SYLLABUS – MATH 7800

SINGULARITIES IN ALGEBRAIC GEOMETRY AND COMMUTATIVE ALGEBRA

Description: We will learn about singularities in commutative algebra and algebraic geometry. Particularly we will focus on singularities defined by Frobenius and connections with the singularities of the minimal model program. Topics will include Kunz's theorem, Frobenius splittings, F-regularity, test ideals and connections with log terminal, log canonical, and rational singularities, as well as multiplier ideals. Some focus on

- **Time:** Monday, Wednesday 3:00-4:20pm
- **Location:** FASB 250
- **Instructor:** Karl Schwede
- **Contact information:**
  - email: schwede@math.utah.edu
  - office: JWB 315
  - website: `http://www.math.utah.edu/~schwede/math7800`
- **Office hours:** TBD
- **Textbooks:**

  We will largely follow this book draft.
  `https://raw.githubusercontent.com/kschwede/FrobeniusSingularitiesBook/main/FrobeniusSingularitiesBook.pdf`
  However, we will also supplement with some survey articles.

- **Background texts** Introductory commutative algebra, regular rings etc, can be found here.
  - *Introduction to Commutative Algebra* by Atiyah and MacDonald.
  - *Commutative Ring Theory* by Matsumura.

  Some supplementary homological algebra can be found in
  - *An introduction the homological algebra* by Weibel.

  Some supplementary algebraic geometry can be found in
  - *Algebraic Geometry* by Hartshorne.

Or see the stacks project for everything.

Grade: Your grade will be determined by the following formula.

100% Homework and computer/ai assignments (due about once every two weeks – not every problem will be graded).

Students are allowed, and even encouraged to work together when solving homework problems (although each student is responsible for their own write-up). LaTeX use is encouraged. We will be using gradescope to submit homework.

Prerequisites: Students should know thSe material described on the 6310 syllabus. They should also know the much of the material in 6350 or equivalent (ie, regular rings, normal rings, going up). Some basic algebraic geometry (sheaves and schemes) and slightly more advanced commutative and homological algebra (Cohen-Macaulay and Gorenstein rings) will also be needed periodically. We will define things like dualizing complexes and Kawamata log terminal singularities when we get to them.

Academic Integrity: All University of Utah policies regarding ethics and honorable behavior apply to this course.

University policies

Updated mandatory syllabus policies regarding the ADA Act, Safety at the U, Addressing Sexual Misconduct, and Academic Misconduct can be viewed at:

`https://cte.utah.edu/instructor-education/syllabus/institutional-policies.php`