Math 382D: Differential Topology

Spring Semester 2008

Unique Number 59185

Schedule

The course will meet MWF 2:00–3:00 in RLM 9.166.
My office hours this semester are 2:00–3:00 Tuesdays, 3:00–4:00 Fridays, and by appointment.

Introduction

Math 382D is designed to prepare you for the preliminary examination in differential topology.

A *manifold* is a topological space which is locally homeomorphic to Euclidean space. It is useful to think of a manifold as constructed from open sets glued together with homeomorphisms. A *differentiable manifold* is one in which the gluing maps are differentiable. Differential manifolds are important and natural objects that occur frequently in many branches of mathematics and its applications. *Differential topology* studies those properties of differentiable manifolds that are invariant under diffeomorphism.

Prerequisites

You should have a working knowledge of introductory point-set topology, advanced calculus, and linear algebra. Familiarity with differential equations would be very helpful.

Texts

Our main text will be:

- **Guillemin, Victor; Pollack, Alan.** *Differential topology.* Prentice-Hall, Inc., Englewood Cliffs, N.J., 1974.

Useful supplementary texts are:

- **Hirsch, Morris W.** *Differential topology. (*Corrected reprint of the 1976 original.) Graduate Texts in Mathematics, **33**. Springer-Verlag, New York, 1994.
- **Lee, John M.** *Introduction to smooth manifolds.* Graduate Texts in Mathematics, **218**. Springer-Verlag, New York, 2003.
- **Milnor, John W.** *Topology from the differentiable viewpoint.* Based on notes by David W. Weaver. (Revised reprint of the 1965 original.) *Princeton Landmarks in Mathematics.* Princeton University Press, Princeton, NJ, 1997.
- **Spivak, Michael.** *Calculus on manifolds. A modern approach to classical theorems of advanced calculus.* W. A. Benjamin, Inc., New York-Amsterdam 1965.

Assessment

Because the purpose of this course is to prepare you for the preliminary exam, you should be prepared to devote substantial time and effort to it!

The abilities to take existing ideas, refine them, generalize them, and adapt them to new situations are vital to research mathematics. So when doing homework, you may use reference works and discuss

problems with one another. However, all work you submit must be your own. Your proofs must be in your own words, not plagiarized from a classmate or reference text. And you must be able to explain and justify your proofs, if requested.

In contrast to homework, your work on exams must be done alone, without discussion or collaboration.

Your grade will be based on the following:

- Twelve homework assignments, collectively worth 40%.
- One take-home midterm exam, worth 30%.
- One take-home final exam, worth 30%.

Schedule

Please note the following:

- The schedule below is only approximate and will almost surely be altered for pedagogical reasons.
- This summary lists only core elements of the course. We will add examples, applications, and extensions of the material listed below. In particular, *you will be responsible for material introduced in class, not just the contents of the assigned text.*
- Homework is due on the Monday of each week marked with a ★.

January 14–18 Introduction and Chapter 1, §1–2.

January 21–25 ★ Chapter 1, §3–4.

January 28–February 1 ★ Chapter 1, §5–6.

February 4–8 ★ Chapter 1, §7.

February 11–15 ★ Chapter 1, §8. Chapter 2, §1.

February 18–22 ★ Chapter 2, §2.

February 25–29 ★ Chapter 2, §3-4.

March 3–7 Chapter 2, §5–6.

Midterm Exam due Friday, March 7.

March 11–15 Spring break

March 17–21 Chapter 3, §1–2.

March 24–28 ★ Chapter 3, §3–4.

March 31–April 4 ★ Chapter 3, §5–6.

April 7–11 ★ Chapter 4, §1–2.

April 14–18 ★ Chapter 4, §3–4.

April 21–25 ★ Chapter 4, §5–6.

April 28–May 2 ★ Chapter 4, §7–8.

Final Exam due Friday, May 9.