MATH 231A: Algebraic Topology

Fall 2024

Instructor:	Fan Ye	**Time:**	MW12-1:15pm
Email:	fanye@math.harvard.edu	**Place:**	TBD.

Course Page: https://scholar.harvard.edu/fanye/classes/math231a-algebraic-topology

Course Assistant: TBD

Office Hours: TBD

Main Reference: Algebraic topology, Chapter 2-3 by Allen Hatcher:
https://pi.math.cornell.edu/ hatcher/
 Lectures on Algebraic Topology, Chapter 1-3 by Haynes Miller:
https://math.mit.edu/ hrm/papers/lectures-905-906.pdf
Other suggested references: W. Fulton: Algebraic Topology; E. Spanier: Algebraic Topology; Greenberg and Harper: Algebraic Topology: A First Course

Prerequisites: An undergraduate-level understanding of topology. An undergraduate may look at Basic Topology by M. A. Armstrong.

Tentative Course Outline: Notes will be posted on the course page after the classes.

- Weeks 1-4: Singular Homology

- Weeks 5-8: Computational methods

- Weeks 9-14: Cohomology and duality

- Weeks 1-2 (Sept. 4-11): smooth manifolds and Lie groups [Taubes, Chapters 1-2]

- Weeks 3-4 (Sept. 16-25): vector bundles [Taubes, Chapters 3-6]

- Weeks 5-6 (Sept. 30-Oct. 9): metrics and geodesics [Taubes, Chapters 7-9]

- Weeks 7-8 (Oct. 14-23, with holiday on Oct. 14): de Rham cohomology and covariant derivative [Taubes, Chapters 12]

- Weeks 9-10 (Oct. 28-Nov. 6): Levi-Civita connections and Riemann curvature tensors [Taubes, Chapters 15, 14.1]

- Weeks 11-12 (Nov. 11-20): characteristic classes and principal bundles [Taubes, Chapters 14, 10-11]

- Week 13-14 (Nov. 25-Dec. 4, with holidays on Nov. 27-29): Yang-Mills equation and applications.

Grading Policy: Homework (60%=5×12%) and Final exam (40%).

Homework: There will be 6 assignments, posted on the course page every two weeks, which are related to the materials in the next two weeks. The first assignment will be posted on the first week. The homework should be submitted via Canvas (see Important Dates for the exact dates). Late homework is accepted only by my permission. LaTeX, scanned copies, photos of writings, and any other types of writings are accepted if they are clear and understandable. The lowest homework score will be dropped and it is allowed to only finish and submit homework for 5 times.

Final Exam: There will be a take-home final exam, posted on the course page on Dec. 1. It should be submitted via Canvas before Dec. 5.

Collaboration: Discussion and collaboration are encouraged for homework but students should write up their own solutions. It is good to write the names of collaborators on the first page of the homework. Collaboration on the final exam is prohibited.

Important Dates:

Sept. 4, Wed .... Assignment 1 will be posted
Sept. 18, Wed .... Assignment 2 will be posted
Oct. 2, Wed, 11:59 pm .... Deadline of Assignment 1
Oct. 2, Wed .... Assignment 3 will be posted
Oct. 16, Wed, 11:59 pm .... Deadline of Assignment 2
Oct. 16, Wed .... Assignments 4 will be posted
Oct. 30, Wed, 11:59 pm .... Deadline of Assignment 3
Oct. 30, Wed .... Assignment 5 will be posted
Nov. 13, Wed, 11:59 pm .... Deadline of Assignments 4
Nov. 13, Wed .... Assignment 6 will be posted
Nov. 27, Wed, 11:59 pm .... Deadline of Assignment 5
Nov. 27-29, Wed-Sun .... Thanksgiving break
Dec. 4, Wed, 11:59 pm .... Deadline of Assignment 6
Dec. 4., Wed .... Final exam will be posted
Dec. 10, Tue, 11:59 pm .... Deadline of final exam