



**Department of Mathematics**

**College of Science**

**Salahaddin University-Erbil**

**Subject: Introduction to Number Theory**

**Course Book: Fourth Stage-First Semester**

**Lecturer's Name: Dr. Andam Ali Mustafa**

**Academic Year: 2023-2024**

# Course Book

<b>1. Course name</b>	Number Theory
<b>2. Lecturer in charge</b>	Andam Ali Mustafa
<b>3. Department / College</b>	Mathematics / Science
<b>4. Contact</b>	<b>E-mail:</b> andam.mustafa@su.edu.krd <b>Tel:</b> +9647504302367
<b>5. Time (in hours) per week</b>	2 hours
<b>6. Office hours</b>	Sunday 11:30-2:30 Or Monday 10:30-1:00
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	<ul style="list-style-type: none"> <li>❖ <b>25/8/2022</b> PhD in University Roma Tre in Rome, Italy.</li> <li>❖ <b>3/3/2015</b> M.Sc. in the Department of Mathematics, College of Science, Salahaddin University-Erbil, Iraq.</li> <li>❖ <b>31/3/2015</b> Assistant lecturer in the Department of Mathematics, College of Science, Salahaddin University-Erbil, Iraq.</li> <li>❖ <b>2/7/2009</b> B.Sc. in the Department of Mathematics, College of Science, Salahaddin University-Erbil, Iraq.</li> <li>❖ <b>2004-2005</b> Awarded a baccalaureate from the Kurdistan High School, Erbil, Iraq.</li> </ul>
<b>9. Keywords</b>	Integers, divisibility, prime numbers, unique factorization, Diophantine equations and arithmetic functions.
<p><b>10. Course overview:</b></p> <p>Number theorists' study prime numbers as well as the properties of mathematical objects made out of integers (for example, rational numbers) or defined as generalizations of integers (for example, algebraic integers). Being one of the oldest branches of math, Number Theory can be dated back to ancient Greece, where people studied integer solutions of the Pythagorean equation and proved there are infinitely many prime numbers. Despite its long history, Number Theory is still making great progress in the 20th century, with important applications to computer science, especially to cryptography, being discovered. It is the mathematics that is hidden behind Bitcoin. The class will be a beginner's guide to number theory.</p> <p>Topics discussed include divisibility, the greatest common divisor and least common multiple, prime numbers and their properties, the unique factorization theorem, basic properties of congruences, linear congruences and linear Diophantine equations.</p>	

**11. Course objective:**

The student will know what many of the most important theorems in elementary number theory say and how they can be proven, and they will be able to do calculations related to those theorems. Students will gain acquaintance with many basic topics in elementary number theory. Students will learn about primes, unique factorization, congruences, divisibility, Diophantine equations, primitive roots, and quadratic reciprocity. You can also choose to learn about sums of squares, number-theory functions, and prime number theory.

At the completion of the course, students should demonstrate competence with number theory concepts. A number theory student should be able to do modular arithmetic and know how to use modular arithmetic to study Diophantine equations. They should know the basic procedures to determine whether or not a Diophantine equation has solutions. They should understand the definition of a prime, their central role in arithmetic problems, and be knowledgeable about primes in number systems other than the integers. They should also be proficient at finding and working with primitive roots.

**12. Student's obligation**

- ❖ Students reign a commitment to come on time and remain in the classroom for the duration of scheduled classes.
- ❖ Nothingness speaks students with each other during lecture.
- ❖ All devices must be turned off.
- ❖ When teacher ask question, Students will be to raise your hand before answer his question.
- ❖ Students own an obligation to write tests and final examinations at the times scheduled by the teacher or the College.

**13. Forms of teaching**

I give hard copy of My lecture notes to students before coming lecturer time. first, I remember students about previous lecture, and then I start new lecture. At the end of the lecture give a homework for the next lecture. During this proses I use presentation and whiteboard.

**14. Assessment scheme**

- 1. Exam:** 30% marks.                      **2. Quiz:** 5% marks                      **3. Homework:** 5% marks  
**4. Final exam:** 60 % marks

**15. Student learning outcome:**

- ❖ Explain some of the concepts of number theory, a primary area of mathematics, using examples.
- ❖ Apply mathematical ideas and concepts within the context of number theory.

<ul style="list-style-type: none"> <li>❖ Solve a range of problems in number theory.</li> <li>❖ Recognize the appropriate use of the division algorithm, the divides relation and congruences in problem solving.</li> </ul>	
<p><b>16. Course Reading List and References:</b></p> <ul style="list-style-type: none"> <li>❖ Elementary Number Theory Seventh Edition by David M. Burton McGraw Hill.</li> <li>❖ Beginning Number Theory Second edition by Neville Robbins Jones and Bartlett.</li> <li>❖ Elementary Number Theory: Primes, Congruences, and Secrets a Computational Approach by William Stein Springer.</li> <li>❖ Elementary Number Theory in Nine Chapters Second Edition by James J. Tattersall Cambridge University Press.</li> </ul>	
<b>17. The Topics:</b>	<b>Lecturer's name</b>
<p><b>Chapter One: Introduction</b> Divisibility, the division algorithm, representations of integers in different bases, the greatest common divisor, the Euclidean algorithm, Lame's theorem.</p> <p><b>Chapter Two: Prime Numbers</b> The sieve of Eratosthenes, the infinitude of primes, the fundamental theorem of arithmetic, more on the infinitude of primes, least common multiple, linear Diophantine equations, the function <math>[x]</math>, the symbols "<math>\circ</math>", "<math>\circ</math>" and "<math>\sim</math>", theorems and conjectures involving prime numbers.</p> <p><b>Chapter Three: Congruences</b> Introduction to congruences, residue systems and Euler's <math>\phi</math>-function, linear congruences, the Chinese remainder theorem, theorems of Fermat, Euler, and Wilson, multiplicative number theoretic functions (the Euler <math>\phi</math> function, the sum-of-divisors function, the number-of-divisors function, the mobius function and the mobius inversion formula), perfect, Mersenne, and Fermat numbers.</p>	<p><b>Dr. Andam Ali Mustafa</b></p>
<b>18. Practical Topics (If there is any)</b>	
<p><b>19. Examinations:</b> Questions in the examination will be arranged the matching mode by way of the examples and exercises that I give delivered in the lecture notes. Sometimes will be have extra mark in examination for worthy students.</p>	

Many of the questions will take from those books that I mentioned in the References part.

**20. Extra notes:**

Answers of examination will find in the board's declaration physics department after every examination.

**21. Peer review**