

This course is primarily for minor and medial Mathematics students and non-Mathematics Honours students. It examines some basic ideas and techniques of algebra that are useful in applied mathematics, computer science, statistics and other areas.

**Textbook:** *Algebraic Methods* (MATH 211 Notes)  
by Kani, Pullman and Rice

**Prerequisite:** A course in calculus and one of MATH-110 or 111.

**Instructor:** E. Kani

<b>Evaluation:</b>	Assignments	15.0%
	October Midterm Test	7.5%
	Christmas Examination	30.0%
	February Midterm Test	7.5%
	Final examination	40.0%
		<hr/> 100.0%

**Outline:**

1. *Integers:* Divisibility, Division and Euclidean Algorithms; Unique Factorization, Linear Diophantine Equations, Prime Numbers.
2. *Modular Arithmetic:* The Calculus of Remainders, Congruence Equations, Chinese Remainder Theorem, Fermat's Theorem, Public Key Cryptography.
3. *Polynomials over  $\mathbb{Q}$ ,  $\mathbb{R}$ ,  $\mathbb{C}$ ,  $\mathbb{F}_p$ :* Review of Complex Numbers, Divisibility, Division and Euclidean Algorithms; Factor Theorem, Fundamental Theorem of Algebra, Unique Factorization, Factoring Methods.
4. *Interpolation, Approximation and the Geometry of  $\mathbb{R}^n$ :* Lagrange Interpolation Formula, Least Square Method, Distance, Angles, Orthogonality in  $\mathbb{R}$  (dot product), Cauchy, Triangle Inequality, Gram-Schmidt Method, Fourier Approximation.
5. *Matrix Polynomials and Discrete Linear Systems:* Evaluation via Cayley-Hamilton and Spectral Decomposition Methods, Review of Diagonalization, Generalized Remainder Formula, Discrete Linear Systems; Recurrence Relations.
6. *The Jordan Canonical Form:* Generalized Eigenvectors, Procedure for finding JCF, Proof of Cayley-Hamilton Theorem.
7. *Powers of Matrices:* Power Convergence, Power Method of Solving Eigenvalue Problem; Spectral Radius and Geršgorin's Theorem, Geometric Series and Applications.  
*Nonnegative Matrices:* Perron's Theorem, Markov Chains as Examples of Models of Discrete Linear Systems.
8. *Permutation Groups:* Orbits and Cycles, Rigid Motions, Theorems of Lagrange and Burnside - applications to combinatorics, if time allows.

In addition, students were encouraged to use the computer package MAPLE; and specific homework problems were assigned to practice using this package.