

Math 776, Spring 2019

Algebraic Topology

Credit hours: 3

Department: Mathematics

Time/location: MWF, 12:20PM – 1:10PM in Phillips 301

Instructor: David Rose

Office hours: 11am–12pm on Wednesdays and 10am–11am on Thursdays in Phillips 302 (or by appointment)

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Target audience: Mathematics graduate students, and any others, who are interested in algebra, geometry, topology, and related topics.

Course prerequisites: Formally, Math 676 and 681. More specifically, I expect everyone to be comfortable with abstract and linear algebra, point-set topology, the fundamental group, and covering space theory. In particular, you should be comfortable with the quotient topology, the correspondence between covering spaces and subgroups of the fundamental group, various lifting criteria, and deck/covering transformations. We will *quickly* review the necessary elementary algebraic topology (Chapters 0 and 1 of Hatcher) during the first week (or so).

Course goals and learning objectives: To develop a working knowledge of algebraic topology and the related homological algebra, and to learn classical applications of the theory.

Course requirements To demonstrate knowledge of the above, via homework assignments and examinations.

A note about the textbook: We are using *Algebraic Topology* by Allen Hatcher. Physical copies of the text should be available at the bookstore (and are quite affordable), but you can also freely obtain the text at the link here:

<http://pi.math.cornell.edu/~hatcher/AT/AT.pdf>

Course content: We aim to cover the materials in Chapters 2, 3, and 4 of Hatcher (plus select optional topics). Here is a preliminary schedule:

	Dates	Topics
Week 1	1/9, 1/11	Chapter 0 and 1 Review
Week 2	1/14, 1/16, 1/18	Chapter 0 and 1 Review
Week 3	1/23, 1/25	Singular homology and excision
Week 4	1/28, 1/30, 2/1	Cellular homology and Mayer-Vietoris
Week 5	2/4, 2/6, 2/8	Formal structure and classical applications
Week 6	2/11, 2/13, 2/15	More on homology
Week 7	2/18, 2/20, 2/22	Singular cohomology
Week 8	2/25, 2/27, 3/1	The cup product and ring structure
Week 9	3/4, 3/6, 3/8	Poincaré and Alexander duality
Spring break!	3/11 – 3/15	No lecture!
Week 10	3/18, 3/20, 3/22	Some applications and the Kunneth formula
Week 11	3/25, 3/27, 3/29	More on cohomology
Week 12	4/1, 4/3, 4/5	Higher homotopy groups
Week 13	4/8, 4/10, 4/12	The Hurewicz Theorem and the Fibration L.E.S.
Week 14	4/15, 4/17	Cohomology revisited and Obstruction Theory
Week 15	4/22, 4/24, 4/26	More on homotopy theory
Final Exam	4/30 at 12:00pm	

Professor Rose reserves the right to deviate from the listed schedule as needed.

Grades: Your grade will be based on the following:

- Homework (30%)
- Mid-term examination (30%): it will take place in class on **March 1**. There may also be a take-home component assigned that day, and due on **March 4**.
- Cumulative final examination (40%) on **April 30 at 12:00PM**.

Although not a formal component of the grading scheme, students are expected to regularly attend and actively participate in lectures.

Missed midterm exams will be treated on a case-by-case basis. If the absence is excused, the final exam grade will be substituted in place of the missed midterm. **No** make-up midterm will be given.

Homework: In order to properly learn the course material, it is crucial to develop the necessary problem-solving skills. As such, homework will be assigned regularly, on the course website. As is the case with many standard textbooks, you may be tempted to search for homework solutions online; I urge you **not** to do so, as 1) you will learn best by struggling

with the problems, and eventually fighting through your confusion (which won't happen if you look up solutions), and 2) it is a violation of the UNC Honor Code.

Academic integrity: Don't cheat. Don't act dishonestly.

Device policy: Phones may not be used during lecture. Laptops and tablets may only be used for note taking.

Syllabus changes: Professor Rose reserves the right to make changes to the syllabus, including test dates, should any unforeseen circumstances occur. These changes will be announced as early as possible so that students can adjust their schedules.