Mathematics 308: Abstract Algebra
Spring 2005

Instructor: John Rhodes

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Office Hours: M 9–10, W 2–3, F 10–11 and by appointment

Web page: http://www.dms.uaf.edu/~jrhodes/M308.html

Prerequisites: Math 215 – If you have not already completed this course, you must get the instructor's approval.

Credit Hours: 3.0

Text: Contemporary Abstract Algebra, 6th ed., by J. Gallian, Houghton Mifflin

Class Meetings: M W F 11:45-12:45 in Gruening 307

Midterm Exam: Take-home due Wednesday, March 8; In-class Friday, March 10

Final Exam: Take-home due Friday, May 5; In-class 10:15-12:15, Wednesday, May 10

Course overview and goals:

Abstract Algebra is not an easy subject to explain in everyday language. Roughly, 'algebra' deals with sets of objects and operations with which they can be combined. For instance, in the algebra you first learned in elementary school, the objects were numbers, and you combined them with the operations of addition and multiplication. In high school, you focused on the algebra of polynomials. If you took Math 314 here, you learned the algebra of matrices, vectors, and scalars.

While all the examples above will appear somewhere in this course, our greatest concern is not with any particular example, but with understanding all possibilities at once. For instance if we have a set of objects, what would it mean for two operations to 'behave' like addition and multiplication of numbers? If we had such operations, is it possible that an additive identity element (an object behaving like 0) and a multiplicative identity element (an object behaving like 1) be equal (can $0 = 1$)?

We will progress through studying three different levels of algebraic structures, given the fairly meaningless names *groups, rings,* and *fields.* While each structure will be defined, and examples will motivate much of what we do, we

will focus primarily on proving properties that follow from the basic definitions. Thus we will explore how all possible structures must behave.

Although, as the title of the course and textbook indicate, we will be *abstract* in our approach, there are in fact many applications of this material that we will touch on. For instance, understanding particular groups plays an important role in chemistry and physics through crystallography. Modern encryption system, used in banking and internet communication are based on ideas emerging from abstract algebra. Computer algebra systems, such as Mathematica or Maple, are as powerful as they are only because of the insights developed in studies such as you will be beginning this semester.

Mechanics of the course:

The class will be run as an interactive lecture. That means that while I will be presenting material at the board, and you will be taking notes, I will also be asking for suggestions, ideas, and questions about the material as we go along. I don't expect 'correct' answers, but I do expect you to be actively following and participating — that makes the class more interesting for us all.

Homework will usually be assigned daily, but only collected each Monday (due in class, but accepted until 5pm). I will typically begin each class by asking if there are questions about the last lecture and its homework assignment. That means you should review notes and make an initial attempt on homework problems before the next class meeting, even though problems may not be collected until several days later. While it never hurts to ask, in general I will defer questions about any earlier assignment to my office hours, in order to keep the course moving along.

Although I will not formally take attendance, obviously it will factor into your evaluation in class participation. If you miss class, you should get notes from another student, and can find homework assignments posted on the course web page.

I will not accept any late homework that has not been cleared ahead of time. Due to the class size, and so that the grader is not unfairly burdened, *there will be no exceptions to this* other than for a genuine emergency (e.g., a death in the family, documented illness, etc.). Even though you may find you can't do every problem, you must make a reasonable attempt on them all.

I encourage you to work with others on the homework, *but to write up the solutions independently.* In writing up your work, you should present your arguments in such a way that an intelligent, but ignorant, person can understand them. In particular complete sentences and a logical presentation are expected.

The entire homework assignment will be checked to be sure you have attempted everything. Selected problems will be graded more completely.

Examinations:

Both the midterm and final examinations will consist of two parts: an in-class part that will focus on definitions, examples, and 'routine' proofs, and a take-home part that will consist of more challenging proofs which you will be able to work on for at least several days. For the take-home parts you will be able to refer to your textbook, class notes, and homework, but nothing else.

Any form of cheating on these exams will be dealt with harshly. At a minimum, the full examination (take-home and in-class) will receive a score of zero. Depending on my concern with the extent of cheating, any incident may result in a course grade of F, and I may also request a University Disciplinary and Honor Code Committee hearing which could result in suspension or expulsion. Please note that evidence of collaboration on work in mathematics is usually obvious, so even if your personal honor is worth nothing to you, cheating is a foolish risk to take.

For missed examinations that are not approved in advance, no make-up exams will be given except in case of emergencies.

Grades:

Your performance will be evaluated based on 15% homework, 5% class participation, 35% midterm exam , 45% final exam.

Course grades will be determined according to the following cutoffs:

$$A \geq 90\%,$$
$$B \geq 80\%,$$
$$C \geq 70\%,$$
$$D \geq 60\%.$$

I reserve the right to move the cutoff points downward if particular exams turn out to be unexpectedly difficult. Note that you are not in competition with your peers – everyone in the class may get an A, or everyone may get an F.

University and Department Policies:

Your work in this course is governed by the UAF Honor Code. The Department of Mathematics and Statistics has specific policies on incompletes, late withdrawals, and early final exams which can be found at

`http://www.dms.uaf.edu/dms/Policies.html`.

If you have any disabilities that I should know about, you should bring them to my attention soon so that we can work with the Office of Disability Services to set up any necessary accommodations.