

Math 175 Elementary Number theory
Section 30, Autumn Quarter 2006
TTh 10:30 – 12:00 a.m. in E207

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Office Hours: Mondays 12:00 – 13:30, Wednesdays 17:00 – 18:00 and by appointment.

Reader: Lola Thompson, lola@uchicago.edu, phone 773-330-5652

Main Textbook: *An Introduction to the Theory of Numbers* by Niven, Zuckerman, Montgomery, Fifth Edition.

General Policy: There will be a one hour test in class during the quarter and a final exam at the end. Homework will be assigned every week in class and will be due the following week at the beginning of class. You are encouraged to work together on homework problems, but everyone has to write up the solutions independently. Please order the pages and staple them. Unreadable homework will not be corrected.

Hour test: 30%, Final Exam: 40%, Homework: 30%

Important Dates:

Hour Test: Thursday, October 26 (in class)

Final Exam: Tuesday, December 5, 10:30 – 12:30 in E207

It is the policy of the Department of Mathematics that the following rules apply to final exams in all undergraduate mathematics courses:

1. The final exam must occur at the time and place designated on the College Final Exam Schedule. In particular, no final examinations may be given during the tenth week of the quarter, except in the case of graduating seniors.
2. Any student who wish to depart from the scheduled final exam time for the course must receive permission from Paul Sally (his office is Ry 350, his phone is 773-702-7388, his email is sally@math.uchicago.edu). Instructors are not permitted to excuse students from the scheduled time of the final exam except in cases of an Incomplete.

I am planning to cover more or less the following material:

Chapter 1 *Divisibility*: Euclidean Algorithm, Unique Prime Factorization, Miscellaneous.

Chapter 2 *Congruences*: Fermat's Theorem (I), Euler's Theorem, Fermat's Theorem (II), Chinese Remainder Theorem, Public Key Cryptography, Solving Congruences. Potentially something about finite fields.

Chapter 3 *Quadratic Reciprocity*: Legendre Symbol, The Gaussian reciprocity law, Jacobi Symbol.

Chapter 4 *Quadratic Forms*: In this chapter I want to discuss some things relating questions about quadratic forms to geometry which are not covered in the book of Niven, Zuckerman and Montgomery but play an important role in some recent problems in number theory. Binary Quadratic Forms, Geometry of the Space of Positive Definite Quadratic Forms, Geometry of the Space of Lattices, Geometry of Numbers (Section 6.4. in Niven, Zuckerman, Montgomery).

Chapter 5 *Farey Fractions and Continued Fractions*: Farey Numbers, Continued Fractions, Rational Approximations of Irrational Numbers.

If we have more time, I would be happy to discuss in addition the following things:

Chapter 6 *Some Functions and Principles*: How to compute the weekday of a date, Pigeonhole Principle, Inclusion/Exclusion-principle.

Chapter 7 *Diophantine Equations* Diophantine Equations, Elliptic Curves,

Chapter 8 *Algebraic Numbers*: Algebraic Numbers, Transcendental Numbers, Algebraic Integers

Chapter 9 *Density of Sequences of Integers*: Schnirelmann Density and Applications

As you see this plan is still tentative and subject to changes. And we will see how far we get. If you have special interests or if you come across a nice theorem you would like to have discussed in class, please come and tell me about it.

For further reading:

Three pearls of Number Theory by Khinchin.

A Course in Arithmetic by Serre.

A classical introduction to modern number theory by Ireland and Rosen.

Uncle Petros and the Goldbach conjecture by Apostolos Doxiades (Fiction).