References for M611

Our primary reference for M611 will be the assigned textbook, *Partial Differential Equations*, 2nd Edition, by Lawrence C. Evans, but we'll have several additional references as well. My goal in providing this list is not to suggest that students get copies of these books, but rather to give students an idea of where my lectures are coming from. The editions listed are the ones I happen to have; not necessarily the most recent.

Analysis

1. *Principles of Mathematical Analysis*, 3rd Ed., by Walter Rudin.

Known as "baby Rudin," this is the classic undergraduate reference on analysis.

2. *Real Analysis: Modern Techniques and Their Applications*, by Gerald B. Folland.

Currently, the Texas A&M math department uses this text for our first-year graduate sequence in analysis, M607-M608. It's a bit of a slog in places, but a dependable reference.

3. *Sobolev spaces, 2nd Ed.*, by Robert A. Adams and John F. Fournier

This is the definitive reference on Sobolev spaces, which won't appear until M612.

Ordinary Differential Equations

1. *The qualitative theory of ordinary differential equations, an introduction*, by Fred Brauer and John A. Nohel.

This is a nice, readable text that covers all the main topics at a fairly low level: constant coefficient systems, systems with periodic coefficients, general linear systems, existence, uniqueness, continuation, etc.

2. *Ordinary Differential Equations*, by Jack K. Hale.

This is the most definitive single-volume reference on ODE I'm aware of, but it's not an easy read. Our purpose is neither to follow the development of material (which is almost pathalogical), or even to take much from the individual proofs (which are often sketchy), but rather simply to have a reference in which everything I want to say is stated (somewhere) and proved (in a manner of speaking). I should probably add that Jack Hale is one of the leading researchers on ODE and dynamical systems, and so even if he's not always a model of clarity, we can trust that he knows what he's talking about.

Partial Differential Equations

1. *Applied Partial Differential Equations: with Fourier Series and Boundary Value Problems, 4th edition*, by Richard Haberman.

This book covers topics in undergraduate PDE in a spirit commiserate with standard textbooks on calculus and elementary differential equations (i.e., it serves as a nice extension of the material covered in those courses without much increase in level of difficulty). A course in undergraduate PDE should cover (at least) the method of characteristics, separation of variables (and fourier series), the method of eigenfunction expansion, polar and cylindrical coordinates, Fourier and Laplace transforms, and Green's functions. Haberman covers all this. I should probably mention that in certain places the presentation is somewhat idiosynchratic and not entirely representative of a standard course.

2. *Partial Differential Equations, an introduction, 2nd Ed.*, by Walter Strauss.

This relatively slim text covers undergraduate PDE at a higher level than Haberman's book.

3. *Fourier Series and Boundary Value Problems*, *7th Ed.*, by J. W. Brown and R. V. Churchill.

In most undergraduate PDE courses (including two-semester sequences) the methods are introduced with little rigorous justification. A second year could easily be spent justifying and generalizing the various techniques introduced in a first-year course. A good deal of nineteenth century mathematics was developed in order to justify aspects of fourier's analysis of the heat equation, and an entire semester could easily be spent on this alone. For example, it is extremely instructive to understand why the piecewise $C^1(-\pi,\pi)$ spaces used in classical Fourier analysis are less satisfactory than the Lebesgue $L^2(-\pi,\pi)$ spaces. (We will find that the advantage of Lebesgue spaces is that stronger limit-convergence results are possible.)

4. *Partial Differential Equations: Methods and Applications*, by Robert C. McOwen

This is a solid reference for graduate PDE.

5. *Partial Differential Equations*, *4th Ed.*, by Fritz John.

This classic graduate PDE text puts a strong emphasis on Cauchy problems and finite difference techniques, which we won't say much about.

6. *An Introduction to Partial Differential Equations*, by M. Renardy and R. C. Rogers.

This graduate PDE text puts a strong emphasis on distributions.

7. *Elliptic partial differential equations of second order*, by David Gilbarg and Neil S. Trudinger

This classic text is the starting point for just about every modern treatment of elliptic problems, including the one in Evans. It may not be the sort of read you'd take on vacation with you.

8. *Second order parabolic differential equations*, by Gary M. Lieberman

As Lieberman states in his introduction, this text was written to be "a companion volume to *Elliptic Partial Differential Equations of Parabolic Type*."