Geom/Top I: Algebraic Topology, Fall 2012: Syllabus

Professor: Benson Farb

This is my favorite course to teach. I think that the material in this course consists of some of the deepest, most beautiful, most powerful and most widely applicable ideas in mathematics. It is also usually the first course where students see two different areas of mathematics connected in a profound way. This course will likely require you to put in an immense amount of work and mental effort, but anything worth doing is hard. This is worth doing.

Prerequisites

I will assume that everyone knows all of this material extremely well at the start of the course.

1. Point-set topology: metric and topological spaces; subspace topology; continuous functions; homeomorphisms; the **quotient topology** (a particularly important one!); the quotient of a topological space by a group action; connectedness, path connectedness and compactness (and local versions of these); the Hausdorff property, lots of different examples of topological spaces (as in Munkres's book).

   Good source: James Munkres, Topology: a first course.

2. Algebra: Basics of groups (definitions, homomorphisms, quotients, isomorphism theorems, classification of finitely generated abelian groups); basic ring theory (PIDs, including group rings, polynomial rings, ideals); basics of modules (direct sums and products, quotients, free and torsion modules, modules over a PID); how a group G acting on an abelian group A makes A into a module over the group-ring $\boldsymbol{Z}G$; multilinear algebra (tensor and wedge products, tensor and alternating algebras, universal properties, etc.)

   Good sources: Any beginning algebra book. I like Jacobson's "Basic Algebra I"; other books inlcude Lang's "Algebra" and Hungerford's "Algebra".

Text

The main material in this class will come from my lectures. However, I will basically follow in outline, and will often refer to, Hacher's book: "Algebraic Topology". A free, downloadable version is available at:

http://www.math.cornell.edu/ hatcher/AT/ATpage.html

The plan is to thoroughly cover the material in Chapters 1, 2, 3, and much of 4, with very few of the "Additional Topics" at the end of each chapter. This is a lot of material for a 10 week class, but in past courses I've been able to cover it all.

Lectures

I've decided this year to have the main transfer of knowledge come from my lectures. One goal of my lectures will be to try to give you streamlined "crash courses" on each topic. I will emphasize the most important concepts and theorems and examples, and will exhibit them "in action".

In addition to the material in the lectures, I will also assign readings from Hatcher. You will be responsible for knowing all of this material.

Please feel free to ask questions in class. I will also be happy to discuss material with you at any time. Finally, please share with me any comments/questions/complaints you may have at any time.

Homeworks

Homework will be due at the *start* of class on the due date. Late homeworks will not be accepted. Please don't come to class 5 or 10 minutes late (or more!) and ask me to accept your homework. Homeworks must be written neatly, clearly, and must be stapled or clipped.

I encourage you to work together, in groups of no more than *two* people. At the top of the first page of your homework please write : "I worked on this homework with X", where X is your collaborator.

There will be two types of problems: those to hand in and those to look at. While you only need to hand in the first type, I strongly suggest you try all the "look at" problems as well.

NOTE: Due to budgetary constraints, homeworks will be graded only for those students registered for this class.

Course grade

50% homework; 25% midterm (in class) ; 25% Final (in class). This is subject to change.

Policies

1. No grade on a problem from homework, the midterm, the quizzes, or the final will be changed except in instantly obvious cases. Please don't ask.

2. Extra time will not be given for those arriving late for a pop quiz or for an exam.

Office Hours, etc.

My office hours are simply whenever I happen to be in (which is often), and by appointment. My office is 356 Ryerson Hall. The best way to make an appointment

is by seeing me after class, by sending me e-mail (farb@math.uchicago.edu), or by calling me at my office: 702-3444.

Other texts

Here are some additional texts which present some of the same material which we will be covering.

1. J.P. May, A concise course in algebraic topology.
2. M. Greenberg and J. Harper, Algebraic topology: A first course.
3. E. Spanier, Algebraic Topology.
4. J. Munkres, Elements of Algebraic Topology.
5. W. Massey, Introduction to Algebraic Topology (the OLD version, with just fundamental group and covering spaces).