

**Math 697: Symplectic and Combinatorial Methods  
in Low-Dimensional Topology  
Winter 2021**

**Time.** Mondays, Wednesdays, and Fridays at 2-2:50pm

**Location.** Class meets virtually on Zoom. The Zoom link will be distributed by email.

**Instructor.** Linh Truong (tlinh@umich.edu)

**Office hours.** Fridays after class, and by appointment, on Zoom (same as class Zoom link)

**Course website.** <http://www-personal.umich.edu/~tlinh/winter21/topics697.html>

*Course Description.* The heart of low-dimensional topology is the study of three-manifolds and four-manifolds. Constructions of three-manifolds include taking the complement of a knot, performing Dehn surgery along a knot, or forming a covering space branched along a knot, while four-manifolds can be described by Kirby diagrams involving knots. Thus knot theory is intimately connected to three-dimensional and four-dimensional topology. This course will present modern invariants of low-dimensional manifolds and knots that arise from symplectic geometry or combinatorial methods.

Since its introduction in the late 1980s, Floer homology has become one of the most important tools in symplectic and low-dimensional topology. This course will introduce a version of Floer homology called Heegaard Floer homology, an invariant for knots, three-manifolds, and four-manifolds. The course will begin with background on Morse theory, symplectic geometry, and Heegaard diagrams. We will then define Heegaard Floer homology and compute examples. As applications we may discuss minimal genus problems, detecting exotic smooth structures on four-manifolds and finding topological properties of knots. Topics will be chosen according to class interests.

*Prerequisites.* This course will assume a basic understanding of smooth manifolds (smooth maps, derivatives, differential forms) and algebraic topology (homology, cohomology).

**Textbook.** There is no textbook for this class. References will be available on the website.

**Grading Policy.** Based on class participation (25%) and the final project (75%).

**Final Project.** The final project is a choice of a paper or 40-minute in-class presentation. The final paper is an exposition on a topic related to the course and should:

- be 2 to 10 pages in length;
- be written in latex and submitted as a pdf;
- be emailed to me by Friday, April 30 at 1:30pm.

Suggested topics will be made available during the semester. For either the paper or presentation, the proposed topic should be emailed to me for approval by March 31.

**Environment.** Let's strive to contribute to a positive learning environment for everyone.