Course syllabus for Math 6121
Algebra I

Fall 2016

Course description: This is a graduate level course on abstract algebra, which covers groups, rings, modules and fields. One of the goals is to prepare graduate students for the algebra comprehensive exam. Students not preparing for the comprehensive exam, including undergraduates, are welcome, but see the prerequisites, and please note that learning abstract algebra is a significant commitment.

Text: Abstract Algebra, 3rd Edition by David S. Dummit, Richard M. Foote John Wiley and Sons

Time and place: TR 9:35-10:55am. Skiles 257. Webpage via T-square.

Instructor contact information: Kirsten Graham Wickelgren, e-mail: kwickelgren3@math.gatech.edu, office: Skiles 227.

Office hours: by appointment or

- Tuesday 12-1pm and Wednesday 3-4pm when there is an assignment due or an exam on Thursday.
- Monday 12-1pm and Thursday 12-1pm when there is an assignment due or an exam on Tuesday.
- Tuesday 12-1 and Thursday 12-1 when there is no assignment due or exam.

Office hours will be rescheduled during certain weeks of the semester.

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

Note in particular that students are be expected to have basic familiarity with groups, rings, and fields at the beginning of the semester (because Math 4107 is a prerequisite). If this may be a weak point for you, please come and see me early in the semester. We can discuss how to make this course a successful experience for you.

Topics outline: See also `http://www.math.gatech.edu/course/math/6121`. We will study groups until about September 17, then rings until about October 19, then modules until about November 10, and finally fields until December 6.

- review of elementary group theory: groups, subgroups, homomorphisms, quotient groups, Lagrange's theorem (i.e., the order of a subgroup divides the order of the group), permutation groups
- Group actions
- The Class Equation, the Sylow theorems
- Simple groups and composition series
- Free groups, generators and relations
- Direct and semidirect products
- Structure theorem for finitely generated abelian groups
- Rings, ideals, quotient rings
- The Chinese Remainder Theorem
- Euclidean domains, Principal Ideal Domains, Unique Factorization Domains
- Polynomial rings
- Modules, submodules, quotient modules, free modules
- Finitely generated modules over a Principal Ideal Domain
- Rational and Jordan Canonical Forms
- Fields, algebraic and transcendental extensions
- Splitting fields, algebraic closure
- Finite fields
- Separable and inseparable extensions
- Galois extensions

- Classical straightedge and compass constructions

As basic familiarity with groups, rings, modules, and fields is assumed, we will emphasize interesting examples. To fully appreciate these examples, we will sometimes use mathematics which is not in the prerequisites. Any consequences of this math will not be tested and will not appear in the homework. We will discuss it in class, but it is for your own benefit. It will be written in a different color (or otherwise clearly distinguished from the main part of the lecture).

Homework, exams: There will be be two problem sets on group theory, two on ring theory, one on module theory, and two on field theory. There will be at least one week to do each problem set, although usually there will be more time. You are encouraged to work together on the homework, but solutions are to be written up independently. You are also free to consult outside references to complete the homework, but solutions are to be written up in your own words. An unfortunate consequence of allowing the use of outside resources is that some students use them heavily to do the homework and then have difficulty with exams. It is not practical to forbid the use of outside resources, and it can also be helpful, but please restrict their use to that which will increase your understanding of abstract algebra. Any sources you use or collaborators you consult should be credited in writing on your work, of course. Problem sets are to be handed in during class. A selection of the problems will be graded.

There will be two in-class midterms. The first will be on group theory. The second will be on ring theory, and module theory. Although some group theory may appear on the second midterm, it will not be the emphasis. The first midterm is tentatively scheduled for September 29, and the second is tentatively scheduled for November 8. Georgia Tech's withdrawal deadline and grade mode change deadline are both October 29. In the case of absences from midterms for Georgia Tech official business, religious holidays, illness, and the like, the final exam will count for the midterm and the final in the final grade.

The final will cover all the material in the course and is on Thursday, December 8, 2:50-5:40pm.

Grading: Grades will be computed by weighting the homework 25%, each midterm 20%, and the final 35%. Letter grades will be determined after all the number grades have been determined, using natural cut-offs in the distribution. The following will be true: at least 25% of students will get an A, at least 75% of students will get a B or higher. Any student with more than 90% will receive an A, any student with more than 80% will receive a B or higher, any student with more that 70% will receive a C or higher.

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www.catalog.gatech.edu/rules/18b.php