Course ICON site: To access the course site, log into Iowa Courses Online (ICON) https://icon.uiowa.edu/index.shtml using your Hawk ID and password.

Course Home: The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the policies and procedures for its courses. Graduate students, however, must adhere to the academic deadlines set by the Graduate College.

Instructor: Robert DeYeso III  
Office location: 1N in MLH  
Student drop-in hours: Monday 2-3pm; Wednesday, Friday 3-4pm  
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Prerequisites: (MATH:5400 and MATH:5410)

Course Description and Objectives: This will be a single-semester course devoted to the study of prominent 3-manifold and knot homology theories. We will initially explore Heegaard Floer homology, which is a family of modules associated to 3-manifolds due to Ozsváth and Szabó obtained by applying borrowed techniques from symplectic geometry to Heegaard diagrams. These authors, and independently Rasmussen, then determined a way to generate analogous modules for knots, resulting in Knot Floer homology. These two constructions alone have led to significant advancements in low-dimensional topology, and specific attention will be paid toward their connection in the context of Dehn surgery and related open problems.

The main goal of this course is to equip students with the intuition and techniques needed for active research in these fields. However, computations with basic definitions tend to be difficult to tame. As such, we will study associated relative invariants to these homology theories which are incredibly useful for easing computational complexity. In keeping with the classic cut-and-paste mantra of topology, we will split our 3-manifolds along an essential surface and consider relative invariants on these pieces in order to reconstruct the hat-flavor of Heegaard Floer homology of the glued manifold. This is possible due to the bordered invariants and associated pairing theorem of Lipshitz, Ozsváth, and Thurston (LOT).

We will eventually study a geometric reinterpretation of these bordered invariants for manifolds with torus boundary due to Hanselman, Rasmussen, and Watson. Their program consists of encoding data from the LOT bordered invariant as a collection of (possibly decorated) immersed curves in the boundary of the manifold. The LOT pairing theorem is also suitably adapted to this setting and provides a vastly simpler way to determine the (hat-flavor) of Heegaard Floer homology of a 3-manifold. Contemporary research using the HRW framework has already led to significant advancement in open problems concerning Dehn surgery, and we will follow these developments to build familiarity with the techniques. Toward the end of the semester, we will cover a similar suite of relative constructions for 4-ended tangles in the 3-ball due to Kotelskiy, Watson, and Zibrowius. The associated pairing theorems for such invariants recover reduced and unreduced Khovanov homology for links formed by gluing two such tangles together.

Textbook and/or Materials: We will refer to a variety of textbooks, surveys, and papers concerning the homology theories of interest written in recent years. Primary resources for the various theories include:

- Heegaard Floer homology – An Introduction to Heegaard Floer Homology by Ozsváth and Szabó
- Knot Floer homology – An Introduction to Knot Floer Homology by Manolescu
- Bordered Heegaard Floer homology – Bordered Heegaard Floer Homology by Lipshitz, Ozsváth, and Thurston
Grading System: S/U grading will be used. Progress will be determined by
20% ~Monthly Worksheets
80% Final Presentation (~25 minutes)

Midterm and Final Exams:
We will not have exams in this course.

Monthly Worksheets:
Containing a few problems selected and designed to reinforce core aspects of material, ~monthly worksheets will be due on the first Monday of the month. Students are heavily encouraged to work with one another to devise and write their solutions to the selected problems. However, the names of all collaborators must be included on the (joint) submission to ensure credit.

Final Presentation:
Students will select a topic related to course material/techniques to study, and craft a ~25 minute talk to present during the final weeks of the semester. Students will submit an (organized) copy of their talk notes no later than three days before the date of their talk. Students are encouraged to work toward this component early, and come to the instructor for guidance/explanation on material often. The talk schedule will be maintained via the course ICON page.

Academic Honesty and Misconduct:
All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. Graduate academic misconduct must be reported to the Graduate College according to Section F of the Graduate College Manual.

Student Complaints:
Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the Director or Chair of the school, department, or program offering the course.

Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Associate Dean for Graduate Education and Outreach and Engagement when additional support is needed.

Drop Deadline for this Course:
You may drop an individual course before the deadline; after this deadline you will need collegiate approval. You can look up the drop deadline for this course here. When you drop a course, a “W” will appear on your transcript. The mark of “W” is a neutral mark that does not affect your GPA. Directions for adding or dropping a course and other registration changes can be found on the Registrar’s website. Undergraduate students can find policies on dropping CLAS courses here. Graduate students should adhere to the academic deadlines and policies set by the Graduate College.

Attendance and Absences:
CLAS recommends that departments regularly discuss and agree upon, when appropriate, reasonable attendance guidelines for courses depending on the level, scope, and role of course in departmental curriculum. CLAS also encourages instructors to consider flexible absence policies. You can find CLAS guidance on absences here.
**Communication - UI Email:**
Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community. For the privacy and the protection of student records, UI faculty and staff can only correspond with UI email addresses.

**Mental Health Resources and Student Support:**
Students are encouraged to be mindful of their mental health and seek help as a preventive measure or if feeling overwhelmed and/or struggling to meet course expectations. Students are encouraged to talk to their instructor for assistance with specific class-related concerns. For additional support and counseling, students are encouraged to contact University Counseling Service (UCS). Information about UCS, including resources and how to schedule an appointment, can be found at counseling.uiowa.edu. Find out more about UI mental health services at mentalhealth.uiowa.edu.

**Student Care and Assistance** provides assistance to University of Iowa students who are experiencing a variety of crisis and emergency situations, including but not limited to medical issues, family emergencies, unexpected challenges, and sourcing basic needs such as food and shelter. More information on the resources related to basic needs can be found at basicneeds.uiowa.edu/resources/. Students are encouraged to contact Student Care & Assistance in the Office of the Dean of Students (Room 135 IMU, dos-assistance@uiowa.edu, or 319-335-1162) for support and assistance with resources.

**University Policies**
**Accommodations for Students with Disabilities**
The University is committed to providing an educational experience that is accessible to all. If a student has a diagnosed disability or other disabling condition that may impact the student’s ability to complete the course requirements as stated in the syllabus, the student may seek accommodations through Student Disability Services (SDS). SDS is responsible for making Letters of Accommodation (LOA) available. The student must provide an LOA to the instructor as early in the semester as possible, but requests not made at least two weeks prior to the scheduled activity for which an accommodation is sought may not be accommodated. The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide. Additional information can be found on the SDS website.

**Classroom Expectations**
**Free Speech and Expression**
**Non-discrimination**
**Absences for Religious Holy Days**
**Sexual Harassment/Misconduct and Supportive Measures**
**Sharing of Class Recordings** (if appropriate)