

MATH 230A: DIFFERENTIAL GEOMETRY

Fall 2022

Instructor:	Fan Ye	Time:	10:30-11:45 am, T-Th
Email:	fanye@math.harvard.edu	Place:	SC 221.

Course Page: <https://scholar.harvard.edu/fanye/classes/math230a-differential-geometry>

Course Assistant: To be confirmed.

Office Hours: Fan Ye, SC 505H, Tuesday 1:30-3:20 pm.

Office hours by CA are to be confirmed.

Main Reference: Differential Geometry: Bundles, Connections, Metrics and Curvature, Chapters 1-16, by Clifford H. Taubes.

Prerequisites: An undergraduate-level understanding of manifolds. An undergraduate may look at the first chapter of Cliff's book for preparation.

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

- Weeks 1-2 (Sept. 1-8): smooth manifolds and Lie groups [Taubes, Chapters 1-2]
- Weeks 3-4 (Sept. 13-22): vector bundles [Taubes, Chapters 3-6]
- Weeks 5-6 (Sept. 27-Oct. 6): metrics and geodesics [Taubes, Chapters 7-9]
- Weeks 7-9 (Oct. 11-25): de Rham cohomology and covariant derivative [Taubes, Chapters 12]
- Weeks 9-11 (Oct. 27-Nov. 10): Levi-Civita connections and Riemann curvature tensors [Taubes, Chapters 15, 14.1]
- Weeks 12-13 (Nov. 15-22): characteristic classes and principal bundles [Taubes, Chapters 14, 10-11]
- Week 14 (Nov. 29-Dec. 1): Yang-Mills equation and applications.

Grading Policy: Final exam made by problems in homework (100%).

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 Sept. 1. There are no due days for homework, but you are encouraged to finish them in 3 weeks (see Important Dates for the exact dates).

Final Exam: There will be a take-home final exam. It is made by 5 problems picked in all assignments. The exam will be posted on the course page on Dec. 1. It should be submitted via Canvas before Dec. 5. Since the final exam is made by problems in the homework, students may finish the problems in the assignments before the final exam period (Dec. 1-5) and then submit solutions for ones in the final exam. LaTeX, scanned copies, photos of writings, and any other types of writings are accepted if they are clear and understandable.

Collaboration: Discussion and collaboration are encouraged for homework (during the semester) but students should write up their own solutions for the final exam.

Important Dates:

Sept. 1, Thu Assignment 1 will be posted
Sept. 15, Thu Assignment 2 will be posted
Sept. 22, Thu, 11:59 pm Encouraged finishing day of Assignment 1
Sept. 29, Thu Assignment 3 will be posted
Oct. 6, Thu, 11:59 pm Encouraged finishing day of Assignment 2
Oct. 13, Thu Assignment 4 will be posted
Oct. 20, Thu, 11:59 pm Encouraged finishing day of Assignment 3
Oct. 27, Thu Assignment 5 will be posted
Nov. 3, Thu, 11:59 pm Encouraged finishing day of Assignment 4
Nov. 10, Thu Assignment 6 will be posted
Nov. 17, Thu, 11:59 pm Encouraged finishing day of Assignment 5
Nov. 22, Tue Range of final exam will be posted
Nov. 23-25, Wed-Fri Thanksgiving break
Dec. 1, Thu, 11:59 pm Encouraged finishing day of Assignment 6
Dec. 1., Thu Final exam will be posted
Dec. 5, Mon, 11:59 pm Deadline of final exam