

## MATH 552 ALGEBRAIC GEOMETRY I

Izzet Coskun, MWF 12:00-12:50 p.m.

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**Course description, Goals and Learning Objectives:** 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.

**Webpage:** <http://www.math.uic.edu/coskun/math552.html>

**Venue and time:** Burnam Hall BH 316, MWF 12-12:50

**Drop-in hours:** MF 11-12

**Credit Hours:** 4

**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.

**Attendance Policy:** Registered students are expected to attend and participate in all of the lectures and should notify me before any planned absence.

**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 BAG p. 175-187
- 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 No class: Thanksgiving
- Nov 28 No class: Thanksgiving
- Dec 1 Bezout's theorem BAG p. 236-241
- Dec 3 Surfaces BAG p. 241-245
- Dec 5 Cubic surfaces BAG p. 246-251

**Grievance Procedures:**

UIC is committed to the most fundamental principles of academic freedom, equality of opportunity, and human dignity involving students and employees. Freedom from discrimination is a foundation for all decision making at UIC. Students are encouraged to study the University's "Nondiscrimination Statement". Students are also urged to read the document "Public Formal Grievance Procedures". Information on these policies and procedures is available on the University web pages of the Office of Access and Equity: <http://oae.uic.edu/>.

**Student Evaluation of Teaching Program (Course Evaluations):**

Student evaluations of teaching play a fundamental role in improving course content, format, and delivery (teaching) at UIC. Students are invited to share feedback on the course with the instructor throughout the semester, and should complete to the online course evaluation form emailed to them at the end of the semester before 12am on the first day of finals.

**Academic Integrity Policy:**

For written assignments in the course, students are encouraged to work together. However, the final write-up must be done individually. As an academic community, UIC is committed to providing an environment in which research, learning, and scholarship can flourish and in which all endeavors are guided by academic and professional integrity. All members of the campus community—students, staff, faculty, and administrators—share the responsibility of insuring that these standards are upheld so that such an environment exists. Instances of academic misconduct by students will be handled pursuant to the Student Disciplinary Policy: <http://dos.uic.edu/docs/Student%20Disciplinary%20Policy.pdf>

**Religious Holidays:**

Students who wish to observe their religious holidays shall notify the faculty member by the tenth day of the semester of the date when they will be absent unless the religious holiday is observed on or before the tenth day of the semester. In such cases, the student shall notify the faculty member at least five days in advance of the date when he/she will be absent. The faculty member shall make every reasonable effort to honor the request, not penalize the student for missing the class, and if an examination or project is due during the absence, give the student an exam or assignment equivalent to the one completed by those students in attendance. If the student feels aggrieved, he/she may request remedy through the campus grievance procedure. <http://oae.uic.edu/docs/ReligiousHolidaysFY20152017.pdf>

**Disability Accommodation:**

UIC is committed to full inclusion and participation of people with disabilities in all aspects of university life. Students who face or anticipate disability-related barriers while at UIC should connect with the Disability Resource Center (DRC) at [drc.uic.edu](http://drc.uic.edu), or at (312) 413-2183 to create a plan for reasonable accommodations. In order to receive accommodations, students must disclose disability to the DRC, complete an interactive registration process with the DRC, and provide their course instructor with a Letter of Accommodation (LOA). Course instructors in receipt of an LOA will work with the student and the DRC to implement approved accommodations.

**Classroom Conduct Policy:** Towards the goal of making learning as impactful as possible this semester, we will strive to abide by two overarching principles in this class:

- (1) engage in clear and frequent two-way communication regarding my expectations of you, the class workflow, and unexpected challenges arising that may impede your participation in required class sessions, including exams, or timely completion of assignments;
- (2) build an inclusive learning community in which we all abide by the same ground rules and ethical code of conduct.

I look forward to connecting with you this fall. I will do my best to support your learning experience by listening to your needs and by conducting this course with compassion, empathy, and patience.

**Learning Environment:** UIC values diversity and inclusion. Regardless of age, disability, ethnicity, race, gender, gender identity, sexual orientation, socioeconomic status, geographic background, religion,

political ideology, language, or culture, we expect all members of this class to contribute to a respectful, welcoming, and inclusive environment for every other member of our class. If there are aspects of the instruction or design of this course that result in barriers to your inclusion, engagement, accurate assessment or achievement, please notify me as soon as possible.

**Community Agreement:**

- Be present (turn off cell phones and remove yourself from other distractions)
- Be respectful
- Assume good will
- Challenge with care – approach discussion as a “think out loud”
- Be flexible when things don’t work
- Share helpful tips
- Use preferred names and gender pronouns
- No side conversations
- Be willing to work together
- Be mindful of one another’s privacy –do not invite outsiders into our classroom
- Commit to upholding a class honor code in which we trust one another and engage only in behaviors that reflect our community standards of academic integrity