18.155 Fall 2008
DIFFERENTIAL ANALYSIS

Lectures: Mondays and Wednesdays 11am–12:30pm, Room 26-302

Lecturer: David Jerison, Room 2-247, 253-4394, last name at math.mit.edu

Office hours: TR 2–3 or by appointment

Web site: coming soon

COURSE OUTLINE

1. Normed vector spaces; Banach spaces; duality.
2. Distributions
2. Schwartz space and tempered distributions
4. Convolution and Fourier transform
5. Homogeneous distributions
6. Sobolev spaces; Sobolev embedding theorem
7. Initial value problems for partial differential equations
8. Elliptic boundary value problems: variational and maximum principle methods
9. Spectral theorem; eigenfunctions and eigenvalues (if time permits)

Homework: Course grades will be based on homework. There are no exams. Weekly problem sets are handed out in class and due in class. The first problem set will be handed out on Monday, Sept 8 (due Monday, Sept 15).

REFERENCES

Some problems will be taken from the first two references below, namely, the Notes for 18.155 by Richard Melrose and from the book by Jeffrey Rauch. These two will serve as a text for significant parts of the course. The book by Evans is also highly recommended. For further background and other points of view, see references 4–7.

1. Notes for 18.155 (2004) by Richard Melrose. Available from his web site or open courseware. You may also want to refer to his problem sets for hints.

2. *Partial Differential Equations* by Jeffrey Rauch (Springer-Verlag)
(has distribution theory and initial value problems)

3. *Partial Differential Equations* by Lawrence C. Evans (AMS)
(skips distributions and Fourier analysis nearly entirely, but very good on nonlinear pde and method of characteristics)

4. *The analysis of linear partial differential operators vol I*, 2nd ed, by Lars Hörmander (Springer-Verlag)
(precise, complete proofs; a systematic and comprehensive treatment; clear, but hard to read)

5. *Introduction to partial differential equations*, 2nd ed, by Gerald B. Folland (Princeton U. Press)
(has a very readable basic treatment of elliptic boundary value problems from the point of view of Fredholm operators)

6. *Real and complex analysis*, 3rd ed, by Walter Rudin (McGraw-Hill)
(classic text that does measure theory well and has quite a bit more analysis)

7. *Functional analysis*, 2nd ed, by Walter Rudin (McGraw Hill)
(systematic treatment of Banach and Fréchet spaces, duality, distributions, spectral theory, including unbounded operators; good as a reference, but not enough examples or connection to partial differential equations to make it very useful for this course)