AMATH 353
Partial Differential Equations and Waves
Spring 2019

General Information:	**Lecture**:	MWF 10:30 - 11:20
	Location:	Guggenheim (GUG) 218
	Main Course Website:	`https://canvas.uw.edu/courses/1311616`
	Homework/Quiz Website:	`https://www.gradescope.com/courses/44210`
Instructor Information:	**Name**:	Jeremy Upsal
	Email:	jupsal@uw.edu
	Office Hours:	WED 11:30-12:30
	Location:	LEW 129
TA Information:	**Name**:	Erin Angelini
	Office Hours:	THURS 10:00-12:00
	Location:	LEW 129

1 Communication

The main mode of communication for this course will be Canvas.

- **Course announcements:** The instructor will regularly post course announcements with information about upcoming due dates and scheduling changes. You are responsible for reading all of the announcements.
- **Submitting and viewing homework:** Assigned homework will be posted on both the Canvas webpage and the Gradescope webpage. Homework will be turned in on the Gradescope webpage so an account should be made there immediately.
- **Email:** Email is the best way to reach me if you have any non homework questions or concerns. I will not respond to homework questions over email. For homework questions, please use the Canvas message board.
- **Course feedback:** I would like any and all feedback from students on how the class is going, any improvement suggestions, or any other questions. The first two options are to (a) speak with me in person or (b) send me an email. If you would prefer to anonymously send feedback, please use the suggestionox link provided on the canvas webpage.

2 Prerequisites

Either AMATH 351, MATH 136, or MATH 307. You should be comfortable with taking derivatives of elementary functions, the chain rule, solutions of common differential equations, and using scientific computing software (*e.g.* python, MATLAB, Mathematica, Java, etc.) to create plots and do other simple computations.

3 Learning objectives/goals

Learning mathematics takes place in three domains: the affective domain, the cognitive domain, and the content domain. The affective domain regards attitudes towards mathematics and beliefs about one's ability to succeed in mathematics. The cognitive domain regards practices and actions with which we apply learned knowledge. The content domain regards knowledge-based skills. The "course objectives" you usually see on a syllabus are in the content domain.

3.1 Affective learning goals

Learning goals in the affective domain will not be explicitly tested, but you will be asked to evaluate your progress in this domain on homework. In this class, students will

- begin to attribute success to effort instead of luck or ease of a given problem;
- begin to see low grades or difficulties in their work as temporary, fixable, and helpful for learning instead of as unfixable or impossible and due to "lack of ability";
- increase their expectations for success in mathematics;
- develop a growth mindset instead of a fixed mindset;
- become more creative and willing to try new things instead of giving up when confronted with difficulties;
- evaluate their level of cognitive knowledge using Bloom's taxonomy for learning in the cognitive domain (see next section); and
- continue to grow their "mathematical maturity" which is, in part, the understanding of and recognition of the interconnected nature of mathematics.

3.2 Cognitive learning goals

Learning in the cognitive domain is not course dependent. The cognitive learning goals presented here can be applied to many other mathematics courses. In this class, students will

- present legible work on homework and exams;
- present their work in a logically consistent manner;
- make sure they have completed what is asked of them on a given problem before considering it complete;
- focus their study on topics with which they struggle instead of on all of the course content;
- collaborate productively with others;
- ask questions of the instructor when they are unclear about a topic, without fear of "bothering" the instructor;
- construct examples and counterexamples to test their understanding of new topics; and
- check their work for inconsistencies before submitting it.

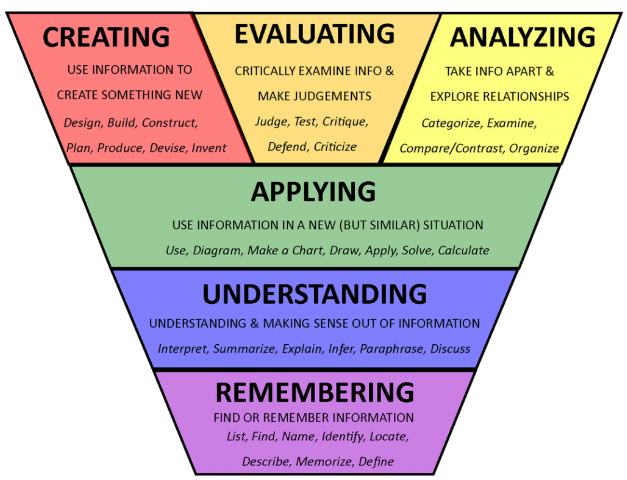
3.3 Content learning goals

This class is about partial differential equations (PDEs). As such, by the end of this course, a successful student should be able to do the following, at varying levels of knowledge.

- **(Familiarity with waves and PDEs)** Students will be able to
  - discuss quantitative features of a given PDE and side conditions;
  - discuss wave-like solutions in the physical sciences; and
  - change coordinates as necessary for a given PDE.
- **(Properties of PDE solutions)** Students will be able to
  - discuss what it means for something to be a solution of a given PDE;
  - discuss the qualitative behavior of solutions of a PDE, without finding a solution; and
  - determine the range of validity of a solution.
- **(PDE solution techniques)** Students will be able to
  - recognize when solution techniques do and do not work depending on properties of a PDE;
  - recognize why solution techniques do not work for all PDEs;
  - implement a variety of solution techniques for different types of PDEs; and
  - recognize that solution techniques learned in this class follow the form of reducing a PDE to an ODE.

