TA and myself*.

- Send me an email (mdube04@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

Lab Assignments (15% Total):
Each assignment will contain a single question which is to be completed on paper and submitted in-person at the beginning of the specified lab. All solutions must be written in your own words and completed independently. The question will be unique to your specific lab section. Each assignment will be marked out of three marks, as follows:

- 1/3 marks: submitting anything with your name on it

- 2/3 marks: attempting the question with some valid steps taken

- 3/3 marks: a perfect or mostly perfect solution with a couple errors

These assignments will focus on topics from recent applications content covered in labs and make use of the content covered in lectures.

There will be a total of 9 assignments. Your mark will be calculated based on the best 7 assignments submitted. Therefore, if you are unable to attend lab or complete some of the assignments due to sickness, a family emergency, or any other circumstances you can miss two without penalty. If less than 7 assignments are submitted, you will receive zero for these unsubmitted assignments and this will impact your grade.

Assignment	Available on Courselink	Due
Assignment 1	September 8th	Lab 2
Assignment 2	September 15th	Lab 3
Assignment 3	September 22nd	Lab 4
Assignment 4	September 29th	Lab 5
Assignment 5	October 6th	Lab 7
Assignment 6	October 20th	Lab 8
Assignment 7	October 27th	Lab 9
Assignment 8	November 3rd	Lab 10
Assignment 9	November 10th	Lab 11

Aids for Quiz, Tests, and the Final Exam:
You will be permitted to use a calculator during the assessments. Additionally, for tests and the final exam a formula sheet will be distributed a week before and be provided to you during the assessment. Use this to practice during your preparation. No other resources will be permitted.

Warm-Up Quiz (10%):
Friday, September 27th
7:00 – 8:15 PM or 8:45 – 10:00 PM

This quiz will focus on reviewing some of the important concepts from previous courses that are necessary for this course. This includes functions, calculus, and linear algebra. If you receive a mark on the final exam greater than the mark received on this quiz, then the weight of this quiz will be automatically transferred to the final exam.

Tests (20% Each):

Saturday, October 19th   Saturday, November 16th
3:00 – 4:15 PM or 4:45 – 6:00 PM   3:00 – 4:15 PM or 4:45 – 6:00 PM

Tests will focus on topics from recent content covered in lectures.

Final Exam (35%):
Wednesday, December 4th
2:30 – 4:30 PM

The exam will be face-to-face and will be cumulative covering material from both lectures and labs.

Alternative Grading Schemes:
The grading scheme from the table below which maximizes your final grade will be used.

Assessment	Scheme 1	Scheme 2	Scheme 3
Lab Assignments	15%	15%	15%
Warm-Up Quiz	10%*	10%*	10%*
Test 1	20%	10%	20%
Test 2	20%	20%	10%
Final Exam	35%	45%	45%

*As stated previously, if you receive a mark on the final exam which is greater than the warm-up quiz, then the weight of the quiz will be transferred to the final exam.

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. Consult the undergraduate calendar for information on regulations and procedures for Academic Consideration.

Accommodation of Religious Obligations:
If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations.

Passing grade:
You must receive a final grade of 50% or greater 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).

Copies of Out-of-class Assignments:
Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

When You Cannot Meet a Course Requirement:
When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration.

4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

This course covers the solution of differential equations that arise from problems in engineering and science. Topics include linear equations of first and higher order, systems of linear equations, Laplace transforms, series solutions of second-order equations, and an introduction to partial differential equations.
Department: Mathematics and Statistics
College: Engineering and Physical Sciences
Prerequisites: One of ENGG*1500, MATH*1160, MATH*2150, or MATH*2160 and one of IPS*1510, MATH*1090, MATH*1210, or MATH*2080
Credits: 0.5 credits

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. The 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 the 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 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 behavior 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, Assignments, Tests, Exam
2. Problem Analysis	1, 2, 3, 4, 5	Labs, Assignments, Tests, Exam
3. Investigation	-	-
4. Design	-	-
5. Use of Engineering Tools	-	-
6. Communication	1, 2, 3, 4, 5	Labs, Assignments, Tests, Exam
7. Individual and Teamwork	1, 2, 3, 4, 5	Labs, Assignments
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Lifelong 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 many people enrolled in this class from all walks of life and of all skill levels. Your understanding and respect for 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 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.

Email Communication:
As per university regulations, all students are required to check their uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

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 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:

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
4-11	Solutions to First-Order DEs	Section 2
12-13	Introduction to Higher-Order DEs	Section 3
14-16	Solution Techniques for Higher-Order DEs	Section 4
17-21	Solution Methods for Nonhomogeneous DEs	Section 5
22-27	Laplace Transforms	Section 6
28-30	Power Series Solutions to DEs	Section 7

31-33	Solving Linear Systems of DEs	Section 8
34-36	Introduction to Fourier Series	Section 9

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

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

5.4 Drop Date

The final day to drop Fall 2024 courses without academic penalty is the last day of classes: November 29th, 2024.

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will be shown on the student's transcript and will be calculated into their average. The regulations and procedures for course registration are available in the [Undergraduate Calendar - Dropping Courses](#).

5.5 Other Important Dates

Thursday, September 5: Classes commence
Monday, October 14: Thanksgiving Day (no classes scheduled)
Tuesday, October 15: Fall Study Break Day (no classes are scheduled)
Thursday, November 28: Tuesday class schedule is in effect
Friday, November 29: 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 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the [SAS website.](#)

8 RECORDING OF MATERIALS

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

9 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.

Campus Resources:
If you are concerned about any aspect of your academic program: Make an appointment with a [Program Counsellor](#) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the [Learning Commons](#) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Health and Wellbeing:
The University of Guelph provides a wide range of health and wellbeing services at the [Vaccarino Centre for Student Wellness](#). If you are concerned about your mental health and not sure where to start, connect with a [Student Wellness Navigator](#) who can help develop a plan to manage and support your mental health or check out our [mental wellbeing resources](#). The Student Wellness team are here to help and welcome the opportunity to connect with you.

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](#) 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.