Math 5345H: Honors Introduction to Topology

Fall Semester 2025, 4 credits
Course meeting times: 12:20 PM-02:15 PM MW in Vincent Hall 206
Instructor: Peter Webb, 350 Vincent Hall, webb@umn.edu, 612-625-3491,
Home page: http://www.math.umn.edu/~webb
Office Hours: Monday and Wednesday 10:10-11:50, Thursday 11:15-12:05, or by appointment, in 350 Vincent Hall.
Course Site: The Canvas course site, and also my home page.

Course Summary

What is topology? Many people have heard of it as the study of properties of objects that are unchanged when we stretch and deform the object. We may imagine various objects such as spheres and donuts etc. made out of rubber sheeting that we can pull around as much as we wish. No matter how much we deform the donut it still keeps its hole in the middle (as well as its inside and outside if it is hollow) so we regard the hole in the middle as a topological invariant. This property distinguishes it from the sphere, which only has an inside and an outside.

Before we reach this kind of rubber sheet topology we have to go through a lot of preliminary work first which is sometimes abstract, and where the geometric aspect may be hidden. These foundations are at least as important as the geometric applications because they are used fundamentally in many branches of mathematics. By learning about them and proving theorems in this generality we set the stage simultaneously and free of charge in diverse areas ranging from analysis through combinatorics to algebraic geometry.

Course Prerequisites

The official list of prerequisites is one of [2263 or 2374 or 2573] and one of [2283 or 2574 or 3283]. These are calculus courses, and they are not strictly relevant for Math 5345H. Their main relevance is that they give you experience working with ideas of continuity, distances between points and manifolds, so that you can see the relevance of what we do in this course. We will be reading and writing logical arguments. Experience in doing this is very helpful, and otherwise this might be the hardest aspect of the course.

Textbook

Czes Kosniowski, A first course in Algebraic Topology, Cambridge University Press 1980.

This text is available by free online access from the University of Minnesota library: you can download it.

The first 67 pages of Kosniowski's book introduce topological spaces and many abstract properties that they have. The language of these properties is essential in very many parts of mathematics. After that the book describes the classification of compact surfaces without

boundary, things like the donut and the Klein bottle. Finally, if we get that far we will study the fundamental group and covering space theory. We will not go beyond that in the book. The nature of this material is that it is very important to know about it as an essential language for other parts of mathematics. More-or-less no one does research into these things, as described in the book.

Another book that is often specified for courses of this type is by J.R. Munkres: Topology. This is a bigger book, it takes longer to read and goes into more detail. It does have many exercises (for which solutions can probably be found online). It also does a number of things that are less essential. Some other books that could be helpful are Messer and Straffin: Topology Now!, also Steven Gaal: Point set topology, and J.L Kelley: General Topology.

Course Assessment

You will be assessed by:

Homework	4%
Quizzes	16%
Mid-term exams	48%
Final exam	32%

Calendar for homework, quizzes and exams

Exams

There will be three 50 minute mid-term exams, to be held in person during the second part of class on **Wednesday October 1**, **Wednesday October 29** and **Wednesday December 3**. There will be a final exam held at the official university time, which is **10:30-12:30 Saturday December 13**. The final exam will be held online. You will need a Zoom connection and I would like you have the camera turned on so that I can see you working.

Homework and Quizzes

There will be 12 homework sets and 9 quizzes. Homework will be due on Wednesdays, starting September 10. For part of the instruction in this course we will be using worksheets, some of which will be worked on in class, and some of the questions on the worksheets will be marked as homework to be handed in. Only the questions marked as homework should be uploaded to Gradescope. Homework will be graded by completion, each question scoring a point if you submit a genuine attempt at it. Of the 12 homework assignments the lowest 4 scores will be dropped.

Except on days when there is an exam, there will also be a short quiz on Wednesdays, done in class, on the topics covered as far as the homework due that day. The first quiz will be on

Wednesday September 10, the same day the first homework is due. There will be 9 quizzes, of which the lowest score will be dropped.

Absence from exams

Missing a midterm is permitted only if you have a compelling reason. Except in extraordinary situations you should obtain permission from me to miss an exam in advance; otherwise you will be awarded a 0. If you are excused from taking a midterm, one possibility is that your course grade will be determined by giving extra weight to the final exam. I will give make up exams only for reasons sanctioned by the university. This includes university sponsored activities and documented illness. Students missing the final exam will fail the course unless they have a very good reason, in which case see Incompletes below.

Attendance

Students are expected to attend all classes. I get an impression of who is attending and who is not, and this can affect a decision when someone is close to a grade boundary.

Expectations of written work and the use of AI

In most cases in quizzes and exams you will not get full credit if you simply write down the correct answer. To get full credit you may need to give reasons or write an explanation of how you got your answer. Where explanations need to be given, these should be written out in sentences i.e. with verbs, capital letters at the beginning, periods at the end, etc. and not in an abbreviated form.

Solutions to problems can be hand-written. If they are typed, make sure they give the appearance somehow that they are your own work, and that I am in no doubt about this.

I encourage collaboration with others and working in groups. For work you submit I want it to be your own. It should not be too similar to something that another person in the class has done, or that can be found online.

I do not want you to use any form of AI or online assistance that supplies content to the work you submit, either in the form of mathematical content, or in the form of complete sentences. Thus a solution to a problem that you find online is not acceptable, and neither is a version of your own solution where the sentences are written out by some AI assistance. Correction of grammar and of spelling are acceptable.

Computers and calculators

Calculators will be allowed at all times, but are not relevant. Other electronic equipment may not be used or be available during quizzes and exams (except if the exam is online). There will be a standard rubric on quizzes and exams, to the effect that you must show your work and give explanations so that we can see you know how to do the question. You must show all steps in what you do.

Incompletes

These will only be given in exceptional circumstances. A student must have satisfactorily completed all but a small portion of the work in the course, have a compelling reason for the incomplete, must make prior arrangements with the professor for how the incomplete will be removed, and submit a request for the incomplete on the official form.

Academic dishonesty

Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of F or N for the entire course.

University Policy

The University's Education & Student life policies are available in the online Policy Library.

In particular, see the Teaching and Learning: student responsibility policy. As a student at the University, you are expected to adhere to the Board of Regents Policy: Student Conduct Code.

If you have, or think you have, a disability in any area such as, mental health, attention, learning, chronic health, sensory, or physical, please contact the Disability Resource Center (DRC) to arrange a confidential discussion regarding equitable access and reasonable accommodations. If you are registered with the DRC and have a current accommodation letter please share your letter with your instructor as soon as possible.

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University services are available to assist you via the Student Mental Health Website.

Date of this version of the schedule: 8/29/2025