

Math740 Syllabus

Fall 2022 - Anton Lukyanenko - alukyane@gmu.edu

Class times: TR 1:30-2:45 in 4016 Exploratory Hall

Office hours: TR 2:45-3:30, in person in 4113 Exploratory Hall and online at <https://gmu.zoom.us/j/9860600799>

Textbook: *Differential Topology* by Guillemin and Pollack.

Students should supplement with other books on differential topology and manifolds, such as Bredon or Warner. See also the books by Spivak on differential geometry, by Hatcher on algebraic topology, by Munkres on point-set topology, and by Cohn on measure theory.

Course content

We will cover all 4 chapters of Guillemin and Pollack, followed by student presentations.

These chapters cover: (1) manifolds and smooth maps, (2) transversality, (3) oriented intersection theory, and (4) integration on manifolds. We will intersperse some additional topics, such as Lie groups, discrete groups, quotients by group actions, and geodesic flow on Riemannian manifolds.

End-of-semester student presentations will focus on a topic of the student's choice.

Course format

We will aim to cover one sections per day; going faster or slower as needed as the semester progresses.

Before each class (3 hours) Students will read the next section of the book, work on the suggested homework problems (individually or in groups), and then write an informal summary including key ideas, points of confusion, homework problem ideas, and/or questions. This should be 1-2 pages in length.

In class I will start with a quick overview of the two sections, and then we will work in groups to discuss any points of confusion, share problem solutions, and solve additional problems.

After class (1-2 hours) Working in groups of 2-3 students, students will submit a finalized **1-page**¹ summary of the sections before the next class period. Students may take turns writing up the summary, but it must be approved by everyone in the group. Longer proofs or calculations may be

Badly-written or incomplete summaries will be frowned upon, and returned for rewriting.

Verbal Assessments

At the beginning of the course ("chapter 0"), and once we complete each chapter, a list of 10 questions will be announced. A week later, students will register for brief assessments during office hours.

¹ Here and elsewhere, "1 page" means a standard LaTeX page with 11-text font, up to a multiplicative constant. The primary goal of all submissions should be to be informative, correct, and concise.

During an assessment, 3 of the 10 questions will be selected at random. To pass the assessment, the student must correctly answer 2 of the 3 questions and any clarification questions **in 10 minutes**.

A failed assessment can be retaken at no penalty at a future office hour, with newly-randomized questions. Assessments must be taken sequentially: prerequisites passed before Ch.1 attempted, etc. A student failing two or more successive assessments will be required to follow a study plan and attend office hours before continuing.

Presentations The last week will be devoted to 20-minute student presentations, discussing a recent (past 10 years) thesis of their choice that is related to differential topology. This is a chance to explore topics of interest to the student, and a glance at the final product of the PhD program.

In preparation, students will submit 2-page answers to the following questions:

- (due October 24) What 3 topics related to differential topology are you considering reporting on? (This is a chance to explore your interests, so take the time to look into this. Use a mix of resources, including [Google scholar](#), [MathSciNet](#), and general googling/Wikipedia). For each topic, include a general overview and 3 researchers that have mentored a PhD thesis in the last 10 years (see [mathgenealogy.com](#)). For each researcher, provide a quick overview of their topic and tell me how many students they have had in the past 10 years.
- (due November 7) What 3 theses are you considering reporting on? Provide a quick description of each one and attach a PDF of the thesis. Note that short theses are generally denser and harder to make sense of.
- (due November 28) Notes for your talk, to be shared with others in the class.

Attendance and Participation

Attendance and participation are expected. Students who are not feeling well should of course stay home. Attendance via zoom can be arranged, by request, in such cases.

Grading

All submissions will be made on Blackboard.

As will be given to students who submit all summaries, pass all assessments, give a good presentation, and participate actively in class; A+s will be reserved for exceptional work.

Weak presentations or un-passed assessments will reduce the grade by 1/3 of a letter grade each (e.g. 3 passed assessments and a weak presentation leads to a B). Additional penalties will be imposed for lack of participation or unsubmitted summaries.

Accommodations, Advising, etc

Let me know if anything comes up, including:

- you require accommodations,
- there are any issues with the course (including workload and conducive work environment),
- you need any general advising,
- there are topics you are particularly interested in covering.