**MA 501-001, FALL 2017, Advanced Mathematics for Engineers and Scientists I**

TR, 8:30-9:45 am, SAS 2225. Final exam Tues Dec 5, 8-11 am.
**Professor:** S. R. Lubkin, lubkin@ncsu.edu, 515-1904, [http://www4.ncsu.edu/~lubkin](http://www4.ncsu.edu/~lubkin/index.html)
Office hours: SAS 4226, MW 2-3 unless announced otherwise

**Official listing:** Survey of mathematical methods for engineers and scientists. Ordinary differential equations and Green's functions; partial differential equations and separation of variables; special functions, Fourier series. Applications to engineering and science. Not for credit by mathematics majors.

**Goals:** Upon successfully completing this course,

* You will be skilled in solving the fundamental linear PDE's that engineers use.
* You will be familiar with the properties of the heat/diffusion equation, the wave equation, and the potential/Laplace equation.
* You will be able to find series and integral solutions to these PDE, in Cartesian and/or polar coordinates.
* You will be able to display solution curves and surfaces in space and time on the computer.
* You will be able to interpret and implement different kinds of boundary conditions.

**MA 501 versus 401:** These two courses are almost identical. I teach both of them. However, I expect more from my students at the 500 level, so we cover more topics in the same amount of time. In particular, we cover integral transforms in 501 but not in 401.

 **Required Text:** *Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, 5th edition* by Richard Haberman, 2013. You should own your own copy, so you can read it any time, mark it up, *use* it.

Possible supplements: Some people like using *Schaum's Outline of Advanced Mathematics for Engineers and Scientists* and/or *Schaum's Outline of Fourier Analysis with Applications to Boundary Value Problems* (less than $20 each) as a supplement for extra practice problems and fully worked examples. There will be supplementary material posted on the class website, <http://www4.ncsu.edu/~lubkin/ma501syllabus.htm>

**Grades** final exam 25%, 2 midterms @ 15%, 15% HW and possibly quizzes, 30% team "projects" (which are like in-depth HW problems).

* The main **purpose of HW** is give you **practice** using the individual methods through solving problems ranging from easy to hard. Through HW graphical implementation, you will also gain familiarity with the behavior of solutions of different equations with different IC and BC.
* The main **purpose of projects** is to give you experience applying the methods to **more complex** and/or **realistic problems** than on the HW. Your grade on the projects is some indication of your ability to understand and solve complex problems.
* The main **purpose of exams** is to determine your **fluency** with the essential techniques and underlying concepts. Note that **exams measure different aspects of your learning from HW and projects.** You will get practice tests to try at home the week before an exam.
* I cannot promise that your HW and quizzes will be graded with great precision, but I can promise that your HW/quiz grade will be representative of your work.
* Maple calculations will be required on most of the assignments. Nobody is expected to purchase Maple; it is available on campus computers and via [VCL](http://vcl.ncsu.edu/) from your own computer. If you have another package that you prefer, you are free to use it, but I will not teach how to use other packages, nor should you expect my help with them.

**Policies**

* If you have a disability or conflict that I need to know about, let me know as soon as possible (not the week of the first exam). Note that I am not sympathetic about vacation plans and cheap airfares. Your final exam cannot be moved.
* You are welcome to work on HW with other students, with some restrictions. Since **the point of HW is learning**, you should work with others only to the extent that it facilitates your learning and your partner's learning. Giving each other ideas: good. Explaining to each other: good. Finding each other's errors: good. Copying answers: bad. Letting your partner do the work: bad.
* You are welcome to use Maple or any other computer package to help on the HW. Please say when you are using technological help. For instance, "Integrating this term by parts (Maple) yields...."
* You may not work with others on the exams. Most quizzes will be a solo effort. Group quizzes will be specifically identified as such. In accordance with the NCSU policy on academic integrity, found in the Code of Student Conduct, it is assumed that in turning in any assignment to the instructor, the student has thereby implicitly taken the honor pledge: "I have neither given nor received unauthorized aid on this test or assignment."
* I should not even have to say this (why isn't it obvious to everyone?), but you may not copy any solutions from any source for any assignment.

**Courtesy**

* Some of you may need to eat or drink during class. I don't mind this, but your fellow students might, so please keep noises, crumbs, and odors under control.
* What I do mind is the newspaper. Do not attempt to read it in class. I'm not wild about you checking sports scores online either.
* If you are sick, please stay home, rest up, and get the notes from a classmate.

**Homework aesthetics**

* Staple homeworks. Don't fold in half. Loose sheets get lost.
* Every graph must be labeled. Always label all axes. Arrowheads have a very specific meaning indicating the direction of motion or of a vector or time. Arrows do not belong on axes or curves unless they are intended to indicate time or motion or vectors.
* If you are asked to make an argument, or "show that..." then you need to use enough words to make that argument. Mathematical symbols without context make no sense. Look at your textbook: it is mostly words with symbols used within the sentences. That is how your homework should be written.
* If you do calculations in Maple (for instance) and hand in the Maple session, the printout should be edited for clarity and conciseness just as you would edit your handwritten notes (only giving me your best work). Show me all the necessary lines and don't show me unnecessary lines. Do show me the results of calculations, unless they are very long. I can't grade properly unless I see your intermediate results. It is easy to make graphs in Maple, but you should only show those graphs which illustrate your point. Delete graphs which do not contribute to your discussion.
* If a solution has both hand-written work and Maple work, the pages should be next to each other. Do not cluster Maple outputs separate from handwritten work.
* If, for some reason, you need to turn in your HW or project electronically, the preferred format is pdf.
* If you are asked to show an animation, the ideal way to show it on paper is to use superimposed curves on the same axes, with some indication of the time sequence. Do not print blank graphs. If I can’t see them, I can’t grade them.

**Tips**

* **You are expected to own the book and read it.**
* Look carefully at your Maple plots and animations. Do they satisfy the IC and BC? If they look wrong, then your solution is wrong.
* A great amount of learning happens when you correct your own HW and find your own errors and misconceptions. That is why you will get solutions. Your engagement with the homework should not stop when you hand it in.
* Check the website frequently. You may need to refresh the page.
* You are expected to check email daily. I often send reminders or explanations or assignments by email. You are responsible for making sure that the email NCSU has for you is the one you check.
* If your Maple outputs are getting too big, print them 2-up, or resize before printing.
* I am hard to find by just stopping at my office, and when I am in, I am not always free. I tend to respond pretty promptly to email, although sometimes if I am off campus, my emails don't send.
* Did I mention that you should actually **read the book**?

**Links**

* **Mathworld and** [Wikipedia](http://www.wikipedia.org/) **are great sites for getting an overview of an area of math, or finding those obscure formulas that you vaguely remember (what was a lemniscate, anyway? and that sinh thingy she was talking about, which I can't even pronounce?) Note: sometimes formulas don't display correctly in some browsers. The solution is to look at the page in a different browser.**
* Applets that show various phenomena that we model in this class (heat, waves, etc.): <http://www.falstad.com/mathphysics.html>
* Waves: <http://www.kettering.edu/~drussell/demos.html>
* [Handbook of Mathematical Functions](http://www.knovel.com/knovel2/Toc.jsp?BookID=528), Milton Abramowitz and Irene Stegun, courtesy of the US National Bureau of Standards has all the facts you need on special functions and not-so-special functions. This is what your grandparents had on their desk if they were engineers or physicists. Now it's online, and free.
* Khan Academy (www.khanacademy.org/math/differential-equations) is a great resource for review. It does not have material on PDE, but it does cover ODE and Laplace transforms.