

Algebra I
MATH 629, Fall 2022
TTh12:00-1:15pm, Exploratory 4106

Instructor: Dr. Rebecca R.G., she/her email address: rrebhuhn@gmu.edu

Office Hours: TBD, in person in Exploratory 4406 and over Zoom (see Blackboard for link).

Textbooks (optional): Vermani, *An elementary approach to homological algebra* and Weibel, *An introduction to homological algebra*.

We will start using Vermani, then shift over to Weibel once we've covered modules and some category theory.

Prerequisites: Algebra I (Math 621) or equivalent. Commutative algebra is helpful but not required.

Course Summary: Homological algebra is a tool for using algebraic methods (like groups and maps between them) to study objects from many areas of math (topological spaces, rings and modules, and groups). In this course, we will cover the main structures of homological algebra, including complexes, commutative diagrams, homology, cohomology, and some specific examples of these things that come up in algebra and topology.

Course Content: The course will include topics from the following list:

1. Modules
2. Complexes, exactness, tensor products
3. Injective, projective, free, and flat modules
4. Categories and functors
5. Snake Lemma and chain homotopy
6. Left and right derived functors
7. Tor and Ext, and equivalent ways to compute them
8. Hereditary, semihereditary, and Prüfer rings
9. Homological dimension theory

Covid safety/what to do if you're sick: Mason does not currently (as of 8/22) require masks on campus, but I will be wearing one and you are welcome to do so as well. If you are sick, please stay home and get tested as appropriate. I recommend sharing contact information with other students in the class to find out what material to make up. I can also provide lecture notes. If you will be

out for more than a week, please email me so we can make a better plan for helping you make up the material.

What to bring to class: Note-taking materials.

Expectations:

- Come to class, pay attention to lectures, and participate in any in-class activities.
- Do the homework problems. Try to stay on schedule and do them by the deadlines, but if you get behind, talk to me about how to get caught up as soon as possible.
- Ask lots of questions.

Grading: Grades are based on the homework and class attendance/participation. If you do not yet have an advisor, I expect you to turn in most to all of the homework. If you already have an advisor and can't spend as much time on the class, email me so we can make an alternate plan as early as possible.

Homework: Homework will be assigned roughly weekly, and must be typed in LaTeX. Homework is graded on a correct/retry basis. If a problem is incorrect, you will receive some feedback on what needs to be changed. Rewrite the problem and turn it in by a week after the homework is returned to you. You may rewrite any problem up to 2 times. To ensure you get credit for your rewrite, I recommend going to office hours to discuss the problem before you turn in your rewrite. A rewrite must include your original solution, your new solution, and a brief explanation of what you changed and why.

Collaboration: Please work together on the homework! Once you've worked on the problems together, please write your solutions individually, in your own words. Include a list of everyone you spoke to about the problems and any sources you used (or write "worked alone" if you worked alone). When you are doing rewrites, you may (and should) get help from me and your classmates, but again, you should write up the problem on your own.

Flexibility: If you need flexibility in deadlines, number of rewrites, or anything else, talk to me about it as soon as possible. The earlier you ask, the easier it is to find a way to accommodate you. I will do my best to give you extra help, time, or tries, while not overloading myself.