

Physics 430

Partial Differential Equations Using Matlab

Winter 2009

Instructor: Bryan Peterson

Office: N355 ESC

Phone: 422-7417

Research Area: C341 ESC

Phone: 422-5665

Email: bryan.peterson@byu.edu

Office hours: 9:30-10:30 MWF or by appointment

Course Objectives: In this course you will:

1. Learn to use loops, logic commands, and other programming techniques to solve partial differential equations.
2. Gain a better understanding of what partial differential equations mean.
3. Learn to apply linear algebra to physical systems described by data on grids.

Texts: There are two texts for this course:

1. *Computational Physics 430*, the lab manual for the course, is available at the BYU Bookstore. This text contains explanations and the assignments for each laboratory period. As you work through the manual you will learn how to turn problems involving ordinary and partial differential equations into linear algebra problems, and you will also more fully develop your programming skills. You will also gain a better understanding of partial differential equations as you use computer graphics, and especially animations, to display their solutions. This text is also available online. If you want a paper copy it is generally cheaper to buy the packet from the Bookstore than it is to print your own (it is inappropriate for you to print a copy of this manual on department printers without paying for the printing costs).
2. *Introduction to Matlab*, available by request at the BYU Bookstore. (You should already have a copy if you took Physics 330.) If you need this manual you will need to request them to print it from the Spring materials for Physics 330. This will be a useful language reference manual to help you as you program in Matlab. Again, this manual is available online.

Finally, you should consider buying the student editions of Maple or Mathematica and Matlab while they are still cheap because you have a student ID. These two pieces of software become much more expensive when you graduate.

Course Structure:

Showing up ready: The lab material in this course is more difficult than the material in Physics 330, so you will need to spend 1/2 hour, or so, reading each lab before you come to class. If you just show up and try to learn as you go, you will most likely fall behind.

Laboratory work: The reason that this course is taught as a lab instead of as a lecture/homework course is that it can take hours to find and fix simple programming mistakes without the help of trained professionals. Furthermore, the lab setting provides an active learning environment where problems are encountered, discussed by lab partners, TAs, and the instructor, then solved. Occasionally mini-lectures at the board in the classroom will be given to explain difficult concepts or to teach good programming practice. **So come to class.** Experience has shown that if you don't, you will almost certainly do poorly in the class. A grade of E is the usual result of not showing up.

You must work in pairs and pass off sections of labs in pairs. You can pair up any way you like, but you must sit next to your partner and you must pass off the labs together. This makes efficient use of the TA and instructor's time so that you can complete and pass off your labs as soon as possible without

waiting. More importantly, it is a much more efficient approach to learning (which is, of course, an objective of the class). *This may not be the most efficient way to leave class early, depending on who you choose as a partner, but leaving early is not listed as an objective of this class.*

Checkpoints: We have learned by sad experience that it is the nature of nearly all 430 students to fall behind. On the course calendar are listed 4 checkpoints. *All lab work must be caught up the the end of the class period on the checkpoint day.*

Grading: Your grade in the course will be determined by three things.

1. Your performance on the laboratory exercises. You will be graded mostly on how many you complete, but I will also assess your understanding of the lab material as the course progresses by periodically asking questions.
2. There will be two short take-home problems given during the semester. These will consist of a problem, or two, to be solved using the computational methods you have learned up to that point in the course. These problems will be open book, open notes, open previous work, but closed lab partner. After you complete the problem you will email your work to me.
3. There will be a final exam during our scheduled final exam time. The first part will be closed book and will consist of about 15 terms taken from the index of the lab manual *Computational Physics 430*. I will give you about an inch of space to write, or draw, enough about each term to convince me that you understand what it means. The second part will have about four short programming exercises in Matlab. This part will be open book, meaning that you can use both *Introduction to Matlab* and *Computational Physics 430*. You will not use a computer, but will just write Matlab commands on paper. I will give you some problems to solve and you will be expected to describe an algorithm to solve them, and then write a little bit of Matlab code to show that you know how to turn the algorithm into a working script.

Most of the grades in the course will be A and A-. An A means that you have completed all of the laboratory exercises and have shown that you have mastered the material. An A- means either that you got behind and missed a lab, or two, or that your performance on the exams has shown that you aren't proficient at writing good code and at finding and fixing programming mistakes. Not understanding the basic physical concepts associated with partial differential equations will also lower your grade. Poor performance on the exams might lower your grade into the B- range.