

Immerse 2008

Algebra Course

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Required Paper: Mordechai Katzman, *Counting monomials*, J. Algebraic Combin. **22** (2005), no. 3, 331–341. [MR2181370 \(2006i:05008\)](#)

Objectives:

- Write original proofs demonstrating an understanding of the vocabulary and interconnections of the concepts.
- Approach mathematics with creativity, flexibility, and curiosity, often lacking in more computational courses.
- Learn how to read a research mathematical research paper.
- Prepare for graduate school.
- Gain familiarity with the computer algebra system Macaulay 2.

Course Outline:

1. Groups, Fields, Rings and ideals
2. Vector spaces, modules, and algebras
3. Chain conditions and short exact sequences
4. Graded rings, Hilbert functions, and Hilbert series
5. Monomial orderings and Gröbner bases
6. Krull dimension (time permitting)

Additional References:

1. David Cox, John Little, and Donal O'Shea, *Ideals, varieties, and algorithms*, third ed., Undergraduate Texts in Mathematics, Springer, New York, 2007, An introduction to computational algebraic geometry and commutative algebra. [MR2290010 \(2007h:13036\)](#)
2. Gert-Martin Greuel and Gerhard Pfister, *A **singular** introduction to commutative algebra*, extended ed., Springer, Berlin, 2008, With contributions by Olaf Bachmann, Christoph Lossen and Hans Schönemann, With 1 CD-ROM (Windows, Macintosh and UNIX). [MR2363237](#)
3. M. F. Atiyah and I. G. Macdonald, *Introduction to commutative algebra*, Addison-Wesley Publishing Co., Reading, Mass.-London-Don Mills, Ont., 1969. [MR0242802 \(39 #4129\)](#)
4. David S. Dummit and Richard M. Foote, *Abstract algebra*, third ed., John Wiley & Sons Inc., Hoboken, NJ, 2004. [MR2286236 \(2007h:00003\)](#)
5. Thomas W. Hungerford, *Algebra*, Holt, Rinehart and Winston, Inc., New York, 1974. [MR0354211 \(50 #6693\)](#)
6. Martin Kreuzer and Lorenzo Robbiano, *Computational commutative algebra. 1*, Springer-Verlag, Berlin, 2000. [MR1790326 \(2001j:13027\)](#)
7. Martin Kreuzer and Lorenzo Robbiano, *Computational commutative algebra. 2*, Springer-Verlag, Berlin, 2005. [MR2159476 \(2006h:13036\)](#)

Students will receive a copy of the first book, and the others that are available will be on reserve in the library.