

# Department of Basic Sciences—Philadelphia University

## Course Syllabus

Course Title	Number Theory
Course Code	250313
Semester	First/2021–2022
Lecturer	Amin Witno
Office Room	403 Nursing Faculty Building
Office Hours	Sun/Tue/Thu: 10–11; Mon/Wed: 10–11
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## Short Description

This module is an introduction to elementary number theory, covering the basic theory of divisibility, prime numbers, and congruences—leading up to the law of quadratic reciprocity—and with selected applications in cryptography.

## Topics by the Week

1. A survey into number theory, basic theorems of divisibility, residues, and the greatest common divisor (GCD) function.
2. The Euclidean algorithm, Bezout's lemma, the extended Euclidean algorithm and its application in solving linear equations.
3. Primes, trial division, factoring a composite into prime numbers, the fundamental theorem of arithmetic, evaluating GCD via factorization.
4. The infinitude of primes, the prime number theorem, Dirichlet's theorem and some well-known conjectures concerning prime numbers.
5. Congruences, residue classes and complete residue systems, solving linear congruences, modular inverses.
6. Wilson's theorem, the Chinese remainder theorem, solving a system of linear congruences.
7. Fermat's little theorem, reduced residue systems and the Euler's phi-function.
8. Euler's theorem, evaluation of the phi-function, computing power mod and the successive squaring algorithm.
9. The RSA cryptosystem.
10. Orders and primitive roots, the existence of primitive roots modulo primes.
11. The primitive root theorem, solving discrete logarithm problems.
12. Quadratic residues and nonresidues, the Legendre symbol, Euler's criterion.
13. Gauss's lemma, the quadratic reciprocity law and its proof.
14. Evaluation of the Legendre symbol using the Jacobi symbol, computing modular square roots.

## Recommended Textbook

*Theory of Numbers* (2008) BookSurge Publishing.

The pdf version of the chapters can be downloaded free of charge at the following site.

<http://witno.com/numbers>

## Supporting Material

There are three revision notes relevant to this course:

1. *Number Theory*, main lecture notes and exercise sets.
2. *The Primitive Root Theorem*, to supplement Chapter 5.
3. *The Quadratic Reciprocity Law*, to supplement Chapter 6.

The above materials can be obtained via the link below.

<http://witno.com/philadelphia/notes.htm>

## Online Resources

The following shortcut will take you to my web homepage at the University, where you find the course syllabus, exam dates, copies of old exams, links to the above materials, and any important announcement related to the current semester.

<http://phi.witno.com>

## Grade Distribution

The following guideline may be modified as necessary according to the developments of Covid-19 situation this semester.

Homeworks	
Quizzes	20%
Class participation	
First Exam	20%
Second Exam	20%
Final Exam	40%

## Exam Dates

Exam dates, once determined, will be posted online at the homepage as well as at the University student-portal page.

## Homework Sets

Homework problem sets with check answers can be downloaded also from the above homepage.

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