Math 302 Introduction to Proofs via Number Theory Summer 2010

Instructor Dr. Amites Sarkar

Text Number Theory Through Inquiry
Marshall, Odell and Starbird

Overview

Number theory, the "queen of mathematics", has a long and rich history. In this course we will encounter some fundamental ideas of **Euclid** (who lived around 2300 years ago), as well more recent contributions from great mathematicians such as **Fermat**, **Euler** and **Gauss**. Fascinating work in number theory is still being done today, since there are many important unsolved problems. These include the **twin prime conjecture** (are there infinitely many pairs of primes which differ by exactly 2), **Goldbach's conjecture** (is every even number greater than 2 the sum of two primes) and the **Riemann hypothesis** (which is a bit harder to explain). Number theory also provides the mathematical basis for modern **cryptography**, some of which we shall study in this course.

However, the main course objective is to introduce you to mathematical **proof**. Moreover, you will learn about proofs not by reading them but by **inventing them yourself**. This will, for most of you, be unlike any other mathematics course you have taken. It will involve 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.

The success of this course will hinge on **your active participation**. You will be asked to present solutions to assigned problems, as well as to discuss and assess other student's presentations.

Exams

Midterm Monday 12 July
Final Thursday 29 July

Homework

Your standing daily assignment is to read the book, solve the exercises, and prove all the theorems. You should be prepared to present your proofs in class. Each Monday you must also submit one written proof of a theorem that was presented in class that week. You may choose to use the proof presented in class or an alternate proof, but it must be written in your own words. I will provide feedback and evaluation of your proofs based on both the mathematical content and the writing style. We will talk more about how to write proofs in class.

Grading

Your grade for the course will be based as follows:

Class presentations and participation	25%
Written proofs	20%
Midterm	25%
Final	30%

If you feel too ill to take an exam, don't take it, but bring a doctor's certificate to me when you feel better and I will make arrangements.

Office hours

My office hours are 3–4 on Mondays, Tuesdays, Wednesdays and Thursdays, in 216 Bond Hall. My phone number is 650 7569 and my e-mail is amites.sarkar@wwu.edu

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 congruence arithmetic and use of the Chinese remainder theorem.

7. Knowledge of the proofs of Fermat's and Wilson's Theorems and their applications.

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 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. That would contradict the spirit of the course.