Math 5590H and 5111 **Algebra I** Autumn 2023

MTWRF 11:30-12:25, CC (Enarson Classroom Building) 312

Instructor: Alexander (= Sasha) Leibman
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office hours by appointment

Course: This a year-long *very intensive* course of abstract algebra. Formally, we have lectures on MWFs and recitations on TRs, but (due to lack of time) I plan to lecture M-R and only have a sort of "problem solving sessions" on Fridays. Your attendence is not required (but is welcome, of course): on the course webpage you'll find a sort of "lecture notes", containing all the definitions and theorems of the course in a compact form; if you prefer, you may just study the textbook, or any other book of your choice that would cover all the material.

The course webpage: *https://people.math.osu.edu/leibman.1/algebra/* There I'll be posting the lecture notes, the course calender, homework assignments, solutions, and exams. The course Carmen will be linked to it.

Office hours: I don't plan to have predetermined office hours, if you want to meet with me let me know. You may also contact me via email or Carmen.

Textbook: D.S.Summit and R.M.Foote, *Abstract Algebra*, 3rd edition. We will cover Chapters 1–9 (groups, rings, polynomials) this semester and Chapters 10–14 (modules, fields, the Galois theory) the next semester. I will mainly follow the book, but will sometimes change the order in which the material is presented, and skip or add some topics. (Nevertheless, just reading and understanding the book will suffice to pass the course.)

Topics: **Groups:** Definitions, examples, basic properties. Subgroups, cosets; Lagrange's theorem. Normal subgroups, quotient groups. Simple groups. Subnormal, normal, and composition series. Conjugate elements, conjugacy classes. Normalizers and centralizers. Group homomorphisms. The isomorphism theorems. Actions of groups, orbits and stabilizers; actions of groups on themselves. Direct products of groups. Classification of finitely generated abelian groups. Groups of automorphisms. Semidirect products. Sylow's theorems. Groups of orders p, p^2, p^3, pq, p^2q. Commutator calculus, nilpotent and solvable groups.
Rings: Definitions, examples, basic properties. Rings of fractions. Ring homomorphisms, ideals, quotient rings. Isomorphism theorems. Prime and maximal ideals. Nilradical, primary ideals. Direct products of rings, the Chinese remainder theorem. Prime and irreducible elements. Euclidean, principal ideal, unique factorization domains. Quadratic integer rings.
Polynomials: Roots of polynomials. Polynomials over UFDs and Gauss's lemma. Irreducibility criteria. Symmetric polynomials. Polynomials in several variables, Gröbner bases (if time allows).

Homework: Every week I'll give you a long list of exercises, mainly from the textbook, and assign 4–7 of them for homework; the rest we will have an opportunity to discuss on Fridays. You may turn in your solutions in person, by mail, or by Carmen; Carmen is preferable. Solutions to many problems from the book can be found on the internet, and it is ok to use them; it would, however, be much more useful for you to try to solve these problems by yourself.

Exams: There will be two in-class exams: a midterm (devoted to groups) and a final (rings and polynomials).

The final grade: will be calculated by the formula 40% homework+30% midterm+30% final.