Math 397—Spring 2011 (Advanced Topics in Applied Math)

Partial Differential Equations: Analysis, Computation, and Applications

Instructor: Rob Manning
Hilles 207C (up 1 flight from Hilles main entrance)
896-1210
rmanning@haverford.edu

Office Hours: W 12:30-2 PM, Th 2-4 PM
W 7-9 PM (MQC), or arrange another time with me

Course Description: This course is an introduction to partial differential equations, from a mixed perspective that covers several key themes of modern applied math: (1) *analysis* (the use of various tools to ask questions of existence and uniqueness of solutions and, in special cases, find solutions), (2) *computation* (the development of numerical techniques to find approximate solutions on the computer, e.g., for cases that can not be solved exactly), and (3) *modeling* (the connection of mathematics to real problems).

Prerequisites: Math 317 (Analysis I) or permission of the instructor. Even though much of the material could be called "advanced differential equations," **no prior differential equations course is required** in order to take the course; we will cover some material from ordinary differential equations that is needed later in the course

Text: "Partial Differential Equations: Analytical and Numerical Methods", Second edition, Gockenbach, (SIAM, 2010). There may also be supplementary material (on finite difference methods or nonlinear problems) that will be distributed later in the semester.

Homework: Weekly problem sets most weeks, usually due on Fridays by 1 PM.

Late homework: You can leave late HW in the Math 397 box in the "waiting area" outside my office. If I retrieve it from the box before I grade that batch of HW, there will be no grade penalty (but I can not promise I will check the box between 4 PM on the due date and the time when I begin grading). Thereafter, there will be a 20% grade penalty, up until the point when I return that HW in class. After then, that HW can not be turned in for a grade, although I will be happy to mark it for correctness.

Tests: There will take-home tests due on Feb. 25, Apr. 8, and at the end of the final exam period. The third test will have a somewhat different structure: it will consist of a short "standard" test on material since Test # 2 that you do by yourself, plus a more extended project (from among a few choices) that you can do with a partner.

Grades:

Homework : 20%	
Tests #1 and 2: 25% each	
Test #3: 30%	

Honor Code: For homework problems, discussion with other students in the class or with me is highly encouraged, e.g., in Math Question Center, my office, or elsewhere. Please indicate on your homework who your collaborators were. *Please see*

`http://www.haverford.edu/math/collaboration.html` *for discussion of appropriate modes of collaboration on homework. The short version is that the actual writing of the assignment should be done individually, without using detailed notes from your collaborative discussions, so that it represents your personal understanding of the problems.* For the tests, no collaboration is allowed (except for the project portion of Test #3). You may ask me for clarification of the questions on tests, but I will not give suggestions about the actual solutions.

Moodle: All course materials will be available through Moodle.

Anticipated Schedule:

1/19–1/21	Nomenclature, classic PDEs, and some key ideas from linear algebra (Ch. 1–3)
1/24–1/28	Linear algebra (con't) (Ch. 3), key ideas from ordinary differential equations (Ch. 4)
1/31–2/4	ODEs (con't) (Ch. 4), boundary value problems in ODEs – analysis (Ch. 5)
2/7–2/11	Boundary value problems in ODEs – finite differences (not in book)
2/14–2/18	Boundary value problems in ODEs – finite elements (Ch. 5)
2/21–2/25	Heat equation – analysis (Ch. 6)
	2/25: Test # 1 due (on material 1/19–2/16)
2/28–3/4	Heat eqn – numerics (Ch. 6)
3/7–3/11	SPRING BREAK
3/14–3/18	Wave equation – analysis (Ch. 7)
3/21–3/25	Wave equation – numerics (Ch. 7)
3/28–4/1	The method of characteristics (Ch. 8)
4/4–4/8	PDEs in 2 and 3 dimensions (Ch. 11)
	4/8: Test # 2 due (on material 2/18–3/30)
4/11–4/15	Nonlinear PDEs (outside material)
4/18–4/22	Convergence of finite elements (Ch. 13)
4/25–4/29	Green's functions (Ch. 9)
5/2–5/13	FINAL EXAM PERIOD, **Test # 3 due by 5/13 (on material 4/1–4/29)**