Math 211

Algebraic Methods

Syllabus – Fall/Winter 2021/22

Instructor: Dr. Ernst Kani

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Office hours: 1 hour after each class

Course Description: This is an introduction to some basic methods used in algebra in order solve various types of algebraic equations. The topics are as follows:

• **Integers:** Greatest common divisor, Euclidean Algorithm, prime factorization, Linear Diophantine equations (ch. 1). Modular arithmetic, Chinese Remainder Theorem, Fermat's Theorem, Public Key Cryptography (ch. 2)

• **Polynomials:** Review of complex numbers. Greatest common divisor, Euclidean Algorithm, unique factorization for polynomials. Roots of polynomials, how to solve polynomial equations (ch. 3)

• **Approximation:** Data fitting: Lagrange interpolation polynomial, Least-Square method, Gram-Schmidt orthogonalization method. The geometry of $\mathbb{R}^n$ (ch. 4)

• **Matrices:** Matrix polynomials, discrete linear systems, difference equations, Markov chains (ch. 5). Diagonalization of matrices, eigenvalues (ch. 5). Applications of the Jordan canonical form (chs. 5–7). Powers of matrices, stochastic matrices, Perron's Theorem (ch. 7)

Prerequisites: A course in Linear Algebra (e.g. Math 110, 111 or 112). Some knowledge of Calculus is also required.

Learning Outcomes: After completing Math 211, the students should be able to:

1. Solve various types of equations: Linear Diophantine equations, linear modular equations, polynomial equations (of small degree), discrete linear system equations, difference equations, etc.

2. Choose the most appropriate method for solving a specific problem from among several different viable techniques.

3. Be able to use the MAPLE software package to compute and solve similar (but more complicated) problems like those discussed in class.

Course Materials: 1) Course Reader: E. Kani, N. Pullman, N. Rice, Algebraic Methods. (Available from the Campus Bookstore.)

2) PC Software: MAPLE - available for free from the Queen's Software Centre website.

Assignments: There will be weekly assignments which are due each Friday (with some exceptions).

Tests: There will be 2 midterm tests, one in October and one in February or March. These will be written during class time.

Exams: There will be a midyear exam in December and a final exam in April. These will be scheduled by the exam office.

Marking scheme:

Weekly homework	15%
October Midterm Test	7.5%
December Midyear Exam	30%
March Midterm Test	7.5%
Final Exam	40%

Course Delivery: Three 50 minute lectures on Tuesdays, Wednesdays and Fridays.

Course Web-page: All the information, assignments and news for the course can be found on the course web site:

mast.queensu.ca/~math211

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Calculator Policy: As noted in Academic Regulation 9.2, Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the Casio 991 series calculator is permitted and is the only approved calculator for Arts and Science students.

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Please also notify me early in the semester so I can schedule for special arrangements.