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/nmath552.html

Venue: Addams Hall 302

Office hours: M 11:30-12:30 and W 9:30-11:30 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. 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 24	Affine varieties	BAG p. 22-32
Aug 26	Examples: Plane curves	BAG p.1-21
Aug 28	Examples	
Aug 31	Rational Functions	BAG p. 32-40
Sep 2	Examples	
Sep 4	Projective varieties	BAG p. 41-53
Sep 7	No class: Labor Day Products	BAG p. 54-60
Sep 9	Examples	FC p. 1-16
Sep 11	Maps of projective varieties	FC p. 17-31
Sep 14	Examples; Finite maps	BAG p. 61-66
Sep 16	Dimension	BAG p. 67-76
Sep 18	Dimension	FC p. 133-150
Sep 21	Dimension of Fibers	BAG p. 76-82
Sep 22	Examples: Grassmannians	FC p. 63-71
Sep 25	Applications	FC p. 151-162
Sep 28	Hilbert Polynomials	FC p. 163-173
Sep 30	Degree of projective varieties	FC p. 88-97
Oct 2	Degree	FC p. 224-238
Oct 5	Examples	FC p. 239-250
Oct 7	Tangent spaces	BAG p. 83-97
Oct 9	Examples	FC p. 174-185
Oct 12	Gauss maps, dual varieties	FC p. 186-199
Oct 14	Power series rings	BAG p. 98-113
Oct 17	Blow-ups	BAG p. 114-124
Oct 19	Blow-ups	FC p. 72-87
Oct 21	Normal varieties	BAG p. 125-131
Oct 23	Curve singularities	BAG p. 131-138
Oct 26	Divisors	BAG p. 151-159
Oct 28	Divisors	BAG p. 159-166
Oct 30	Divisors on curves	BAG p. 168-174
Nov 2	Divisors on curves	BAG p. 168-174
Nov 4	Rational curves	
Nov 6	Elliptic curves	BAG p. 175-187
Nov 9	The group law on elliptic curves	
Nov 11	Abelian varieties	BAG p. 188-194
Nov 13	Differential forms	BAG p. 195-204
Nov 16	Differential forms	BAG p. 204-210
Nov 18	The canonical class	BAG p. 210-215
Nov 20	The Riemann-Roch Theorem for curves	BAG p. 215-222
Nov 23	Applications	
Nov 25	Applications	
Nov 27	No class: Thanksgiving	
Nov 30	Intersection numbers	BAG p. 223-232
Dec 2	Intersection numbers	BAG p. 232-236
Dec 4	Bezout's theorem	BAG p. 236-241