A list of specific **component skills** which will be tested on each quiz can be found in the `amath353.class.content.1.01.pdf` document.

Each of the above cognitive and course goals will be "learned" at different levels. These different levels of knowledge are best described by Bloom's taxonomy of learning in the cognitive domain.



The levels in Bloom's taxonomy are hierarchical, *e.g.* application relies upon understanding and remembering. Homework and quizzes will be structured around testing your level of knowledge with regards to Bloom's taxonomy. Generally speaking, those who are have higher levels of knowledge will have higher grades.

4 Course Materials

We will use lecture notes written by Professor Bernard Deconinck which will be provided on Canvas or can be found on his webpage. A highly recommended (and very cheap) optional textbook is Roger Knobel's *An Introduction to the Mathematical Theory of Waves.* Other useful books include Richard Haberman's *Applied Partial Differential Equations: With Fourier Series and Boundary Value Problems* or Stanley Farlow's *Partial Differential Equations for Scientists and Engineers*, particularly for the Fourier Series aspect of this course, and Peter Olver's *Introduction to Differential Equations* which covers theoretical aspects of PDEs well. Each of these books can be found in the library.

5 Grading

For this course I will be using what is called *mastery based grading.* This means that some assignments can be attempted multiple times until the topic is *mastered.* The goal of this approach is to (a) ensure that students come away from the course knowing at least some topics very well, (b) to reduce exam anxiety, and (c) to limit the number of students who pass the course only by getting partial credit on every assignments. Your course grade will be calculated by weighing your homework and quiz scores in the following proportions:

Homework:	40 %
Quizzes (5):	60 %

5.1 Homework

There will be two different kinds of assignments. All homework will be turned in on Gradescope in .pdf format.

Once to twice per week you will be asked to read material before coming to class. You will then answer some questions targeted at the "remembering" level in Bloom's taxonomy. For example, you might see a question like "define what it means for a PDE to be linear." This means that your first contact with material will be through your reading. In class we will discuss the reading and go through examples in detail. This part of the homework will be graded on completion, as long as an honest effort was put into answering the questions.

You will then be assigned a longer homework assignment which will be aimed mostly at the "understanding" and "applying" levels of knowledge. This homework will be graded for correctness. Each problem on each of these assignments will have equal weight in the grades.

5.1.1 Reflection on homework

There will be some sort of reflection portion for every homework. Research suggests that reflecting on one's own work is important to learning. Feedback also helps the instructor see how the students are thinking about things and where they are struggling.

Whenever I post homework solutions, I will explicitly state which learning goal and which level of Bloom's taxonomy the question was testing. It is recommended (and sometimes will be required) that you reflect on your level of knowledge for every one of the learning goals.

5.1.2 Presentation and turning in

Every homework set you turn in should have a header containing your name, the due date, and the homework number. Your homework should be neat and readable. Your homework score may reflect the presentation of your homework set. Students are encouraged to type homework solutions and strongly encouraged to use LaTeX. If there are questions about using LaTeX I am happy to answer these. You are also encouraged to use LyX if the time commitment to learning LaTeX is a deterrent. **Homework will be turned in on Gradescope and must be in .pdf format.**

5.1.3 Collaboration

You are encouraged to discuss the homework with other students. However, please write your own homework solutions and please do not share your homework solutions with others. Your work should be your own. If you work with other students on the homework, please acknowledge who you worked with on the homework, such as "I worked on this problem with Jane Doe." Academic honesty (cheating) will be taken seriously in this class. You can view the guidelines for academic misconduct here.

5.1.4 Late Homework Policy

You may turn in one homework assignment as late as you would like, up to the final exam date. Any subsequent late homework will be awarded a 0. If you have no late assignments, you may redo up to one homework assignment, up to the final exam date. Assignments which are turned in late due to documented school functions or documented illness/injury do not count towards this limit.

5.2 Quizzes

We will do mastery based grading for the quizzes. Each quiz will be approximately 30 minutes and will take place at the beginning of class. Quizzes will be graded with very little to no partial credit. If you are not pleased with your grade, you may retake the quiz at a later date. **Upon choosing to retake the quiz, you must agree to forfeit your old grade and accept the new grade you get on the quiz.** I will proctor an out-of-class retake day once per week. Each retake may be (not significantly) longer than 30 minutes, depending on difficulty. **There will be no final for this course.** The last retake opportunity will replace the final and will take place on June 10, 2019. Any quiz may be retaken at this time.

To see the content of each individual quiz, see `amath353.class.content.1.01.pdf`.

6 Access and Accommodations

It is important to me that you have a good experience in this class and that any and all accommodations you require are met. If you have established accommodations with Disability Resources for Students (DRS), please communicate those accommodations with me at your earliest convenience and we can discuss how they will work with this course.

If you do not yet have, but feel you need, special accommodations, please feel free to contact me or DRS directly. DRS can help accommodate conditions including, but not limited to: mental health, attention-related, learning, vision, hearing, physical, or other health conditions.
DRS can be contacted at 206-543-8924 or uwdrs@uw.edu or `disability.uw.edu`.