MATH*4270

Advanced Partial Differential Equations

Fall 2020

(Revision 1: August 31st, 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/ and circulated by email.

1 Instructional Support

1.1 Instructor

Kimberly M. Levere, Ph.D.
Office: MacN 539, ext. 56908
Email: klevere@uoguelph.ca
Office hours: TBA after class survey of availability is completed

2 Learning Resources

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the MATH*4270 Courselink website. You are responsible for keeping up-to-date on this site.

2.2 Required Resources

Course Notes and Textbook:

- K. Levere, *MATH*4270 – Partial Differential Equations Course Manual (1st Edition).*
    - This is the primary resource for this course and functions as a notebook that we will complete together in class as the course progresses.
    - As I am still writing parts of this manual, I will be posting these notes on Courselink in sections. As a result, you will not need to purchase this resource this term (and it is not available in the bookstore). Please respect my efforts; do not sell or otherwise post my notes (blank or completed) to anyone or on any website.
- R. Haberman, *Applied Partial Differential Equations with Fourier Series and Boundary Value Problems. (5th edition)*, Pearson Education, Inc., New Jersey, 2013.
    - You may purchase this as a hardcopy textbook or an e-book (both available at the bookstore, or on their website). Since references to practice questions will be with respect to the 5th edition, it is important that you have this specific edition. This resource will be used for supplemental reading and will serve as your sole resource for practice questions (and assigned questions).

Resources Required for Assessments:

(you must have all of these in working order no later than October 1st, 2020)

- downloaded and installed copy of video conferencing software, Zoom (for which a basic licence is free);
- a webcam;
- a microphone;
- a printer with adequate toner/ink;
- a scanner (or free app for your phone such as CamScanner); and
- an internet connection

2.3 Recommended Resources

Not applicable.

2.4 Additional Resources

Supplementary questions and other resources may be posted on the Course website as needed. Again, it is important that you check regularly to keep up-to-date.

Lecture Information:

Due to the COVID-19 pandemic, for your safety lectures will be delivered in a remote, asynchronous style. I will do my best to make this experience as close to what it would have been in a face-to-face setting. I will post blank fill-in-the-blank style lecture notes and then record a video that fills in these notes and teaches the related concepts. Videos will be available via links on Courselink (housed in YouTube). In addition, completed lecture notes corresponding to each video will be uploaded to the Course website. This is not a substitute for video lecture attendance! I strongly recommend that you watch every lecture video as I feel that some things are better explained in words than in text.

Disclaimer: Student Identity Disclosure in Recordings

The university has requested that I include the following disclaimer regarding recorded materials (even though my lectures are asynchronous, there may be a scenario in which I record an office hour or other group video which makes this relevant to us):

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other "live" course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

1. turn off their camera
2. mute their microphone
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

2.5 Communication & Email Policy

Please use office hours and Courselink discussion forums as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** 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.

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3 ASSESSMENT

3.1 Dates and Distribution

Your grade will be determined using the following grading scheme:

Assessment	Weight
Academic Misconduct Quiz	1%
Graded Homework Assignments	12%
Homework Check-ins	12%
Midterm**	25%
Project	15%
Final Exam**	35%

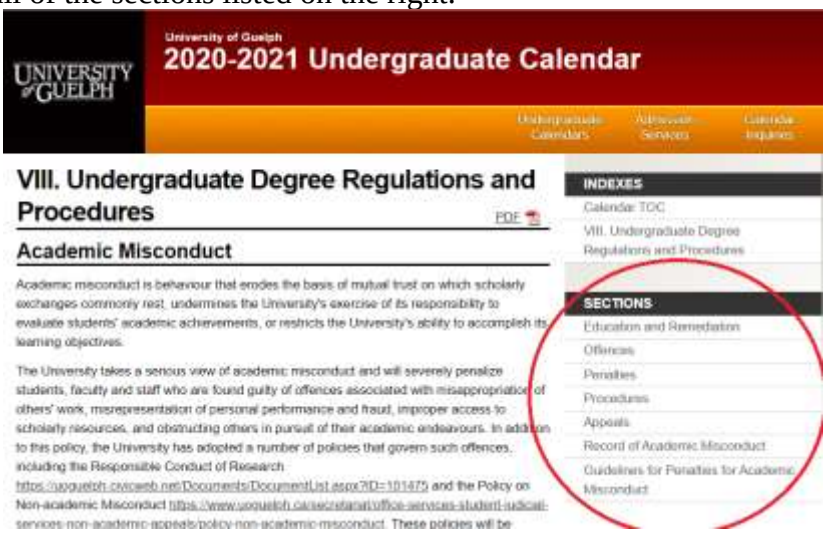
**You must receive at least 50% of the marks available, in total, on the midterm and final exam that are used to calculate your final grade. That is,

