

# Math 203 - Algebraic Geometry

**Instructor:** Dragos Oprea, [doprea@math.you-know-where.edu](mailto:doprea@math.you-know-where.edu).

**Textbook:** None. I will occasionally use Andreas Gathmann's notes available online, as well as Shafarevich, Hartshorne and Mumford's Red Book.

**Lectures:** WF (3:00-4:20PM), 7-321.

**Webpage:** <http://math.ucsd.edu/~doprea/203f19.html>.

**Goals:** This course provides an introduction to algebraic geometry. Algebraic geometry is a central subject in modern mathematics, and an active area of research. It has connections with number theory, differential geometry, symplectic geometry, mathematical physics, string theory, representation theory, combinatorics and others.

Math 203 is a three quarter sequence. Math 203A will be about varieties, roughly corresponding to Chapter 1 of Hartshorne. Math 203a will serve as preparation for scheme theory.

**Syllabus.** In Math 203A, we will tentatively cover the following topics:

- Affine space and affine varieties. The correspondence between ideals and affine sets. Zarisky topology. Irreducibility. Dimension.
- Functions on affine varieties. Coordinate rings. Sheaves. Morphisms. Isomorphisms. Rational maps.
- Prevarieties. Gluing. Projective space. Projective varieties. Examples.
- Homogeneous coordinate rings. Morphisms. Examples including Segre embeddings, Veronese embeddings. Rational varieties.
- Dimension theory. Smoothness. Blowups. The 27 lines on a smooth cubic surface.
- Hilbert functions. Degree. Intersections in projective space, Bezout's theorem.

**Prerequisites:** Algebraic geometry requires some mathematical maturity and background. Since it is hard to determine the precise background needed for this course, I will be happy to discuss prerequisites on an individual basis. If you are unsure, please don't hesitate to contact me.

In any case, some knowledge of modern algebra at the level of Math 200 is required. Familiarity with complex analysis, point set topology, differentiable manifolds is also helpful. I will try to make the course reasonably self-contained, but at times I draw on other fields to build intuition.

**Problem Sets:** The final grades are based entirely on lecture attendance and weekly homework. Homework is mandatory and is a very important part of the course. The problem sets will be posted online.