Syllabus for MATH 5345H Honors: Introduction to Topology (Fall 2018)

September 4, 2018

Schedule: 11:15 – 12:05 Monday, Wednesday, Friday, Vincent Hall 2.

Office hours: 12:30 – 2:30 Tuesday and 2:30 – 3:30 Friday, Vincent Hall 459, and by appointment.

Instructor: Craig Westerland

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Course webpage: http://www.math.umn.edu/∼cwesterl/docs/5345Fall2018.html

Text: *Topology*, 2$^{\text{nd}}$ edition, James R. Munkres.

Prerequisites: One of [2263 or 2374 or 2573] and one of [2283 or 2574 or 3283]. Some background with mathematical proofs is required (and will be used in homework).

Goals and Objectives: We'll learn to work with abstract topological spaces, both the concrete and the very formal, the non-intuitive and the geometric. We will develop qualitative tools to characterize them (e.g., connectedness, compactness, second countable, Hausdorff...), and develop tools to identify when two are equivalent (homeomorphic). Several important results will be proved, notably the Tychonoff theorem on products, but an equal focus will be placed on understanding examples coming from geometry, algebra, and number theory. Towards the end of the class, we will study the fundamental group and if time permits, covering spaces.

Through this course, you will learn to develop formal proofs and careful mathematical arguments, and will be able to communicate them effectively in writing. You will master the basics of point-set topology and have a good understanding of the examples and counterexamples that inform the development of the subject.

Writing component: While this is not officially a writing-intensive course, writing mathematics is a central part of the work in this course. The most fundamental aspect of pure mathematics is a proof. While proofs are written in very technical, stylized language, they are fundamentally about presenting a convincing argument to the reader of the truth of some mathematical statement. Many of the difficulties in mathematical writing are in balancing the need to use extremely careful and precise language against the need to explain things clearly and in a straightforward manner. This takes a lot of practice.

You are most likely at a stage in your mathematics education where you have a handle on the mechanics of proof-writing; I would like you to focus your efforts this semester on the main goal, which is to also make a compelling argument to the reader. As such, we will practice writing to different audiences – informal explanations of the sort you might give to your family, casual proofs that you might explain to your peers, and of course the very careful writing expected in formal proof.

Even if you have no intention to pursue proof-writing in your future career, the ability to write a compelling, clear, logically sound argument will undoubtedly be of use in your future. And so I hope that you do take the writing component of this class very seriously.

Topics: Here is a loose plan of the subject, keyed to the relevant chapters of Munkres' text.

Week 1-2 Set theory and Logic (ch. 1)

Week 3-5 Topological spaces and continuous functions (ch. 2)

Week 6-7 Connectedness and Compactness (ch. 3)

Week 8-9 Countability and Separation axioms (ch. 4)

Week 10 The Tychonoff Theorem (ch. 5)

Week 11 Complete Metric Spaces and Function Spaces (ch. 7)

Week 12-14 The fundamental group (ch. 9, 11, 13)

Assessment: Has three components:

50% Weekly homework assignments.

20% Midterm takehome exam (15-22 October).

30% Final takehome exam (due 5pm, Monday December 17)

Extra credit is not intended to be part of this course. Late homework will not be accepted, but your two lowest grades will be dropped.

Policy Statements: on grade definitions, scholastic dishonesty, student conduct, sexual harrasment, equity, diversity, equal employment, affirmative action, mental health and stress management services, and academic freedom and responsibility are available via links in part B of the document:

`http://policy.umn.edu/Policies/Education/Education/SYLLABUSREQUIREMENTS.html`