Math 430 – Applied Algebra

Course Description from Bulletin: Relations; modular arithmetic; group theory: symmetry, permutation, cyclic and abelian groups; group structure: subgroups, cosets, homomorphisms, classification theorems; rings and fields. Applications to crystallography, cryptography and check-digit schemes. (3-0-3)

Enrollment: Elective for AM and other majors.

Textbook(s): Gallian, *Contemporary Abstract Algebra, 6th* Edition, Houghton Mifflin.

Other required material: None

Prerequisites: MATH 230 or MATH 332

Objectives:

1. Students will achieve command of the fundamental definitions and concepts of groups, rings and fields.
2. Students will understand and apply the core definitions and theorems, generating examples as needed.
3. Students will achieve proficiency in writing proofs, including those using basic number theory, induction, homomorphisms and isomorphisms.
4. Students will become familiar with the major viewpoints and goals of abstract algebra: classification, symmetry, abstraction, algorithms and structure.
5. Students will practice their knowledge of abstract algebra to problems with exercises and applications, possibly through the use of a computer algebra system or a class project.

Lecture schedule: 3 50 minute (or 2 75 minute) lectures per week

Course Outline:

		Hours
0.	Integers and Equivalence Relations Properties of Integers, Modular Arithmetic, Mathematical Induction, Equivalence Relations, Functions	2
1.	Introduction to Groups Symmetries of a Square, the Dihedral Groups	1.5
2.	Groups Definitions and Examples, Elementary Properties, Applications of Modular Arithmetic	1.5
3.	Finite Groups; Subgroups Subgroup Tests, Examples of Subgroups	3
4.	Cyclic Groups Properties, Classification of Subgroups of Cyclic Groups	3
5.	Permutation Groups Cycle Notation, Properties of Permutations, Check-Digit Schemes	3
6.	Isomorphisms Definitions and Examples, Cayley's Theorem, Automorphisms	2

7. External Direct Products 2
   Examples and Properties, Group of Units Modulo *n*, Applications
8. Cosets and Lagrange's Theorem 2
   Properties, Consequences of Lagrange's Theorem, Application to Permutation Groups, Rotation Group Examples
9. Normal Subgroups and Factor Groups 3
   Examples, Applications, Internal Direct Products
10. Group Homomorphisms 3
    Examples and Properties, First Homomorphism Theorem
11. Fundamental Theorem of Abelian Groups 3
12. Introduction to Rings 2
    Examples and Properties, Subrings
13. Integral Domains 2
    Examples, Fields, Characteristic of a Ring
14. Ideals and Factor Rings 2
15. Ring Homomorphisms 2
    Examples and Properties, the Field of Quotients
16. Polynomial Rings 2
17. Factorization of Polynomials 2
    Reducibility Tests, Irreducibility Tests, Unique Factorization
18. Divisibility in Integral Domains 1
    Irreducibles, Primes, Fermat's Last Theorem, Unique Factorization, Euclidean Domains

Note: Some topics may be covered in less depth depending on time constraints. In some semesters, Sections 16-18 might be omitted in favor of covering material in Sections 1-15 in more depth.

Assessment:	Homework	10-30%
	Quizzes/Tests	20-50%
	Final Exam	30-50%

Syllabus prepared by: Robert Ellis and Michael Pelsmajer
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