

## MATH 274: TOPICS IN ALGEBRA

INSTRUCTOR: TONY FENG

**Class venue:** MWF 12:10pm-1pm in Dwinelle 219. Attendance is mandatory for enrolled students. Lectures will be recorded; *please do not come to class if you feel sick.*

**Office Hours:** Wednesdays 4-5pm and Fridays 5-6pm in my office (Evans-859). *If you feel sick, please do not come to in-person office hours; we can arrange a Zoom office hours by appointment.*

**E-mail:** fengt@berkeley.edu. Please begin the subject line with “[Math 274]”. I aim to respond within one business day.

**Course website:** bCourses and the instructor’s homepage.

**Course description.** This is an advanced topics course aimed at Ph.D. students. Here is the description that I submitted to the registrar:

This course will survey a variety of recent research topics in arithmetic geometry, with an aim to expose open problems which may be reasonable entry points to a Ph.D. thesis. Topics will include: special cycles and arithmetic theta functions, the Langlands correspondence and its geometrizations, the Breuil–Mézard Conjecture, the Artin–Tate Conjecture, and more as time permits.

For the most part, the lectures will be delivered at a superficial level, comparable to research seminar talks. To facilitate engagement with the material, **several assignments will be required** – see the section on “Grading”. According to the registrar’s standard requirements, students should expect to spend 9 hours/week on this class outside of lecture.

**References.** The class will not follow any textbook or paper, but references for each lecture are indicated in the Schedule document.

**Remote lectures.** If class cannot be held in-person for whatever reason, lectures will be given remotely over Zoom at <https://berkeley.zoom.us/j/8047543587>. The same applies to office hours. I will provide as much advance notice as possible if this becomes necessary.

**Pre-requisites.** The lectures will assume familiarity with advanced graduate-level background in arithmetic geometry such as perverse sheaves, six-functor formalisms, algebraic stacks,  $p$ -adic groups, homotopy theory, reductive groups and their representation theory. These can be black-boxed to some extent, so students

need not be familiar with all this material going in to the course, but they will have to work to fill in holes.

**Grading.** Final grades are based on the following division:

- 25% from participation. This certainly includes attending lectures regularly, but in addition to being physically present requires also engaging with the material by asking questions and actively participating in the discussions.
- 25% from scribe notes. Enrolled students will sign up to scribe one week's lecture notes (typed in LaTeX), working in teams of 2-3 people.
- 50% from research report. Working in teams of 1-3 people, students will choose a research problem and write a 10-15 page research report following up on some topic from the lectures. This research report does not need to lead to a publishable paper (it is fine to report things like "we tried such-and-such but realized it could not work because ...") but should demonstrate a solid initiative going beyond existing literature.

The research report will be due by the end of Reading Week. Students will also be required to give a presentation on their results in the last two weeks of class, which will constitute part of their grade.

**Policies.**

- Students are expected to adhere to Berkeley's academic integrity policy. Examples of cheating include copying off of your classmates, or other resources (possibly online).
- Eating or using cell phones in class will not be tolerated. Laptops, iPads, etc. may be used *for note-taking purposes only*. If you come to class, please do so on time and stay for the whole period.
- AI: you may use tools such as ChatGPT to help your learning. However, be warned that such tools are currently quite unreliable. Furthermore, *copy-pasting from such tools will be considered plagiarism*.

**Schedule.** Please see "schedule.pdf" for a detailed schedule of topics that will be covered in class. Important dates are highlighted here.

- Feb 17: holiday
- April 2: no class
- April 25: Research report topic, presentation title and abstract due.
- April 28: student presentations begin
- May 9: Research reports due.

**If a personal or medical issue is interfering with your studies:**

- Contact your medical provider if you need medical attention.
- Please do not come to class if you are sick. Instead, read the lecture notes or textbook for the sections you missed.
- Email me.

**If you need disability accommodations:** If you need disability-related accommodations in this class, if you have emergency medical information you wish to share with me, or if you need special arrangements in case the building must be

evacuated, please inform me as soon as possible. Also, please make an appointment with the DSP office to discuss the appropriate procedures. More information is available on their website: <http://dsp.berkeley.edu>.