Math*2270 Applied Differential Equations

Fall 2018

(Revision 0: August 23, 2018)

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1 Instructional Support

1.1 Instructor

Dr. Matt Demers
MACN 543, Extension 53079 mdemers@uoguelph.ca

In-My-Office Office Hours:
Mondays / 2 - 3:30 pm / MACN 543 Thursdays / 12 – 2 pm / MACN 543

Group Office Hours:
Wednesdays / 3:30 – 5 pm / MACN 434 Fridays / 12:30 – 2 pm / MACN 434

1.2 Lab Technician

Not applicable.

1.3 Teaching Assistants

Arvind Iyer	arvind@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. It is your responsibility to log in and check the page every day.

2.2 Required Resources

Math*2270 - Applied Differential Equations – Course Manual (Available only at the MacNaughton bookstore)

This is our primary resource for the course. The Course Manual comes with fill-in-the-blank lecture notes that we will complete together in lecture, so bring it to every class! In addition, "For You to Try" problems are included at the end of every section, which will provide you with a wide variety of problems to practice with.

2.3 Recommended Resources

Not applicable.

2.4 Additional Resources

Lecture Information:

I will upload completed lecture notes to Courselink at the end of every week. Neverthless, I encourage you to come to class whenever possible! I have a greater ability to demonstrate new ideas there, and to show you a few tips and tricks on how to think about certain concepts or problems. I make many announcements in lectures, and I try to make sure that we have a little bit of fun too. Come and keep me company!

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

- Come to my posted office hours. Don't ever hesitate to come by, 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. I will only check these forums from time to time, leaving this mostly as a space for all of you to help each other.

- 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. I do ask that you use this option responsibly, considering that there are over 500 students in this course who might need some help! (Thanks!)

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3 ASSESSMENT

3.1 Dates and Distribution

Warmup Test:
Wednesday, September 19 in class
11:30 am – 12:15 pm in MACN 105 or 6:05 – 6:50 pm in ROZH 101
Worth 10% of your grade if this grade is higher than your Exam grade, or 0% otherwise.

The Warmup Test 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. *Please be sure to attend your designated lecture section on September 17, to make sure there is room for everybody.*

Lab Assignments:
Every week in various sections.
Worth 1% of your grade apiece up to a maximum of 10% (see more below).

Every week, a short assignment will be given in your lab tutorial, generally pertaining to the material from the lectures of the week before. You may work individually or in groups of up to three. Your completed work must be submitted before the end of the lab. TAs will be present to help remind you of concepts, or to give you hints or kicks in the right direction!

Use the TAs and one other to make these labs a great learning experience. *Note: NO labs will run on the week after Thanksgiving, or during the last week of classes.*

Tests:

Friday, October 12
6:00 – 7:30 pm
Worth 20% of your grade
Locations TBA on Courselink

Saturday, November 17
10:00 – 11:30 am
Worth 20% of your grade
Locations TBA on Courselink

Final Exam:
Friday, December 14
7:00 – 9:00 pm
Worth 40% of your grade, if your Warmup grade is better than your Exam grade; *OR*
Worth 50% of your grade, if your Exam grade is better than your Warmup grade;
and in any case, PLUS
the remainder of the 10% weighting from your lab assignments you did not achieve over the semester.

Example 1: *Suppose your friend receives a grade of 84% on the Warmup Test, and a grade of 68% on the Final Exam. Also, they earned 9.2/10 for their lab assignments over the semester.*
For this student, the exam would be worth 40.8% of their grade: 40% (because their warmup was higher than their exam), plus 0.8% (the remainder of their lab mark).

Example 2: *Suppose another friend receives a grade of 55% on the Warmup Test, and a grade of 80% on the Final Exam. Also, they did not submit any lab assignments, thus earning a mark of 0/10.*
For this student, the exam would be worth 60% of their grade: 50% (since their exam was higher than their warmup), plus 10% (the remainder of their lab mark).

3.2 Course Grading Policies

Missed Assessments:
If you are unable to attend any tests due to medical, psychological, or compassionate reasons, please email me. 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. In addition, you cannot pass by virtue of the Warmup Test or the lab assignments alone. *For this course, that means you must pass at least one of the tests or the final exam, or else your final grade will be capped at 48%.*

Missed Tests:
If you miss a test due to acceptable grounds for granting accommodation, the weight of the missed assessment will be added to the final exam. There will be no makeup midterm tests. If you know in advance that you have a conflict for the warmup quiz or 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). Alternative writing times will *never* be given after a test date – only before.

Missed Lab Assignments:
You must attend your own lab section unless you have my explicit permission otherwise. Late submissions of lab assignments will not be accepted. Your work *must* be submitted in-person before the end of the lab in which it is given.

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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. Come prepared to each lecture and 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, in-class or online. There are around 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:
Section 1: Mon, Wed, Fri / 1:30 am – 12:20 pm / MACN 105
Section 2: Mon, Wed / 5:30 – 6:50 pm / ROZH 101

Labs:
Section 1: Mon / 9:30 – 10:20 am / MCKN 229
Section 2: Mon / 1:30 – 2:20 pm / MCKN 232
Section 3: Tues / 11:30 am – 12:20 pm / MCKN 231
Section 4: Tues / 1:30 – 2:20 pm / MCKN 231
Section 5: Wed / 12:30 – 1:20 pm / MCKN 225
Section 6: Mon / 12:30 – 1:20 pm / ALEX 218
Section 7: Thurs / 11:30 am – 12:20 pm / MCKN 231
Section 8: Wed / 9:30 – 10:20 am / MCKN 231
Section 9: Fri / 9:30 – 10:20 am / ALEX 218
Section 10: Wed / 1:30 – 2:20 pm / ALEX 117
Section 11: Fri / 12:30 – 1:20 pm / ALEX 218
Section 12: Fri / 1:30 – 2:20 pm / ALEX 218

5.2 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 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	Section 2	LOs 1,2
Lab 5	**No lab**		
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 6: First day of classes
Monday, October 8: Thanksgiving Day (no classes scheduled)
Tuesday, October 9: Fall Study Break Day (no classes are scheduled)
Friday, November 2: 40th class day; this is the last day you may drop courses
Thursday, November 29: Tuesday class schedule is in effect
Friday, November 30: Last day of classes; Monday class schedule is in effect

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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.

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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