MATH 611
Algebraic Topology I

Fall 2020

Course description: "One of the main ideas of algebraic topology is to consider two spaces to be equivalent if they have 'the same shape' ..." –Allan Hatcher. This course will develop some of the basic tools of algebraic topology.

Text: **Algebraic Topology** by Allan Hatcher.

Some further references that you may find useful: Algebraic Topology: A first course by M.J. Greenberg and J.R. Harper

"Topology" by Munkres for fundamental group and covering spaces; "Elements of Algebraic Topology" by Munkres for homology A Basic Course in Algebraic Topology, by Massey

Elementary Topology, by O. Ya. Viro (Author), O. A. Ivanov (Author), N. Yu. Netsvetaev (Author), and V. M. Kharlamov (Author)

I will post the course notes from lectures on the webpage.

Webpage: Via Sakai

Time: Tuesday and Thursday 12:00-1:15pm via zoom. The zoom links are given in Sakai.

Instructor contact information and office hours: Kirsten Graham Wickelgren,

e-mail: kirsten.wickelgren@duke.edu,

office hours: Mondays at noon, Thursdays at 1:15pm, and by appointment. Office hours will need to be rescheduled some weeks. Zoom link available in

Sakai syllabus.

Prerequisites: Ability to work with topological spaces and continuous maps. Familiarity with basic topological notions including connectedness, path-connectedness, and the subspace, quotient and product topologies. Working knowledge of algebraic notions including group, ring, homomorphism, and isomorphism. (Duke Math 411 and 501 cover these prerequisites and more.)

Topics:

1. Homotopy and homotopy type, cell complexes, homotopy extension property
2. The fundamental group: homotopy of paths, homotopy-lifting property for paths through covering spaces, functoriality, Van Kampen's theorem, covering spaces, classification of covering spaces with the fundamental group, Deck transformations and group actions, K(G,1)s.
3. Singular homology, cellular homology, Mayer-Vietoris Sequences, Homology with coefficients, relation with the fundamental group, relative homology, the long exact sequence of relative homology, applications to computing the homology of surfaces, projective spaces, Axioms for homology, Euler characteristic.

Assignments: Assignments will be administered via Gradescope. There will be be weekly problem sets, a take-home midterm and a take-home final exam. The midterm will be September 23-September 29. The final will be Tuesday Nov 10-Monday Nov 16. You are encouraged to work together on the homework. You are also free to consult any references you wish to complete the homework with the exception that you should not look at solution manuals. Any sources you use or collaborators you consult should be credited in writing on your work.

Grading: Grades will be computed by weighting the homework 60%, the midterm 15%, and the final 25%.

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