Course Description

This is a course at the graduate level on the application of numerical methods to solving differential equations (both ordinary and partial) with an emphasis on finite-difference methods. The equations we examine will frequently be connected to physically relevant models (fluid flow, wave propagation, electromagnetisim, elasiticity). Although it is expected that you will have had past exposure to partial differential equations, a secondary aim of this course is to increase your intuition of the properties of the various types of partial differential equations by working with them numerically.

We will be interested in two parallel lines of work: the implementation of various numerical methods on a computer, and the analysis of how they work. It is not enough in general to perform a computation: one should have an idea that the code used is correct, and ideally an estimate of the error made in the computed approximate solution.

Essential Information

Professor	David Maxwell
Office	Chapman 308C
Email	`damaxwell@alaska.edu`
Phone	474-1196
Web	`http://damaxwell.github.io`
Required Texts:	**Introduction to Numerical Methods in Differential Equations**, *Holmes*, Springer

Prerequisites

Formally: CS F201, MATH F310, MATH F314, MATH F421, and MATH F422. In practice: permission of instructor.

Class Time

Lecture Times

MWF 9:15-10:15 Zoom

Covid 19

We are holding classes in unprecedented times.

- We need to be especially kind and patient with one another.
- Unforseen circumstances are going to occur. I will try to ensure that the class is taught in a way so that if you must miss a class due to illness or other reasons, you will have tools to make up the missed class. Please see the section below on Zoom and recordings.
- If circumstances routinely impact your ability to participate in the course, please get in touch with me so we can determine a best plan of action.
- Course practices or this syllabus may need to be adjusted as the semester progresses. I will announce any changes as needed; syllabus updates will be posted on the web site.

- Univesity policies related to COVID-19 are found at https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students. These can be expected to be updated.

Student Learning Outcomes

Students will:

- acquire intutition about the major categories of PDEs by working with them in a computational setting,
- approximate derivatives using difference quotient techniques,
- apply computational techniques to approximate solutions of differential equations,
- estimate errors between computed approximations and actual solutions.

Zoom Meetings

We will meet remotely via Zoom. A link to the meetings is provided in BlackBoard. We are all learning the norms for holding classes this way, and we will figure out as the semester progresses how make this efficient and effective.

Classes will be recorded so that you can review from them later if your internet connection is poor or if you are unable to attend a class.

Office Hours

My office hours will be posted on my web site . You are welcome to schedule an appointment outside of my regular office hours; please send me an email and we will arrange a time.

Software

Every homework will include problems that require you to implement an algorithm on a computer. You will be able to use your choice of language for this work. Matlab, its open-source clone Octave, Python (via `numpy` and `scipy`), and Julia are all fine choices. I will use Python myself, but will initially post code in both Matlab/Octave and Python.

If you have never used any of these products before, you may find that Matlab is the most straightforward choice; it's easy to install and has a nice graphical interface.

Campuswire

We will use the Campuswire social media site for announcements and after-class questions and discussions. See the course web page for instructions on how to sign up.

Homework

There will be a homework assignment due roughly every week, usually on Wednesdays. Each week's assignment will be posted on my web page. You will submit your homework via a Dropbox File Request link found on the course web site. Uploaded files should be a PDF file that contains both your name and the assignment number in the filename. E.g., `DavidMaxwell-HW1.pdf`.

Homework must be in the form of a single PDF file, with a possible jupyter notebook to accompany it. Solutions will often comprise computer code along with output as well as a written component. You will want to present your work coherently. You are enouraged to use some form of software to author your solutions. LaTeX is mathematical typesetting software that you might find useful; I have posted installation instructions, a guide, and a sample solution so you can see how to use it. Another possibility is Microsoft Word, though mathematics in it is cumbersome. I will accept handwritten solutions so long as your homework arrives as a single PDF, is legible, and it easy to navigate with all components of a solution (code, output, written) appearing together.

