GRANDE PRAIRIE REGIONAL COLLEGE
MATH 2280 Algebra: Introduction to Ring Theory

MA 2289 Algebra: Introduction to Ring Theory 3(3-0-0)

Integers. Mathematical Induction. Equivalence relations. Commutative rings, including the integers mod n, complex numbers and polynomials. The Chinese remainder theorem. Fields and integral domanins. Euclidean domains, principal ideal domains and unique factorization. Quotient rings and homomorphisms. Construction of finite fields. Applications such as public domains, encryption, Latin squares and designs, polynomial error detecting codes and/or addition and multiplication of large integers.

Prerequisite: MA 1020 or MA 1200

Instructor:

Schedule: Lecture: Seminar:

Textbooks: James D. Lewis; Commutative Rings

References: Hungerford; An Introduction to Abstract Algebra
Lidl and Pitz; Applied Abstract Algebra.

Grading:

Assignments	15%
Midterm Exam	35%
Final Exam	50%

Assignments: There will be an assignment given every second week, six in total. All assignments will be due at noon on a Friday. Late assignments will not be accepted.

Midterm: The Midterm Exam will be given during mid-term week. If the midterm is missed for a valid reason, with accompanying letter, its value will be transferred to the final.

Final: The Final Exam time is set by the Registrar's Office.

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Course Outline and Sequence of Topics

1. Properties of the real numbers.
2. Definition of commutative rings and fields.
3. Examples: includes finite fields, Gaussian integers and complex numbers.
4. Mathematical induction: direct and indirect approaches.
5. Division and factoring: Euclid's algorithm for the integers.
6. Greatest common divisors (**GCD**) and the integers as an example of a principal ideal domain (**PID**).
7. Primes and irreducibles, and the fundamental theorem of arithmetic.
8. Least common multiples (**LCM**).
9. Equivalence relations and examples
10. The ring of integers mod n, $\mathbf{Z_n}$**,** zero-divisors, units, integral domains, the Euler-Phi function, Chinese remainder theorem.
11. Solutions of equations over rings and fields, the characteristic of fields, quadratic extensions.
12. Polynomial rings, factorization and Euclid's algorithm, **Q** roots of polynomials in **Z**[x], fundamental theorem of algebra, polynomial rings over a field as an example of **PID** and **UFD** (unique factorization domain); **A** a **PID – A** a **UFD.**
13. Ring homomorphisms, ideals and quotient rings.

Depending on time, some (but not all) of the following topics will be covered.

1. Topics in ring theory: Noetherian rigns, Gauss's Lemma (--**Z**[x] a **UFD**), primes in the ring of Gaussian integers.
2. Applications: Public domain encryption, Latin squares and designs, polynomial and cyclic error detecting codes, addition and multiplication of large integers.
3. Geometric applications: ruler and compass constructions: Impossibility of trisection of an angle and duplication of cube.