Math 261: Introduction to Number Theory
Section 001
Spring 2021

Instructor: Max Kutler **Email:** max.kutler@uky.edu
Office Hours: MW 3–4 pm, Th 1–2 pm, and by appointment
Class Meetings: MWF 11–11:50 am, on Zoom

Course Webpage: http://www.ms.uky.edu/~mbku225/math261/.

Required Text: David C. Marshall, Edward Odell, and Michael Starbird, *Number theory through inquiry.*

Prerequisite: MA 114

Workload: An average, well-prepared student should expect to spend 9 hours per week on this course, outside of regular class meetings. This includes time spent on homework exercises, preparing for presentations, reviewing notes, reading the text, and studying for exams.

Course Content: This is a course in elementary number theory, with a focus on proof techniques, writing proofs, and mathematical exposition. The topics will include:

- Divisibility, the division algorithm, the Euclidian algorithm.
- The Fundamental Theorem of Arithmetic, the infinitude of primes.
- Linear congruences and the Chinese Remainder Theorem.
- Fermat's Little Theorem, Euler's Theorem, Wilson's Theorem.
- Direct proofs, proofs by contradiction, mathematical induction.

In addition to mastering these topics, I hope you will

- develop the ability to ask questions and to communicate mathematics clearly and effectively;
- become capable of tackling problems you haven't seen before;
- be persistent and work through perceived (and productive!) failure.

Course Structure: We will not follow the traditional format for a mathematics class, where the instructor lectures and the students are asked to absorb what information they can. Rather, motivated by the idea that proof-writing is best learned by actually writing the proofs, we will use a more *active* or *inquiry-based* approach to learning. My role is to facilitate and guide your learning process, rather than to hand down knowledge from on high.

A typical class meeting will begin with two student presentations. Each presentation will be followed by a short class discussion in which we will recap the salient points and provide feedback to the presenter. In the remaining time, you will work together in small groups. There may be occasional lectures or mini-lectures, but even these will be structured as a sort of guided group conversation.

I know that many of you are not used to these sorts of activities in a math class, and I understand that I am asking you to step outside of your comfort zone. However, I firmly believe in this approach, and that it will ultimately build your confidence as a proof-writer, give you space to think independently and critically about mathematical concepts, and teach you to communicate clearly and effectively with your peers.

Presentations: You are expected to give *at least three* presentations throughout the semester. Each presentation should contain the problem statement, a carefully worked-out solution, and employ the use of visual aids. While the atmosphere of the class should be informal and friendly, these presentations should be taken seriously, as they are essential to reaching the goals of this class.

It is acceptable to present a solution which is incomplete, so long as you have given the problem serious thought. In this case, you may use your presentation to discuss your various approaches to the problem. You will be rewarded for being courageous and sharing your creative ideas! In fact, this is often how mathematical progress is made—by bringing carefully thought-out partial solutions to one's peers for comment and critique.

Explicit instructions and expectations can be found in the Presentation Guidelines document.

Homework: Homework will be assigned **each class meeting** and will primarily consist of proving theorems from the textbook. You are expected to complete (or try your best to complete) each assignment before coming to the next class meeting.

Solutions must be written clearly, legibly, and with appropriate style. Among other things, this means your work should include proper grammar, punctuation, and spelling. You are expected to write a draft of each of your solutions before writing the final, edited form. See *Guidelines for Good Mathematical Writing* by Francis Su for more details.

You are encouraged to work with other students in the class on the homework, and it is appropriate to acknowledge the assistance of others. While it may be tempting to consult people or resources outside of the class, it will be best for your learning process to refrain from doing so. All solutions you submit must be your own.

Class Portfolio: As we are filling in the proofs of theorems from the textbook, it is vital to keep track of them carefully. Every proof in the class will be carefully typed up by one of you and compiled into a portfolio for the class. It is very important that these proofs are clearly written so you can use them to study—so you should incorporate all feedback on homework, and we may need to make additional revisions. These proofs should be typed using the provided LaTeX template at `overleaf.com`. This will make it easier to combine them into a single document.

At the end of the course, we will have a complete and organized collection of all the proofs you have written!

Exams: We will have three exams in addition to a comprehensive final.

1. Exam 1: **Wednesday, February 17**
2. Exam 2: **Wednesday, March 17**
3. Exam 3: **Wednesday, April 14**
4. Final Exam: **Monday, May 10**

Grading: Grades will be calculated based on the following components.

Homework	20%
Presentations	20%
Participation	10%
Portfolio Contributions	10%
Midterm Exams	$10\% \times 3$
Final Exam	10%

Final letter grades will be assigned based on the standard grading scale (90%–100% for an A, 80%–90% for a B, etc.)

Attendance: Regular attendance is expected and is vital to success in this course. While you will not be explicitly graded on attendance, repeated absences may impact your participation grade. Make-up work will be accepted only in the event of an excused absence as outlined by UK Senate Rule 5.2.4.2.

You must notify me in writing at least one week in advance for all scheduled absences, including for major religious holidays. To excuse unscheduled absences, contact me no later than one week after the absence. I require appropriate verification.

You are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed, per University policy.

You are responsible for announcements made in class, as well as any emails sent to your UK email account.

Special Accommodations: If you are currently registered with the Disability Resource Center for a documented disability, please present your Letter of Accommodation to me as soon as possible and at least one week in advance of the first exam. For more information regarding services available to students with disabilities, visit `http://www.uky.edu/DisabilityResourceCenter/`.

Academic Integrity: Students are expected to adhere to university policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties up to suspension from the university may be imposed.

Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at `http://www.uky.edu/Ombud`. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty.

Plagiarism includes reproducing the work of someone else (including, but not limited to, a friend's homework, an online resource, a chapter of a book, or a published article) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work, which a student submits as his/her own, whoever that other person may be. You are encouraged to work together on assignments and get help from me or other tutors, but all written work must be completed by you and written in your own words. If you feel unsure about the question of plagiarism regarding your work, please consult with me before submitting the assignment.

UK Mathematics Department Professional Themes: This course will address the four themes of the conceptual framework for the UK professional education program: **research, reflection, learning, and leading**. Students will engage with fundamental ideas in mathematical research, reflecting on and analyzing core mathematical content that arises throughout mathematics at all levels. Students will develop as lifelong mathematical learners who will be able to take active leadership roles in their future roles as professionals and citizens. The ultimate goal in addressing these four themes is to produce teacher leaders who work together to improve student learning among diverse populations and improve education in Kentucky and beyond.

Unbridled Learning Initiatives and the Kentucky Core Academic Standards: This course will provide students an opportunity to advance their knowledge and mastery of the tools associated with Kentucky education reform, focusing on the content and practice standards outlined in the Kentucky Core Academic Standards. As students carry out projects and complete assignments that involve mathematical content underlying instructional activities for P–12 students in Kentucky schools, they will address one or more components of the Unbridled Learning initiatives.

Changes to this Syllabus: A current version of this syllabus may be found at the course webpage. This is the syllabus as of March 29, 2021.