(Total marks earned on midterm and exam) ÷ (Total marks available on midterm and exam) ≥ 50%

If you do not achieve this, your maximum possible final grade will be 48%, *no matter what grade you receive on the Homework and Project components*. Provided that you satisfy the above equation, your final grade will be calculated using the above listed grading scheme. Considerations may be made according to the policies listed in Section 3.2.

Academic Misconduct Quiz: One of my biggest concerns with the virtual delivery of courses is academic integrity. I expect that you are taking this course because you are interested in the content and/or to meet a requirement of your degree. Hopefully, that alone is motivation enough to do things honestly! To ensure that everyone fully understands what academic misconduct is, I ask that you read the documentation on this subject on the University of Guelph website found here:
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Be sure to read all of the sections listed on the right:



After reading about Academic misconduct, you'll be required to complete a quiz that tests your understanding. This quiz will be completed in Courselink and you will have unlimited attempts (your highest score will count as your mark). You must complete this quiz with a grade of 80%

or higher before any assignments or homework checkins are submitted (that is, prior to October 2nd at 1:00pm). Failure to do so will result in a grade of 0 on any homework checks and assignments that occur prior to you mastering this quiz.

Assigned Homework Questions: On Courselink, I will be posting "Assigned Homework Questions" comprised of questions I have written myself as well as questions from our course textbook (by Haberman). Completion and correctness of these assigned questions will contribute to two of the above assessments (Homework Check-ins and Graded Homework Assignments), both with the same set of due dates as outlined below. Late submissions will not be accepted as you are expected to be working on these questions on a regular basis and not just before the deadline.

Homework Check-ins: It is really easy to get busy with other courses and ignore the importance of practicing and enforcing the content covered in lectures. In an effort to keep you focused on the course material I have scheduled the following "homework check-in" dates. There are 4 check-ins in total (due dates listed in the table below) each of which will count for 3%. Using the assigned homework questions list posted on Courselink, you are expected to write out full solutions to all questions listed. Please clearly identify the page number and question that you are doing so that I can follow your work. Your efforts are to be uploaded to the Crowdmark system by the dates listed below. Your mark will assess the overall correctness and completeness of your work.

Graded Homework Assignments: A selection of assigned homework questions will be fully graded with feedback. You will not know ahead of time exactly which questions will be marked (to encourage you to do more practice). You will submit a full set of homework questions by the dates/times listed in the table below and I will use this submission to grade and provide feedback on the questions that I have selected as your "Graded Homework Assignment". Your 4 graded homework assignments will contribute 3% each to your final mark.

Assessment	Due on
Homework Check-in & Assignment 1	Friday, October 2 @1:00pm EST
Homework Check-in & Assignment 2	Friday, October 23 @1:00pm EST
Homework Check-in & Assignment 3	Friday, November 13 @1:00pm EST
Homework Check-in & Assignment 4	Wednesday, December 2 @1:00pm EST

Project: Wednesday, November 25, 2020
1:00pm EST both to the Crowdmark System and Dropbox
Typed, 12-point font, 1.5-inch spacing, 1-inch margins
No more than 25 pages
(This is about quality not quantity: You will not receive a higher grade for writing more. The page limit is there to keep things manageable, not as a guide for how long you should be making your project.)

There are SO many topics that we won't have time to cover in this course 😕 One skill that I think it totally invaluable (whether in everyday life, a career, or graduate school) is the ability to read and learn things on your own. I've done my best to guide you through the material in this course, so now, it's your turn! This project entails choosing a topic from the available list (I'll post this a little bit later on!) and writing up a set of lecture-style notes to teach it to me. Assume that I only know the material from this course and its prerequisites (First year Calculus, Linear Algebra, and DEs 1 and 2.) You may use the textbook, or online resources to learn about the topic, but then it is your job to write up a set of "lecture notes" on your own. Your final product must be typed and will be checked for plagiarism using Turn-it-in software. It is important that you write things up in your own words and with your own voice. Please reference any resources that you used to learn the topic (even if you don't directly use any of their words).

