Math 329 – Rings and Fields (Fall 2021)

Instructor: Kevin Woods. Call me Kevin! (he/him)

Contacting me: Kevin.Woods@oberlin.edu or 443-695-1681 (mobile). Email is better for involved or less important questions; texting is better for quick, time-sensitive questions.

Lectures: MWF 11-11:50am, King 243.

Google Drive:

I will post assignments and other material in the course Google Drive folder. You will need to have regular access to this and to your Oberlin email.

Office Hours:

- Wednesday 1:30-3pm and Friday 3-4pm in my office (King 220B) and Thursday, 12:30-2:30pm, in **King 203**. I hope Thursday office hours will be a good time to work with other students who show up.
- Or you can make an appointment via email. If you'd like to meet over zoom, I'm happy to: please email me in advance.

Textbook:

- *Fields and Galois Theory*, by John Howie, first and only edition.
- You can download a free pdf of the textbook from SpringerLink, through our library; go to this link, type in your last name and library bar code number, and click the "Download book PDF" link.
- I plan to follow this book and we will cover the whole book. I'll keep you updated about which sections we're currently covering, using this google doc.
- Many of you used Judson's *Abstract Algebra: Theory and Applications* for Group Theory, freely available to download. We will cover much of the material from Chapters 16-18 and 21-23. This could be a nice second source, if you are confused about something.
- The best book that I have ever seen for learning this material is Dummit and Foote's *Abstract Algebra*. It has many more examples than we can ever hope to get to in class, it is the book that helped me pass my qualifying exams in graduate school, and it would be a great supplement to our text. We will cover much of Chapters 7-9 and 13-14.

Prerequisites:

- MATH 327 (Group Theory). I will constantly be recalling things from this class. You don't have to remember every little detail (and I'll try to tell you in advance to review specific things), but you'll likely be lost if you haven't seen this material.
- MATH 232 (Linear Algebra). We will need a basic understanding of abstract vector spaces and vector space bases, though not too much more.
- MATH 220 (Discrete Mathematics). If you've made it through Linear Algebra and Group Theory, you've either had this class or are comfortable with most of its material. We'll need many topics that come up in Discrete and reappear in lots of upper-level courses, as well as comfort with mathematical problem solving and proofs.

Learning Goals:

At the end of this course, students will:

- Have knowledge of important mathematical ideas in the area of rings and fields, including homomorphisms, quotient rings, unique factorization, irreducibility of polynomials, field

extensions, ruler and compass constructions, splitting fields, the Galois group, and solutions to polynomials of various degrees.
- Develop a working mastery of examples in the above areas.
- Exhibit further sophistication in thinking abstractly about mathematics.
- Struggle with mathematical concepts, practice persistence, and develop confidence in the face of difficulties.
- Have experience working with other students on mathematics (this one is up to you to work on).

Assignments and Grades:

- Your focus should be on **growth**, but grades are a fact of college life. **If I can see that you are working hard and seeking support, you will pass this class.** If you find yourself preoccupied with grades, consider taking it P/NP.
- Your grade will be based on weekly problem sets. For the most part, you can and should work on them in groups, but (in lieu of take home exams) there will be a problem or two on each problem set that I expect you to work alone on.
- I will drop the lowest two problem sets. Averaging the rest will determine your numerical grade, and this may be curved up to determine your letter grade.
- The best way to learn the concepts in this course is to get your hands dirty! I hope you will work in groups on these, though your written solutions must be in your own words. This is also an opportunity to work on writing careful, clear proofs and explanations. Good mathematics is articulate mathematics! Explain things carefully and in complete sentences. Imagine that another student in the class who hasn't done this problem yet will read your solution: they should be able to understand it without having to ask you questions.
- These problems will be graded strictly for how coherently written they are. Problem sets will be due approximately every Friday at 5pm, as a pdf via this google form. (A final problem set, perhaps longer and counting as two problem sets, will be due at the end of the scheduled final exam slot, Friday, January 21, 4pm.)
- Late Work: If you ask in advance, I'll generally give you through the weekend to finish. After that, it is better to move on, because there will be another problem set due the next week. I drop two problem sets because I know that everyone has bad days or weeks.
- Honor Code: I encourage you to work together on the problem sets. Your solutions must be in your own words, however. Work on the problem together, and then go back home and write up your solution. In particular, you should never look at someone else's write-up before it is due. And there will generally be a clearly marked problem or two that you have to work alone on.

Support:

- You belong at Oberlin and you belong in this class. People arrive here with different experiences and backgrounds in mathematics. Put in the work, seek out support, and focus on self-improvement, and I promise you that **your mathematical skills will grow**. The rest of us are here to help, including:
- Me! Come by office hours, any time.
- Your peers! Working with other students helps everyone improve.
- Yourself! Your skills will improve best if you come at this with a growth mindset: embrace the challenge of this class, persist through difficulty, be inspired (not threatened) by the success of others, seek out support.
- If you have a disability of any sort that may affect your performance in this class, please consult with me and with Student Academic Success Programs (Peters 118). I am committed to meeting the needs of all students in my class.
- **I want you to succeed, and I want to help you succeed.** Please let me know how I can help!