Abstract Algebra. Syllabus

Instructor: Yury Ustinovskiy, yu3@nyu.edu

Lectures: Tuesday, Thursday 11:00AM-12:15PM

Recitations: Friday 9:30-10:45PM

TA: Francesco Preta, fp627@nyu.edu

Recitations zoom: TBA

Office hours: Tuesday, Thursday 10:00-11:00AM (or by appointment)

Course description

Welcome to the MATH-UA 343 Abstract Algebra class!

This class will provide an introduction to abstract algebraic structures, including groups, rings, and fields. We will see many examples coming from number theory, linear algebra, geometry, combinatorics and computer science.

We start with a quick recap of the set theory. Proceeding with a background in arithmetics and number theory we will encounter a fundamental example of a group (and a ring) — the congruence group $\mathbb{Z}/n\mathbb{Z}$. With this example in mind, we give the definition of an abstract group and derive its basic properties. Then we will give a new set of examples, called permutation groups. Developing general group theory, we will introduce more advanced topics including cosets, normal subgroups, quotient groups. In the last part of the course we study rings and fields.

Keywords: Sets and relations. Congruences and unique factorization of integers. Groups, subgroups, homomorphisms, isomorphisms. Cyclic groups. Order of an element. Lagrange's theorem. Permutation groups, parity of permutations. Cayley's theorem. Quotient groups. Rings and quotient rings, Euclidean rings, polynomial rings. Finite fields.

Textbooks

Textbook is not required for this course, but Judson's *Abstract Algebra: Theory and Applications* is a good reference, and is available online at http://abstract.ups.edu

Homeworks

There are weekly written homework assignments posted on NYU classes **every Thursday** due the next Thursday before the beginning of the class. **No late assignments allowed**, except with a valid excuse which the instructor should be notified about in advance. One lowest score will be dropped.

Quizzes & Exams

There will be three quizzes during the recitation classes (**February 19**, **April 9** and **April 30**). There will be written Midterm (**Thursday, March 18**) and Final (**date TBA**) exams.

Grades

Grades for homeworks and quizzes will be posted on NYU Classes as soon as they become available. It is the students' responsibility to check that they correspond to the grades on the papers which are handed back to them. No homework or quiz grade change requests will be accepted three weeks after posting or after the final exam. The final grade will be computed with the following weights:

Homework 20% Quizzes 20% Midterm 30% Final Exam 30%

The weighted score will be converted into a letter grade with the following cutoffs

Cutoff	Grade
93%	A
90%	A-
87%	B+
83%	B
80%	B-
75%	C+
65%	C
50%	D

Campuswire

This term we will be using **Campuswire** for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Campuswire.

Policy on out-of-sequence exams and missed quizzes

An excused absence for a quiz or exam requires notification to the instructor before the exam starts (unless your absence is due to an emergency situation, in which case you still need to let the instructor know about it as quickly as possible), followed by valid documentation. Otherwise, you will receive a "0" for any missed exam. We are only able to accommodate a limited number of out-of-sequence exams due to limited availability of rooms and proctors. For this reason, we may approve out-of-sequence exams in the following cases:

- A documented medical excuse.
- A University sponsored event such as an athletic tournament, a play, or a musical performance. Athletic practices and rehearsals do not fall into this category. Please have your coach, conductor, or other faculty advisor contact your instructor.

- A religious holiday.
- Extreme hardship such as a family emergency.

In any case, make-up exams must occur within one week of the scheduled exam.

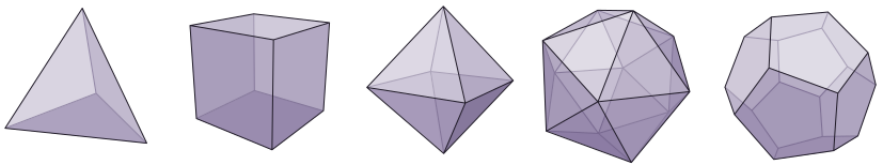
If you require additional accommodations as determined by the Center for Student Disabilities, please let your instructor know as soon as possible.

Academic Honesty

Guidelines regarding cheating and plagiarism are laid out in the Graduate School of Arts and Sciences guidelines and will be adhered to strictly. Collaboration is permitted, in fact encouraged, for home assignments; however, all submitted assignments must be written up independently and represent the student's own work and understanding. Furthermore, collaborations must be acknowledged at the top of the assignment, by naming the participants in it.

How to do well in class?

- Review the material from the previous lecture before coming to class: it is hard to follow if you don't remember what has been said last time.
- Ask questions and try to propose answers to questions asked by the instructor even if you're not sure: making mistakes is part of the normal process of learning. One remembers something very well if one got it wrong the first time.
- Please raise your hand if you think you have the answer to a question asked in class, and only answer the question if you've been prompted to do so, so as to let the others think. Not everyone has the same speed.
- Come to office hours, even if you don't think you have that many questions. You can come by anytime during the specified time range.
- This is a proof-based course. Make sure to go over each proof actively, asking yourself: what would I do if I wanted to prove this? How many steps are there, what is the structure of this proof? Why do we need to do this? Why are we done at the end? Knowing the proof of a theorem helps you get a deep understanding of the theorem itself, I therefore strongly recommend that you learn the proofs at the same time as you learn the theorems.
- Work in groups! It's much more fun doing maths with other people than on one's own.



Tentative weekly breakdown of topics

Week starting	Topics
28/1	Introduction, reminders on set theory
1/2	Integers. Euclidean algorithm
8/2	Congruence relation. Arithmetic in $\mathbb{Z}_n$
15/2	Groups. First examples
22/2	Subgroups. Cyclic groups
1/3	Homomorphisms
8/3	Cosets. Lagrange's theorem
15/3	Review & **Midterm**
22/3	Permutation group
29/3	Even permutations. Cayley's theorem
5/4	Quotient groups
12/4	Classification of finitely generated abelian groups
19/4	Rings. Polynomial rings
26/4	Finite fields.
3/5	Review
TBA	**Final**