MA UA 263: Partial differential equations
Spring 2012

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Textbook:	WALTER A. STRAUSS, *Partial differential equations: An introduction*, 2nd edition Wiley, ISBN: 978-0470-05456-7
Lectures:	MW 11:00 AM – 12:15 PM, WWH 512;
Recitation:	F 11:00 AM – 12:15 PM, WWH 201;
Office hours:	WWH 1306; Time: TBA

A partial differential equation (PDE) is an equation relating an unknown function of more than one variable with some combinations of its partial derivatives. For example, if $u = u(x, y) : \mathbb{R}^2 \to \mathbb{R}$, then

$$u(x, y) - u_x(x, y) - u_y(x, y) = 0 \qquad \text{for all } (x, y) \in \mathbb{R}^2$$

is a PDE. Typically, confronted with an equation like the one above, we ask ourselves questions like: Do functions u satisfying this statement exist? If so, how many? What are their features? Having taken a course on ordinary differential equations (ODEs), these issues should sound familiar to you. However, for reasons that we shall discuss, they are considerably more subtle in the PDE setting. Many things that you can take for granted with ODEs (local existence and uniqueness of solutions to initial value problems, for example) are just not true in general for PDEs.

So why study PDEs, then, aside from pure mathematical curiosity? It turns out that they are absolutely ubiquitous in applications. They arise everywhere from the usual suspects, physics, chemistry, and biology, to less obviously related disciplines like economics and sociology. Phenomena like water waves, diffusion, shock waves, plasma physics, population dynamics — all of them are captured by PDEs. In a sense, the difficulty of PDEs is the price we pay for their universality.

In this course, we shall make a survey of the subject, beginning with the most basic equations and working our way up to some selected advanced topics. A (not-so-comprehensive) list follows.

Topics: first-order equations, waves and diffusion, explicit solutions methods, PDEs in domains (boundary value problems), harmonic functions, general eigenvalue problems, nonlinear PDEs, as well as some applications.

Textbook. As listed above, the book we will use for the course is *Partial differential equations: An introduction*, 2nd edition by W. Strauss. It is important that you get the second edition, because we will use material that is not in the first.

Office hours. There will be two office hours held every week in Warren Weaver Hall (251 Mercer Street), Room 1306. This is a time when I am guaranteed to be in my office and ready to answers questions about the course. Please do not hesitate to make use of it. You can also email me to set up an appointment if you have an unavoidable scheduling conflict.

Recitation. On Friday there will be a recitation session led by Jens Jorgensen. Unlike office hours, you should think of the recitation as part of the course proper. In other words, attendance is expected and any material presented during the recitation is fair game for exams/homework. Jens will answer questions you may have on the material covered in lecture or on the homework, as well as discussing interesting extensions.

Homework. The majority of your learning will come through completing the homework assignments. These will be assigned weekly and *collected Monday at the beginning of class.* You are encouraged to work together, but each student must write up his or her own; *do not simply copy one another*. Also, please remember that the grader has to be able to follow your thought process in order to award credit. It is incumbent on you to ensure that your assignments are readable, both in terms of legibility and intelligibility. Given the size of the course, and the speed at which we're going to be moving, *late homework will not be accepted.*

Exams. There will be two midterm exams as well as a cumulative final. The final exam will have two components: an in class section, administered from 10:00 AM – 11:50 AM, May 14th, and a take home portion. The date for the in class exam is totally inflexible, due to university scheduling, so make your travel plans accordingly.

Grading. Your final grade will be determined according to the following formula:

Homework:	30%
Midterm I&II:	30% (15% each)
Final:	40%.