Math*2270 Applied Differential Equations

Fall 2015

(Revision 0: August 31, 2015)

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Matthew Demers, Ph.D.
Office: RICH 2523, ext. 56933
Email: mdemers@uoguelph.ca
Office hours:
Tuesday 11:00 am – 1:00 pm, THRN 1425 (Group Office Hours)
Fridays, 9:30 – 10:15 am or by appointment, RICH 2523 (One-on-One Office Hours)

1.2 Lab Technician

Not applicable

1.3 Teaching Assistants

GTA	Email	Office Hours
TBA	TBA	TBA

2 LEARNING RESOURCES

2.1 Course Website

The Course Manual, news, announcements, and grades will be regularly posted to the Math*2270 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

Math*2270 - Applied Differential Equations – Course Manual

The Course Manual is work-in-progress! A draft copy of the manual is waiting for you, available on Courselink for free. Please print off the fill-in-the-blank notes and bring them with you to every class so that we can complete them together. There are also "For You to Try" questions at the end of every section that you can use to practice your newfound skills.

2.3 Recommended Resources

1. W. E. Boyce and R. C. DiPrima – *Elementary Differential Equations and Boundary Value Problems* – Tenth Edition, Wiley.

2.4 Additional Resources

Lecture Information: Completed lecture notes will be uploaded to Courselink at the end of every week. It is, however, strongly recommended that you attend every class for all sorts of fun reasons. Lectures give me an opportunity to give you extra tips or reminders, and they give you an opportunity to ask questions to ensure your own understanding. I frequently make announcements or convey other information in lectures. So, consider attending regularly as part of your routine!

Previous Assignments and Tests: As an extra resource available to you, assignments and tests from recent offerings of the course will be posted online with full solutions. 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: Supplementary questions and other resources may be posted to the Courselink website as needed. Again, it is important that you check this site regularly to keep up-to-date.

2.5   Communication & Email Policy

Please use lectures and labs as your main opportunity to ask questions about the course. Additionally, you are welcome to attend office hours or to email me at mdemers@uoguelph.ca. If you do ask a question through email, provide your name, and (if possible) a scan or picture of any work that you have done so that I can better help you. Major announcements will be posted to Courselink. **It is your responsibility to check the Courselink regularly.** As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

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3   ASSESSMENT

3.1   Dates and Distribution

Warm-Up Quiz: 10% (or 0%**)
   Friday, September 18, at 5:30 pm, RozH 104

Lab Assignments: 15%
   Weekly lab tutorials will allow us to check up on your progress with new material. On **eight** weeks during the semester, you will be given a problem (or a small set of problems) to complete and submit to the TAs. These problems will usually test material from the week before. You may work in groups, pairs, or individually to complete these problems. Each lab is worth 2% of your final grade, but your total lab mark is counted out of 15. Thus, by doing well enough, you may add up to 1 bonus mark to your final grade.

Lab Assignments will be given the weeks of:
   September 21 - 25
   September 28 – October 2
   October 5 – 9
   October 19 – 23
   October 26 – 30
   November 2 – 6
   November 16 – 20
   November 23 - 27

Midterm test 1: 20%
   Friday, October 16, 5:30 – 6:50 pm, RozH 104

Midterm test 2: 20%
   Friday, November 13, 5:30 – 6:50 pm, RozH 104

Final Exam: 35% (or 45%**)
Monday, December 14, 11:30 am – 1:30 pm, Room TBA

**Your grade will be calculated in two ways. The first way will use a 10% Warm-Up Quiz and a 35% Final Exam weighting; the second way will use a 0% Warm-Up Quiz and a 45% Final Exam weighting. Your final grade will be the higher of the two results.

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. Please see below for specific details and consult the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://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 the course instructor 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:
http://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. Additionally, you must receive at least half of the marks available, in total, on the warm-up quiz, tests, and final exam that are used to calculate your final grade. If you do not achieve this, your maximum possible final grade will be 48%, even if your lab assignments would otherwise push your grade above this level.

Missed midterm tests: If you miss the warmup quiz or a test due to grounds for granting academic consideration or religious 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 will be away for the warmup quiz or a test, provide me with at least one week of notice. I will try to schedule an alternative writing time ahead of the scheduled assessment, invigilated by either myself or a TA (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.

