Math 430 – Applied Algebra

Course Description (Bulletin): Introduction to groups, homomorphisms, group actions, rings, field theory. Applications, including constructions with ruler and compass, solvability by radicals, error correcting codes. (3-0-3) (C)

Enrollment: Elective for AM and other majors.

Textbook(s): Derek J. S. Robinson, An introduction to abstract algebra.
ISBN-13: 978-3110175448 ISBN-10: 3110175444.

Other required material: None

Prerequisites: MATH 230
Concurrent prerequisite: 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, and asking the next natural question.
3. Students will achieve proficiency in constructing proofs, including those using basic number theory, induction, homomorphisms and isomorphisms; and those concerning set containment, bijections, existence, and uniqueness.
4. Students will achieve proficiency in written and oral communication of proofs and concepts of abstract algebra, producing well exposited proofs.
5. Students will become familiar with the major viewpoints and goals of abstract algebra: classification, symmetry, abstraction, algorithms and structure.
6. 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:

Topic	Hours
Equivalence relations	1
The integers: Well-ordering principle, congruences	3
Introduction to groups: Permutations, binary operations, groups and subgroups	6
Cosets, quotient groups and homomorphisms: Lagrange's theorem, normal subgroups, homomorphisms of groups	6
Groups acting on sets: actions and permutation representation, orbits and	9

stabilizers. Application to structure of groups. Application to combinatorics: count labellings and graphs.	
Introduction to rings: elementary properties, subrings and ideals, integral domains, division rings, fields. Principal ideal domains. Unique factorizations.	6
Introduction to the theory of fields: field extensions, constructions with ruler and compass, finite fields.	5
Galois theory: solvability of equations by radicals.	3
Further topics: Introduction to error correcting codes.	2

Note: Some of the last three topics may be covered in less depth depending on time constraints. In some semesters, emphasis may be placed on one of the three final topics more so than the other two, in order to cover it in more depth.

Assessment:
Homework 10-30%
Quizzes/Tests 20-50%
Final Exam 30-50%
Project 0-20%

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