

Math 261: Introduction to Number Theory

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CB 345, MWF 1-1:50

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In this course we will be using topics from number theory to guide our study of proof writing while learning to express abstract mathematical ideas clearly and concisely. The topics in this course include, but are not limited to, the following:

- Divisibility, Division Algorithm, Euclidean Algorithm
- Fundamental Theorem of Arithmetic, Infinitude of Primes
- Linear Congruences, Chinese Remainder Theorem
- Fermat's Little Theorem, Euler's Theorem, Wilson's Theorem
- Direct Proof, Proof 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 and Approach. The structure of this class might be different from your experience with math classes. We know, often from frustrating experience, that most people do not master the material (or sometimes even learn very much) merely by listening. It works better if we are active when trying to learn! We will incorporate methods from an educational philosophy called inquiry-based learning (IBL).

IBL is a method of instruction that puts you, the material, and your interaction with that material at the center of the learning experience. My role is to guide your learning process rather than hand out knowledge (that does not work well with the sort of material we will cover). In other words, this class is about you and your learning, and my goal is to support you so you can get the most out of your experience.

Most of our class time will be devoted to student-led presentations and class discussion. The details of these in terms of assessment are discussed below. I know if you are not used to these sorts of activities in a math class they can seem challenging. The goal is that we, as a class, will become a team that learns together.

Office Hours Office hours will be an important resource for this class.

Textbook. The text for this course is *Number Theory Through Inquiry* by Marshall, Odell, and Starbird. This text is written specifically for courses using IBL. You will notice that nearly all theorems are missing their proofs. We will fill them in over the semester!

Presentations. A typical class will focus on student presentations/discussion regarding problems completed before class (see Daily Homework). 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.

Presentations will be done on a volunteer basis though all students are expected to be engaged in the process. After a student has presented a proof that the class agrees is sufficient, I will

often call upon another student to come up to the board to recap what happened in the proof and emphasize the salient points. Explicit instructions/expectations can be found in Presentation Guidelines document.

Presentations will be graded using the following rubric:

- ✓+ Completely correct and clear proof or solution. Great!
- ✓ Essentially correct with small flaws/significant progress has been made and is well explained
- ✓- Incomplete/incorrect with only minimal progress made toward a solution

You should not let the rubric deter you from presenting if you have an idea about a proof that you'd like to present, but you are worried that your proof is incomplete or you are not confident your proof is correct. You will be rewarded for being courageous and sharing your creative ideas! (You should not come to the board to present unless you have spent time thinking about the problem and have something meaningful to contribute.)

Homework. There will be two kinds of homework.

Daily Homework. Homework will be assigned each class meeting and will consist mainly 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. You are encouraged to work with other students in the class on the homework but it will be best for you to not consult people or resources outside of the class. All solutions you submit must be your own.

All assignments should be **carefully** and **clearly** written. Among other things, this means your work should include proper grammar, punctuation and spelling. You will almost always write a draft of a given solution before you write down the final argument, so do yourself a favor and get in the habit of differentiating your scratch work from your submitted assignment. Please see the resources on the website for suggestions for writing up proofs.

Since each class meeting will be largely devoted to presenting problems from those that are due that day, you are permitted (and encouraged!) to modify your written proofs based on these presentations; however, you must make such corrections using a different colored pen. At the end of each class, you will submit your write-up of all proofs due that day. These will be graded on a ✓-system. I will drop two low/missing daily homework assignments.

Weekly Homework. In addition to the Daily Homework, you will also be required to submit a few formally written proofs each week. For most of these assignments, you will be asked to submit a formal writeup of 2 - 4 problems you turned in for the daily homework in a given week the following Wednesday.

Each proof you submit will be graded using the following rubric:

- 5 Correct mathematical proof and very well written!
- 4 Small mathematical and/or grammatical errors; correct but difficult to follow
- 3 Some good ideas/progress toward a proof, but overall not a valid proof
- 2 Have set up a proof and tried something.
- 1 There's not much here; come and see me for help!

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 include all feedback on daily and weekly homework and we may need to make additional revisions. These proofs should be typed using the provided 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!

Volunteering for presentations and portfolio submissions. Before each class there will be a quiz on canvas that allows you to volunteer for presentations and portfolio submissions. You get credit for each presentation or submission you volunteer for - even if you are not chosen!

I expect that many students will volunteer and so I will choose the student who has presented or submitted the fewest times.

Before each exam, I will announce how many presentations you should be aiming for to stay on track as this will depend on the number of students in the class and how quickly we make progress.

Exams. We will have three in-class exams in addition to a comprehensive final. Tentative midterm exam dates are as follows:

Exam 1 - Wed. Sep. 19

Exam 2 - Wed. Oct. 17

Exam 3 - Mon. Nov. 19

The final exam will be cumulative with an emphasis on material we cover after Exam 3. It will be

Final Exam - Thursday, December 13, 3:30 – 5:30 pm

Grading. Grades will be assigned based on the following scheme

Homework	20%	Midterm Exams	10% each
Presentations & Participation	20%	Final Exam	20%
Portfolio Contributions	10%		

I will use the usual grading distribution in assigning final grades. (A: 90% - 100%, B: 80% - 89%, 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.

If you are anticipating an absence for a major religious holiday you must notifying me in writing of anticipated absences no later than the last day in the semester to add a class. For other scheduled absences you must notify me at least a week before. For unscheduled absences, not later than a week after. I require appropriate verification for absences.

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

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

Accommodations due to disability: If you have a documented disability that requires academic accommodations, please see me as soon as possible and we can collaborate on a solution.

In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center.

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 life-long 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 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.

Academic Integrity: Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. 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.

Plagiarism and cheating are serious breaches of academic conduct. 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 the following website: <http://www.uky.edu/Ombud>. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Senate Rules 6.3.1 (see <http://www.uky.edu/Faculty/Senate/> for the current set of Senate Rules) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) 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. Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone.

When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.