MATH 552 ALGEBRAIC GEOMETRY I

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Welcome to Math 552! This course serves as an introduction to Algebraic Geometry. Algebraic Geometry is a central subject in modern mathematics, with close connections with number theory, combinatorics, representation theory, differential and symplectic geometry. We will study basic properties of projective algebraic varieties such as dimension, degree and singularities. At the same time, we will develop a large body of examples that motivate the study of the subject. Depending on time, we will develop the classical theory of curves and surfaces. This course should be enough preparation for a course on the theory of schemes.

Course webpage: http://www.math.uic.edu/~coskun/math552.html

Venue: Addams Hall 303

Office hours: M 11-12, W 9-10, 11-12 and by appointment in SEO 423.

Text: There are three recommended texts for this course.

- (FC) Joe Harris, Algebraic Geometry: a first course, Springer 1992.
- (BAG) Igor Shafarevich, Basic Algebraic Geometry I, Varieties in Projective Space, Springer-Verlag 1994.
- David Mumford, Algebraic Geometry I, Complex Projective Varieties, Springer 1995.

Prerequisites: A solid background in commutative algebra, especially in the theory of rings and modules at the level of a first year graduate class. I highly recommend that you attend Prof. Popa's course MATH 531 Advanced Topics in Algebra, concurrently. Some familiarity with complex analysis, algebraic topology and differential geometry useful, but not required.

Requirements: There will be weekly homework. Homework is a very important component of this course. It will count for 100 % of your grade. No late homework will be accepted. You may collaborate on the homework problems, but you must write your own solutions and properly acknowledge any help you receive from others.

Topics: The following is a tentative list of topics that will be covered in the course. Please read the subject in the recommended texts before class.

Aug 25	Affine varieties	BAG p. 22-32
Aug 27	Examples: Plane curves	BAG p.1-21
Aug 29	Rational Functions	BAG p. 32-40
Sep 1	No class: Labor Day	
Sep 3	Projective varieties	BAG p. 41-53
Sep 5	Examples	FC p. 1-16
Sep 8	Products	BAG p. 54-60
Sep 10	Maps of projective varieties	FC p. 17-31
Sep 12	Examples; Finite maps	BAG p. 61-66
Sep 15	Dimension	BAG p. 67-76
Sep 17	Dimension	FC p. 133-150
Sep 19	Dimension of Fibers	BAG p. 76-82
Sep 22	Examples: Grassmannians	FC p. 63-71
Sep 24	Applications	FC p. 151-162
Sep 26	Hilbert Polynomials	FC p. 163-173
Sep 29	Degree of projective varieties	FC p. 88-97
Oct 1	Degree	FC p. 224-238
Oct 3	Examples	FC p. 239-250
Oct 6	Tangent spaces	BAG p. 83-97
Oct 8	Examples	FC p. 174-185
Oct 10	Gauss maps, dual varieties	FC p. 186-199
Oct 13	Power series rings	BAG p. 98-113
Oct 15	Blow-ups	BAG p. 114-124
Oct 17	Blow-ups	FC p. 72-87
Oct 20	Normal varieties	BAG p. 125-131
Oct 22	Curve singularities	BAG p. 131-138
Oct 24	Divisors	BAG p. 151-159
Oct 27	Divisors	BAG p. 159-166
Oct 29	Divisors on curves	BAG p. 168-174
Oct 31	Rational curves	
Nov 3	Elliptic curves	BAG p. 175-187
Nov 5	The group law on elliptic curves	
Nov 7	Abelian varieties	BAG p. 188-194
Nov 10	Differential forms	BAG p. 195-204
Nov 12	Differential forms	BAG p. 204-210
Nov 14	The canonical class	BAG p. 210-215
Nov 17	The Riemann-Roch Theorem for curves	BAG p. 215-222
Nov 19	Applications	
Nov 21	Intersection numbers	BAG p. 223-232
Nov 24	Intersection numbers	BAG p. 232-236
Nov 26	Bezout's theorem	BAG p. 236-241
Nov 28	No class: Thanksgiving	
Dec 1	Surfaces	BAG p. 241-245
Dec 3	Birational maps between surfaces	BAG p. 251-261
Dec 5	Cubic surfaces	BAG p. 246-251