Provisional Syllabus for Math 427/527

Topics in Topology/Algebraic Topology I

Land acknowledgement

UBC Vancouver is located on the traditional, ancestral, and unceded territory of the Musqueam people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

General information

- Term:: Second winter term, 2025–2026.
- Meeting time:: TuTh 9:30am–10:50am.
- Location:: Math 426 is listed as an in-person course, while Math 527 is listed as a hybrid course. Lectures will be held in ESB 4133 (the PIMS library) and will be streamed over Zoom. In person attendance is encouraged for UBC students.
- Instructor:: Ben Williams
- Instructor contact:: email:: tbjw@math.ubc.ca, office:: MATX 1205.

Prerequisites

You must be able to work with abelian groups. This prerequisite can be sometimes overlooked. Beyond this, the course is actually two, crosslisted courses.

For Math 427

The prerequisite for Math 427 (the undergraduate course) is Math 426.

For Math 527

Here is an attempt to list the background you need to have to get the most out of Math 527 as a graduate student. The list may not be exhaustive, but if you are familiar with almost all the topics on this list, you should be fine.

- Point-set topology: Open and closed sets, continuous functions, product topologies, quotient topologies, compactness, path-connectedness and connectedness.
- Basic homotopy theory: the definition of homotopy, contractibility, deformation retracts, homotopy equivalences.
- Algebra: groups and especially abelian groups, the structure theory of finitely generated abelian groups, the isomorphism theorems. Finite dimensional linear algebra.

There are some topics that will be helpful to know about, but should not be strictly necessary for the development of the theory.

- Fundamental groups.
- Covering spaces.
- Modules over commutative rings.

If you are a graduate student who wants to take this course, but are concerned you may lack some prerequisite, please contact me directly.

Textbooks and notes

Primary text

The course will follow Lectures on Algebraic Topology by Haynes Miller. This book is a bound version of the notes that are available online. We will follow the notation and terminology of this book for the most part. The course may also refer to the exercises from Algebraic Topology by Alan Hatcher, which is freely available online.

Other sources

- Course notes for the similar course at the University of Toronto by Alexander Kupers.
- Notes from when I taught this course in 2019.
- Algebraic Topology by Alan Hatcher. This book may suit people who like thinking about low-dimensional examples a lot. It is somewhat less algebraic in tone than the other texts. It covers a large amount of material.
- Lectures on Algebraic Topology by Albrecht Dold.
- Topology and Geometry by Glen E. Bredon
- A Concise Course in Algebraic Topology by J. P. May This is a good second text to read, since it lives up to the adjective "Concise".

Assessment and grade

Homework

There will be fortnightly homework, of which your lowest-scoring assignment will be dropped. Homework will constitute 15% of the overall grade.

Grading of homework will be based on correctness, completeness and readability. That is, points may be taken off for answers that are confusing, poorly presented, poorly explained, or devote a great deal of attention to irrelevant points.

You are encouraged to work with each other on the homework assignments, but the work you turn in must be your own. The use of AI tools for anything other than checking spelling, grammar and LaTeX formatting is prohibited.

Midterm

There is an in-class midterm, worth 20% of the grade. This will be held at a time to be settled later.

Final

The final is worth the rest of the grade, 65%. The time of final will be set by UBC scheduling during the term.

Concession policy

- For homework, the first concession is that we drop the lowest-scoring assignment for all students. Further concessions can be discussed with the instructor if they become necessary.
- Students doing better on the final than on the midterm (including cases where the midterm was not written) will have their final count for 85% of the course grade, replacing the midterm.

Content

The course covers the first three chapters of Miller's book. The following is an approximate weekly schedule of the course.

1. Chains and homology. Categories, functors and natural transformations.
2. Homotopy, invariance of homology.
3. Relative homology and the long exact sequence.
4. Excision. The Eilenberg–Steenrod axioms. Subdivision.
5. CW Complexes and their homology.
6. Examples. Homology with coefficients.
7. Tensor products, Tor
8. Universal coefficients. The Künneth formula.

9. Cohomology. The universal coefficient theorem.
10. Products and coproducts. Local coefficients. Orientations.
11. Cap product. Čech cohomology.
12. Poincaré duality and applications.

University policies and resources

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual assault. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website.