Regarding late homework, I will accept from each student a single late homework with no questions asked. To take advantage of this opportunity, simply hand in a note (in the usual Dropbox File Request) in lieu of your homework notifying me that you are using your free late assignment. Your late homework will be due when the subsequent homework is due, or one week later, whichever comes first. Exceptions: you may not use your freebie for either of the first two, or the last homework assignments.

Subsequent late homeworks will be accepted only under extenuating circumstances to be determined at my discretion. We are living in unusual times, and this will be taken into account.

Making an attempt at the homework is mandatory. If you fail to substantially complete two homework sets you will need to come talk with me about potential extenuating circumstances. I reserve the right to drop students who are not completing homework.

Midterm

There will be one in-class midterm exam. It is tentatively scheduled to be held on Wednesday, March 3.

Project

There will be a class project, in two parts, worth a total of 10% of your grade. It will consist of a slide presentation to the class demonstrating the application of course ideas to a topic of your chosing. More details will be announced later in the semester.

Final Exam

This course is computationally intensive. So there will be a take-home take-home final exam. More details will be announced later in the semester.

Evaluation

Course grades will be determined as follows:

Homework	55%
Midterm	15%
Project	10%
Final	20%

Letter grades will be assigned according to the following scale. This scale is a guarantee; I also reserve the right to lower the thresholds.

A+	97–100%	C+	77–79%	F	< 60
A	93–96%	C	73–76%		
A-	90–92%	C-	70–72%		
B+	87–89%	D+	67–69%		
B	80–86%	D	63–66%		
B-	not given%	D-	60–62%		

Tentative Schedule

The following is a tentative list of the topics to be covered in this class. As we proceed in the course, the course web page will list specific sections to be read for each week.

Week	Topics and Events
1/11 – 1/15	Chapter 1
1/18 – 1/22	Chapter 1 Monday: Alaska Civil Rights Day (no classes)
1/25 – 1/29	Chapter 1
2/1 – 2/5	Chapter 2
2/8 – 2/12	Chapter 3
2/15 – 2/19	Chapter 3
2/22 – 2/26	Chapter 3
3/1 – 3/5	Chapter 4 Wednesday: Midterm
3/8 – 3/12	Spring Break (no classes).
3/15 – 3/19	Chapter 4
3/22 – 3/26	Chapter 5
3/29 – 4/2	Chapter 5 Friday: Last day to withdraw with a 'W'
4/5 – 4/9	Chapter 6
4/12 – 4/16	Chapter 6
4/19 – 4/23	Presentations
4/26 – 4/30	Exam week Monday: Last day of class

Rules and Policies

Collaboration

You are encouraged to work together in solving homework problems. But each student must write up his or her own solutions independently. If you receive significant help solving a problem, it is customary to make a note in your homework to give the person who helped you credit.

Makeup Exams

You can make up an exam if certain extenuating circumstances prevent you from taking it and if you inform me in advance. Contact me as soon as possible if you are going to miss an exam.

Attendance

Attendance is not included directly as part of your grade.

Cell Phones

Turn off your cell phone before you come to class. No texting during class, please.

Disabilities Services
I will work with the Office of Disabilities Services (203 Whitaker, 474-7043) to provide reasonable accommodation to students with disabilities.

Incomplete Grade
Incomplete (I) will only be given in Computer Science, Mathematics or Statistics courses in cases where the student has completed the majority (normally all but the last three weeks) of a course with a grade of C or better, but for personal reasons beyond his/her control has been unable to complete the course during the regular term. Negligence or indifference are not acceptable reasons for the granting of an incomplete grade. (Note: this is essentially the old University policy.)

Late Withdrawals
A withdrawal after the university deadline from a Department of Mathematical Sciences course will normally be granted only in cases where the student is performing satisfactorily (i.e., C or better) in a course, but has exceptional reasons, beyond his/her control, for being unable to complete the course. These exceptional reasons should be detailed in writing to the instructor, department head and dean.

Academic Dishonesty
Academic dishonesty, including cheating and plagiarism, will not be tolerated. It is a violation of the Student Code of Conduct and will be punished according to UAF procedures.