Course Syllabus

Math 302: Introduction to Proofs via Number Theory

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Number theory has a long and rich history, encompassing work by such important mathematicians as Euclid, Euler and Gauss, and it has been called the "queen of mathematics". But fascinating work in number theory is still being done today. Fermat's Last Theorem was a famous centuries-old problem that was solved in the 1990s. Many important unsolved problems still remain, like the twin prime conjecture, and the Riemann hypothesis. Number theory has practical applications as well. It provides the theoretical framework for our current standards of data encryption. Every time you make a purchase on the internet, you are using number theory! At its heart, number theory is the study of whole numbers. In this course we will study divisibility, Diophantine equations, the prime numbers, and modular arithmetic.

Course overview: This course is intended as a first introduction to mathematical proofs. You will learn to both read and write proofs in the context of elementary number theory. The way we will achieve these goals may be unlike most math classes you have taken before. We are going to approach number theory like mathematicians. Instead of sitting in class and listening to a lecture about math, you will be investigating on your own, forming and testing hypotheses, and then trying to prove what you believe to be true. This is the true essence of mathematics. Number Theory is a wonderful playground in which to develop these skills, because we are all already familiar with many properties of whole numbers. For example, you probably already believe that the sum of any two even numbers yields another even number. But have you tried to add every possible pair of even numbers? Of course not, that would be impossible. So how do you know it is true? You will learn to write logical arguments that prove this and many other facts.

Your participation (and hence your presence) in class is very important. You will be asked to present proofs of theorems, as well as discuss and critically assess the presentations of other students. You should expect to make mistakes and be willing to be wrong. This is a very natural part of the learning process. In my own math work, I am wrong most of the time. Trying and failing and trying again is how you eventually get to the truth! Don’t let fear of failure or embarrassment keep you from adding your thoughts to the discussion.

The teaching method I'm using for this course is generally called Inquiry-Based Learning (or IBL). Here's a link to an article (Links to an external site.) that talks a little about this history and benefits of IBL for teaching undergraduate math.

Course Objectives: The successful student will demonstrate:

1. proficiency in writing and presenting clear, complete, and correct mathematical proofs
2. an understanding of the principles of mathematical induction
3. an understanding of the properties and principles of divisibility, including the Euclidean Algorithm

4. knowledge of the proof of the Fundamental Theorem of Arithmetic, and its applications
5. knowledge of basic facts about the prime numbers, and the proof of the infinitude of primes
6. competence in modular arithmetic and use of the Chinese Remainder Theorem
7. knowledge of the proofs of Fermat's and Euler's Theorems and their applications

Coursework: The course is divided into eight modules. Each module begins with a group worksheet to introduce new definitions and concepts, which you will complete in class. Next, you'll be given a list of theorems to prove about the new concepts. You should work on these on your own time, and come to class prepared to present your proofs. You will be responsible for presenting at least three proofs throughout the quarter. You should keep careful notes of your work and the presented proofs in a notebook, as this will serve as your textbook for the course.

Homework: There will be 4 homework assignments given during the quarter. These will require a mixture of computation, problem-solving, and proof-writing. You will be asked to turn in some of these problems to be graded. All submitted homework must be typed or very neatly handwritten. (If you intend to continue studying mathematics, I highly recommend that you learn to use LaTeX. Typing your homework is a good way to practice.)

Exams: There will be one midterm exam and a final exam. Each exam will be comprehensive. There will be no makeup exams. If you are unable to take the midterm exam for a very serious reason verified in writing, please see me beforehand so that alternative arrangements can be made.

Grading: Your grade for the course will be weighted as follows:

20%	Proofs presented in class
30%	Homework assignments
20%	Midterm exam
30%	Final exam

Sources of help: Please talk with me about any questions or concerns you may have about the course, and make use of my office hours. You are also encouraged to discuss material with other students in our class. However, if you have had substantial assistance in doing a problem, it should be a matter of honor not to use that problem for your class presentation. ***You are not allowed to look at other textbooks or the web for solutions to problems or proofs of theorems, or to speak about the problems to students who are not in our class***. This would contradict the spirit of the class.

Academic Integrity: Don't cheat! Please consult this collection of integrity resources (Links to an external site.) for further information.

Accommodation: If you are in need of special accommodation for this course, you should first visit disAbility Resources for Students (DRS, Old Main 120) to register your eligibility, and then submit the necessary requests online. Please also feel free to talk with me early in the quarter to let me know how I can be of assistance.