Math 6121: Abstract Algebra I

Fall 2026

Dr. Matthew Baker
mbaker@math.gatech.edu

Class Time and Location: 12:30 pm - 1:45 pm TuTh in Skiles 269

Office hours: Monday 2–3, Thursday 2–3 in Skiles 128

Textbook: *Abstract Algebra* (3rd edition) by David S. Dummit and Richard M. Foote.

General description: This is a graduate level course in abstract algebra covering the fundamentals of groups, rings, modules, and fields. It is the first course in a two-course sequence which also includes Math 6122.

Prerequisites: Math 4107 and one of Math 2406, Math 4305, or permission of instructor.

Course outline: Topics to be covered will include:

- *Groups:* Intensive review of basic group theory, including homomorphisms, cosets, quotients, normal subgroups, and isomorphism theorems; examples of groups (permutation groups, matrix groups, cyclic and dihedral groups); group actions; applications of group actions to geometric and combinatorial symmetry (e.g. symmetries of regular polyhedra, Polya enumeration, and Burnside's formula); the class equation; the Sylow theorems; simple groups and composition series; the structure theorem for finitely generated abelian groups.
- *Rings:* Homomorphisms; ideals; quotients; mapping properties and isomorphism theorems; polynomial rings; integral domains; fraction fields; prime and maximal ideals; Euclidean domains; unique factorization domains; principal ideal domains; Gauss's lemma; irreducibility criteria; the Chinese remainder theorem.
- *Modules:* Homomorphisms and quotients; generation, freeness, and finiteness properties; the structure theorem for modules over a principal ideal domain.
- *Fields:* Characteristic; prime fields; field extensions; algebraic vs. transcendental extensions; splitting fields; basic properties of finite fields; algebraic closure. Fundamental theorem of Galois theory; examples, including quadratic, cubic, cyclotomic, and finite fields; the primitive element theorem.

Homework: There will be regular homework assignments in the class, and they will be an integral part of the course. Homework will typically be given out on Thursdays and will be due the following Thursday. Late homework will not be accepted. On the homework sets, collaboration is not only allowed but strongly encouraged. However, you must write

up your homework solutions yourself and understand what you are writing, and you should credit ideas to as appropriate. For example, if you get help from a classmate, from a book, from the internet, or from AI, please credit the source in your homework writeup. Copying directly from a classmate's written solutions is prohibited. I take these policies seriously and violations will be dealt with in a strict manner compatible with Georgia Tech's honor code.

Exams: There will be 2 in-class written midterm exams during the course of the semester, plus a cumulative in-class written final exam at the end of the course. No collaboration will be allowed on exams.

Grading: The two midterm exams will each count for 20% of your grade, the final will count 40%, and homework will count 20%.

Piazza: We will be using Piazza to facilitate class discussions. Rather than emailing questions just to me, I encourage you to post your questions on Piazza. Find our class page and sign up at `https://piazza.com/gatech/fall2026/math6121`

Academic Integrity: Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's honor code, see `http://honor.gatech.edu`

Accommodations for students with disabilities: Georgia Tech complies with the regulations of the Americans with Disabilities Act of 1990 and offers accommodations to students with disabilities. If you are in need of classroom or testing accommodations, please make an appointment with the Office of Disability Services to discuss the appropriate procedures. More information is available on their website `http://disabilityservices.gatech.edu/` Please also make an appointment with me to discuss your accommodation, if necessary.