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; Thursday 1:30-2:30 pm (starting at week 4).
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%=5×12%) 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