

Outline of Math 426, Introduction to Topology

Ben Williams

First Winter Term, 2020–2021

1 Contact information

The instructor for this course is me, Ben Williams. I may be reached at tbjw@math.ubc.ca.

The course website is <http://www.math.ubc.ca/~tbjw/426/index.html>.

Office hours are by appointment. This is to say: email me.

2 Meeting Times

The course meets Mondays, Wednesdays and Fridays at 12pm online. A traditional lecture format will be followed.

3 Prerequisites

The formal prerequisites for this course are MATH 321, a second course in real analysis, and Math 322, a first course in group theory. At a minimum, you should be comfortable with arguments regarding continuity of functions from $\mathbb{R}^n \rightarrow \mathbb{R}^m$ and about convergence of sequences. Some homework assignments will also assume knowledge of other kinds of mathematics—please let me know if some assignment requires some knowledge you do not have.

4 Purpose

This course feeds into Math 427/527, which is a first course in algebraic topology. You should learn the basic ideas of point-set topology, and the very beginnings of algebraic topology, namely, the theory of the fundamental group and covering spaces. I will emphasize the aspects of the theory that do not overlap with functional analysis. You should also develop a high level of fluency with abstract arguments in mathematics, and learn the fundamentals of category theory.

5 Textbook

There is no required textbook for this course. Munkres' *Topology* is recommended (a paperback version may be purchased for under \$40, as is Hatcher's *Algebraic Topology* (free online) and for some light reading *Counterexamples in Topology* by Steen and Seebach (about \$15). Both lecture notes and supplementary materials will be made available.

6 Homework

Homework will be assigned throughout the course, at a rate of one assignment of three questions every week. The first assignment will be due on Friday 18 September, at 5pm. Submit homework by email, ideally in the form of a pdf compiled from \LaTeX .

7 Exams

There will be a take-home final exam.

8 Overall Course Grade

The overall course grade will be assigned based on homework (70%) and the final exams (30% for the final). The lowest homework grade will be dropped for each student.

9 List of Topics

The following is a list of topics that will be covered.

1. Topological spaces
2. Separation axioms
3. Continuous functions
4. Generating topologies
5. Induced topologies
6. Co-induced topologies
7. Closure, interior, boundary
8. Density
9. Sequence methods
10. Compactness
11. Connectedness
12. Path connectedness
13. Homotopy
14. The homotopy category
15. Homotopy groups
16. Paths and loops in spaces
17. The fundamental groupoid
18. Covering spaces
19. The relationship between the fundamental group and covering spaces
20. Deck transformations

- 21. The van Kampen theorem
- 22. $K(\pi, 1)$ spaces.
- 23. Topological groups and group actions
- 24. Classifying spaces from quotient constructions
- 25. Further topics as time permits

10 Policy statement

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