Midterm: Wednesday, October 28, 2020
Time TBA following class survey
90 minutes in length
Closed book

Final Exam: Date & Time TBA following class survey
2 hours in length
Closed book

Both the midterm and final exam will be proctored via Zoom. You are expected to **create a basic Zoom account** (free for you!) and ensure that you have **a web camera**. You may be asked to tilt the camera to show your hands or face, or to show the room that you are in at any time during the assessment. These are only precautionary measures and are designed to help us to uphold the academic integrity of the course and our university. You should also ensure that you have **a microphone** should you need to ask a question (alternatively, we can instead chat over the phone). When the assessment is complete, you will be given ample time to scan your completed work and upload to the Crowdmark system for grading. This means that you'll need access to **a printer with sufficient toner/ink** as well as **a scanner** (free apps exist for most phones for scanning such as CamScanner that will work just fine). If you happen to have a tablet with a stylus that you would rather work on to create digital files for upload, this is perfectly fine as well (this is certainly not a requirement though!) We will be sure to do a trial run of this process to ensure that you know what things will look like and how the process will work. **Please ensure that you have each of the above required resources no later than October 1st, 2020.**

Class Surveys: A number of surveys have been set up in Courselink to help me to get important information that will ensure a positive experience for you in MATH*4270. Some of these questions relate to the remote delivery of our course, others to your mathematical background, and others to timing and scheduling. Many of these are already posted on Courselink with a due date of September 18 at 5:00pm, but it is certainly possible that additional surveys will be used throughout the course for different reasons. If you successfully complete all of these surveys by their due dates, I will give you a 1% bonus in the course as a thank you for helping me to deliver

the best course that I can! Bonus marks will may only be applied to those already achieving passing grades.

3.2 Course Grading Policies

Academic Consideration: When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, ID number, and e-mail contact. See the academic calendar for information on regulations and procedures for Academic Consideration:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Illness: The University will not require verification of illness (doctor's notes) for the Fall 2020 or Winter 2021 semesters.

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at 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

Missed assessments: Missed check-ins, assignments or midterms will receive a grade of 0%, unless they are missed due to any of the above reasons, in which case the weight of the missed assessment will be added to the final exam (or midterm where appropriate). There will be no makeup midterms, or assignments.

Passing grade: In order to pass the course, you must receive a final grade of at least 50%. Additionally, in order to pass this course, you must receive at least 50% of the marks available collectively, on the midterm 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%.

Group Work: While you are encouraged to work together to learn the course material, any assessment that is worth marks must be completed individually. It is academic misconduct to complete (in part or in entirety) another student's work (note that showing another student your answer is still academic misconduct!) Please see section 6 of this outline for further details on academic misconduct.

You may use your course notes and the required textbook to complete questions for the homework check-ins and assignments but under no circumstances may you use any other resource (including any other person or peer, online websites that may list answers to exact or similar questions, or paid websites like Chegg or anything similar to this). Both the midterm and final exam are closed book. If academic misconduct is suspected you will be submitted for review and may face penalties such as 0% on the assessment, or possibly worse depending on the offense.

Copies of out-of-class assignments: Keep paper and/or other reliable back-up copies of assignments, homework, your midterm and final exam. You may be asked to submit this work at any time.

4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

This course focuses on first and second-order partial differential equations, with examples and applications from selected fields such as physics, engineering and biology. Topics may include the wave equation, the heat equation, Laplace's equation, linearity and separation of variables, solution by Fourier series, Bessel, Legendre and Green's functions, an introduction to the method of characteristics and Fourier transforms. The classification of linear second-order partial differential equations is discussed.

