

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: Clair Dai, xdai@math.harvard.edu

Office Hours: Fan Ye, SC 505H, Tuesday 1:30-2:30 pm;

Clair Dai, Zoom, Sunday 10:30-11:30 am. <https://harvard.zoom.us/j/9999699695> no password

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:

- 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, Levi-Civita connections, and Riemann curvature tensors [Taubes, Chapters 12,15-16]
- Weeks 9-11 (Oct. 27-Nov. 10): principal bundles and connections [Taubes, Chapters 10-12]
- Weeks 12-13 (Nov. 15-22): flat connections and characteristic classes [Taubes, Chapters 13-14]
- Week 14 (Nov. 29-Dec. 1): Yang-Mills equation and applications.

Grading Policy: Homework ($60\%=5\times 12\%$) 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 Sept. 1. The homework should be submitted to the course assistant Clair Dai via Canvas in 3 weeks (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. The range of the exam will be posted on Nov. 22. The exam will be 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. 1, Thu Assignment 1 will be posted
Sept. 15, Thu Assignment 2 will be posted
Sept. 22, Thu, 11:59 pm Deadline of Assignment 1
Sept. 29, Thu Assignment 3 will be posted
Oct. 6, Thu, 11:59 pm Deadline of Assignment 2
Oct. 13, Thu Assignment 4 will be posted
Oct. 20, Thu, 11:59 pm Deadline of Assignment 3
Oct. 27, Thu Assignment 5 will be posted
Nov. 3, Thu, 11:59 pm Deadline of Assignment 4
Nov. 10, Thu Assignment 6 will be posted
Nov. 17, Thu, 11:59 pm Deadline 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 Deadline of Assignment 6
Dec. 1., Thu Final exam will be posted
Dec. 5, Mon, 11:59 pm Deadline of final exam