MATH 581: Introduction to Algebraic Geometry  
Spring 2014

Class Hours:  To be determined; semiweekly meetings.  
Prerequisite:  MATH 455, (recommended) MATH 442, 454, 471

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Professor Ivan Avramidi</th>
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<td>Office Hours</td>
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Course Goal and Objectives: The traditional focus of algebraic geometry is the study of varieties, which are classically defined as the set of points that simultaneously satisfy a collection of polynomials. Modern usage of the variety has been generalized in numerous ways; this series of lectures will include such elementary topics and some applications, and draw connections between algebraic and differential geometry. In the first section of the course, we shall cover a selection of introductory subjects – elliptic curves, the Zariski topology, Noetherian rings, Hilbert’s Nullstellensatz, projective varieties, morphisms, tangent spaces, etc – and a brief discussion of category theory.

In the latter portion of the semester we will move into more modern topics, namely sheaves, schemes, and the introduction of cohomology. Time permitting, we shall investigate advanced topics such as Stoke’s theorem, de Rham cohomology, Chern classes, and applications in cryptography.

Textbook (recommended):
  
  • M. Reid, *Undergraduate Algebraic Geometry*, Cambridge University Press 1988

Supplementary Material:
  
  • A. Gathmann, *Algebraic Geometry*, University of Kaiserslautern 2002
  • R. Hartshorne, *Algebraic Geometry*, Springer 1977
  • J. Milne, *Algebraic Geometry*, University of Michigan 2008

Class Procedures: The majority of each class period will be lecture oriented.

Attendance Requirements: Regular attendance is expected.

Grading Scheme: Ungraded weekly exercises will be discussed; grades will be based on participation.

Changes: The course plan may be modified during the semester. Such modifications will be announced during class periods. You are responsible for keeping abreast of such changes.
Tentative Schedule:

1. **Preliminaries (1 lecture)**
   - General
   - Linear algebra
   - Abstract algebra
   - Topology

2. **Varieties (7 lectures)**
   - Algebraic sets
   - Noetherian rings
   - Zariski topology
   - Affine varieties
   - Hilbert’s Nullstellensatz
   - Projective varieties

3. **Functions on Varieties (7 lectures)**
   - Introduction to categories
   - Regular functions
   - Sheaves and morphisms
   - Abstract varieties
   - Birational equivalence

4. **Tangent Spaces (6 lectures)**
   - Dimension
   - Tangent spaces
   - Nonsingular varieties
   - Cotangent spaces
   - Blowups and resolution

5. **Introduction to Schemes (6 lectures)**
   - Pre-schemes
   - Affine schemes
   - Morphisms between affine varieties
   - Locally ringed spaces
   - Projective schemes

6. **Additional Topics (3 lectures)**
   - Bézout’s theorem
   - Elliptic curve cryptography