MATH 303: Abstract algebra I

Fall 2018[1]

Instructor: John Bergdall
Time: TR: 8:25 – 9:45 and 9:55 – 11:15
Location: Park 336

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Office hours: Tu 3:00-4:00, W 6:15-7:15, Th 12:30-1:30

Course description: This is the first semester of a year-long introduction to abstract algebra, one of the cornerstones of modern mathematics. You are going to learn about two specific algebraic structures, groups and rings, which are byproducts of an enormous effort throughout the 19th century to synthesize mathematically squishy notions like "symmetry" and "solutions to algebraic equations." For instance, you've probably learned how to respond if I said: "solve $x^2-6x+2=0$." What if, instead, I say "make x^2-6x+2 divisible by 29, if you can." From the point of view of abstract algebra, these problems are the same!

This course, though, is not about solving *specific* problems like that one. Rather, we'll examine topics like "solving equations" from a wildly abstract perspective. To do that, we'll introduce and focus on the role of algebraic structure and axioms (think of data satisfying conditions). Why? Consider the above equation. What if it wasn't quadratic? What if there were more variables? Are specific numbers, like 6 and 2, important? In taking on the larger, surely more abstract, problem there seems to be so many specific details to worry about! So, the problem is impossible to solve then? No! The role of abstraction, putting the abstract in abstract algebra, is to *isolate key details* and *remove inessential ones*. Then, by setting up the problem more abstractly, the truth is actually easier to find.

Learning goals: Regardless of the topic, writing and communicating abstract mathematics is crucial to learning advanced material. It is also worth a ton in the real world. The writing skills you practice each week will help you *dissect problems more quickly* and *evaluate solutions more accurately*.

You will also learn to *emphasize clarity and conciseness*. This will not come naturally and so we will practice *carefully revising* work in order to incorporate suggestions and, especially, correct misconceptions.

Finally, abstract algebra can be used to solve big problems in math. Groups and rings are among the simplest to define objects you'll ever encounter, and what you'll experience is the remarkable process it takes to describe and apply them. So you will *reflect* on that process, to reflect on how so much can be richly said about such apparently simple things.

Problem sets: Weekly problem sets will be handed out on Thursdays. You may (and are encouraged to) discuss problems with your peers, me, and the TA. However, your final solution should be *written on your own*. The problem sets are divided into two parts.

Exercises: Most problems (5-10 per week) will be "exercises." These are complementary and concurrent with lecture. You should *begin working on them as they are handed out*. They will be due the following Thursday at the start of class. You may turn in your exercises up to one week late without penalty twice during the semester.

Writing problems: Each week, you will also have one "writing problem" for which you will produce an especially careful solution, and it will be read and graded for clarity and conciseness. The problem may be more involved, or longer, than an exercise. These will be due by Friday at 5:00 PM through `moodle`.[2] Your solution *must be typed*. You may also revise any (single) previous writing problem each week, with no limits on revisions of any given problem over the semester. In order to submit a revision, you must have turned in an original solution by the original deadline.

[1] Last update: January 15, 2019
[2] Updated September 12, 2018

LaTeX: Mathematics is typed using a typesetting program known as TeX, or LaTeX. You can download software on your personal machine, or you can use the online system at `overleaf.com`. This is recommended if you have not used TeX before. If so, you should also make sure to meet a friend who can introduce you to it. Or come see me!

Problem sessions: Problem sessions will be run by Daniel White (the graduate TA). These will be held each week M 6:30-8:00 in Old Library 104 and W 12:00-1:30 in Old Library 102. Dan may help you with questions you have, and the problem sessions are a good time to meet other students in the course. We stress that *what you turn in for homework must be 100% in your own words.*

Exams: There are two midterm exams: an in-class exam on October 11 and a take-home exam due on November 20. There will also be a self-scheduled final exam. No problem sets will be due during exam weeks.

Textbook: *Abstract algebra: theory and applications* by Thomas W. Judson, 2018 edition. Available for free at `http://abstract.pugetsound.edu`. Available in print from BMC bookstore ($11.95). We plan to cover at least Chapters 1–6, 9–11 and 13–18 in this course.

Learning math at this level may require reading different perspectives, so there are also a number of books on reserve in Collier. It is worth it to compare and contrast the exposition of a few authors. If you do, please come to my office and we can dissect the differences between the texts!

Course participation and contributions: You're expected to come to class each day. I will not take attendance for points, but I will keep track for my own sake. In class, you should contribute whichever way you find comfortable. For instance, you might ask lots of questions, or you may keep careful notes and let me know which concepts you found difficult. The most common, useful, phrase between mathematicians is "I don't understand...explain again." Learn to use it!

Evaluation: Here is the breakdown of the graded components of the course:

- Exercises (10%)
- Writing problems (10%)
- Course participation (5%)
- Midterm 1 (20%)
- Midterm 2 (25%)
- Final exam (30%)

Schedule: A tentative schedule will be posted to `moodle` at the start of the semester.

Enrichment activity: Throughout the semester, the math department (and many others) host activities meant to engage students outside the classroom. You can, if you want, attend two of these events, write up a report/story about your experience, and we will count it as a replacement for one of the writing problems. Details for the activity will be posted to `moodle`.

Accessibility: Bryn Mawr College is committed to providing equal access to students with a documented disability. Students needing academic accommodations for a disability must first register with Access Services. Students can call 610-526-7516 to make an appointment with the Access Services Director, Deb Alder, or email her at dalder@brynmawr.edu to begin this confidential process. Once registered, students should schedule an appointment with the professor as early in the semester as possible to share the verification form and make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement. More information can be obtained at the Access Services website. (http://www.brynmawr.edu/access-services/)

Any student who has a disability-related need to tape record this class first must speak with the Access Services Director and to me, the instructor. Class members need to be aware that this class may be recorded.