Credit Weight: 0.5 **Department:** Mathematics & Statistics **Campus:** Guelph

Prerequisite: MATH*3100 (MATH*2200 strongly advised)

4.2 Course Aims

This is a first course in partial differential equations (PDEs). The lecture material includes theoretical content and derivations of important equations used to model real-world phenomena. More applied content that explains solution techniques and graphical explanations of the physical meaning of these solutions acts to balance the course content and to put the theory into practice. The objective of the course is to give you a strong mathematical background for mathematical modelling using PDEs as well as to teach you about various solution techniques (both closed-form and numerical if time permits) for handling basic through to more involved problems.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Classify a PDE according to order, and type (elliptic, parabolic, hyperbolic, etc.)
2. Understand the derivations of common PDEs such as the heat and wave equations.
3. Solve a PDE using separation of variables.
4. Understand the limitations of separation of variables.
5. Solve variations of the heat and wave equations such as nonhomogeneous or periodic boundary conditions, or the presence of source/sink terms.
6. Use the method of eigenfunction expansion to solve PDEs.
7. Understand the limitations of eigenfunction expansion.
8. Understand Fourier series, even and odd extensions and convergence results.
9. Be able to physically interpret what a basic PDE models.
10. Be able to represent, graphically, solutions to heat and wave equations.
11. Extend above knowledge to higher order heat and wave equations.
12. Use d’Alembert’s solution to solve a wave equation.
13. Understand the method of characteristics (and its limitations) for solving PDEs.

14. Understand Fourier transforms and how they can be used to solve PDEs (including limitations).

4.4 Instructor's Role and Responsibility to Students

As your instructor, I must:

1. Develop and deliver course material in a professional way that facilitates learning for a variety of students and learning styles;
2. Provide video lectures, filling in the course notes as we proceed in each lecture. I will provide corresponding completed course notes on Courselink, but I strongly urge you to watch each video.
3. Respond to you. This includes, as time permits, questions during office hours, or through email (where I reserve the right to reply within a timeframe of 1-2 days). You are more than welcome to contact me at any time through these means if you have questions or concerns about the course or the course material.
4. Evaluate you fairly, and fairly as compared to your peers, providing prompt feedback on your performance and justification for your grade. I must provide academic consideration, where appropriate, as described in Section 3.

4.5 Students' Learning Responsibilities

As a member of this class, you are expected to:

1. Take advantage of the learning opportunities provided during video lectures;
2. Treat others with respect and dignity whenever you address them;
3. Genuinely attempt all homework in a timely manner, including the online quizzes and the practice questions on your own time;
4. Seek help if you have tried the homework and are still having difficulty with the course content. This means contacting me (*not* just at the last minute!) and possibly considering other resources as I recommend them to you;
5. Check all grades against assessments that have been returned to you, once they are posted to the Course website, to verify that the correct mark has been recorded;
6. Notify me, as described in Section 3, in the case that there are missed assessments or 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.

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Video lectures will be recorded and delivered asynchronously. In order to keep you on task, I will ensure that I name my videos according to the week that I intend them to be viewed. Should I have additional videos completed in advance, I will post these as soon as possible to allow you to work ahead/at your own pace. Since I tend to create shorter, more contained videos, they will vary in length and quantity each week. For instance, it may take 5 shorter videos to effectively complete one week of material, while another week of material may be doable in just 2 slightly longer videos.

5.2 Lecture Schedule

As this is my first time teaching this course, I'm unsure of how long each topic will take. The online delivery also changes the timing of the course. Certainly, you can expect that we will cover the course manual in order. Since I haven't quite finished the course manual, you will download the manual in sections on Courselink as I complete them.

5.3 Other Important Dates

First day of classes: Thursday, September 10th, 2020.
Thanksgiving: Monday, October 12th, 2020. (no classes)
Fall Study Day: Tuesday, October 13th,2020. (no classes)
Last day of classes: Friday, December 4th, 2020.

Note that Thursday, December 3rd, 2020 runs as a Tuesday in lieu of Fall Study Day and Friday, December 4th, 2020 runs as a Monday in lieu of Thanksgiving Day.

Drop Date: Courses that are one semester long must be dropped by the end of the last day of classes (**Friday, December 4th, 2020)**; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Course Evaluation Information: Near the end of the term, you will be given the opportunity to evaluate your instructor and provide comments regarding your experience. The evaluations for this class will be done in-class. Your instructor will inform you of when these are to take place.

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.

6.1 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/

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 book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

8 Recording of Materials

Presentations which are made in relation of 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.

Posted online videos and course notes are the property of the instructor and are not to be otherwise disseminated beyond this course.

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.

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