Lab Work: The weekly lab tutorials are there for your benefit and practice. You should attend each week. On eight of the twelve weeks, you will be required to work with a partner or a small group to submit a minor in-lab assignment, for grades. See the lab schedule for more details.

Late Lab Reports: 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

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 engineering applications. The main objective of this course is to motivate the ideas and results of ordinary differential equations for use in the 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

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 in lectures, after classes, during office hours, or through email. I reserve the right to reply to emails within a timeframe of 1-2 days, though I will strive to be as quick as possible. 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 nearly 450 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 are having difficulties;

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 assessments that have been returned to you, to verify that the correct mark has been recorded. If not, get in touch with me right away in person or through email, and we will figure things out.

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*1200, Math*1210, IPS*1500, and IPS*1510. These courses provide the calculus 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*3170, Math*3510, Math*4000, 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:
Monday, Wednesday, Friday 10:30 – 11:20 am in RozH 104

Labs:
Section 0101: Mondays, 8:30 – 9:20 am in ROZH 105
Section 0102: Mondays, 9:30 – 10:20 am in ROZH 105
Section 0103: Mondays, 12:30 – 1:20 pm in MCKN 223
Section 0104: Mondays, 5:30 – 6:20 pm in ROZH 105
Section 0105: Tuesdays, 7:00 – 7:50 pm in ROZH 105
Section 0106: Wednesdays, 9:30 – 10:20 am in MCKN 224
Section 0107: Wednesdays, 5:30 – 6:20 pm in ROZH 105
Section 0108: Thursdays, 8:30 – 9:20 am in MINS 103

5.2 Lecture Schedule

Lecture #	Topic	Manual Section	Outcomes
1-2	**Introduction to Differential Equations**	1	1,3
3-9	**Solutions to First-Order DEs**	2	1,2,3
10-12	**Applications of First-Order DEs**	3	1,2,3,5
13-14	**Introduction to Higher-Order DEs**	4	1,2
15-17	**Solution Techniques for Higher-Order DEs**	5	1,2,3

18-19	Solution Methods for Nonhomogeneous DEs	6	1,2,3
20-21	Vibrations as an Application of 2nd-Order DEs	7	1,2,3,5
22-27	Laplace Transforms	8	1,2,4,5
28-29	Power Series Solutions to DEs	9	1,2,4
30-32	Solving Linear Systems of DEs	10	1,2,3
33-34	Introduction to Fourier Series and PDEs	11	1,2,4
35-36	Wrap-Up/Catch-Up/Review		

5.3 Design Lab Schedule

Not Applicable.

5.4 Lab Schedule (be warned, the topics may vary depending on what we have covered in lecture to that point!)

Week	Topic	References	Evaluation?	Learning Objectives
1	Warm-Up Prep	- - -	No	-
2	Classifying DEs, Direction Fields	Section 2	Yes	1,3
3	Solving Linear and Separable DEs	Section 2	Yes	1,2
4	Exact DEs, Almost-Exact DEs, Substitutions	Section 2	Yes	1,2
5	Applications of First-Order DEs	Section 3	No	1,2,3,5
6	Solving Second-Order Homogeneous ODEs	Section 5	Yes	1,2
7	The Method of Undetermined Coefficients	Section 6	Yes	1,2
8	Vibrations	Section 7	Yes	1,2,3,5
9	Laplace Transforms	Section 8	No	1,4
10	Step Functions	Section 8	Yes	1,2,4,5
11	Power Series Solutions to DEs	Section 9	Yes	1,2,4
12	Linear Systems of DEs	Section 10	No	1,2

5.5 Other Important Dates

Thursday, September 10: Classes Commence
Monday, October 12: Holiday - classes rescheduled to Friday, December 4
Tuesday, October 13: Fall Study Break Day – classes rescheduled to Thursday, December 3
Friday, November 6: 40th class day (last day you may drop a fall course)
Friday, December 4: Last day of classes

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:
http://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:
http://www.academicintegrity.uoguelph.ca/
Please also review the section on Academic Misconduct in your Engineering Program Guide.
The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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 the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

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:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index