Elementary Number Theory And Methods Of Proof

An undergraduate-level introduction to number theory, with the emphasis on fully explained proofs and examples. Exercises, together with their solutions are integrated into the text, and the first few chapters assume only basic school algebra. Elementary ideas about groups and rings are then used to study groups of units, quadratic residues and arithmetic functions with applications to enumeration and cryptography. The final part, suitable for third-year students, uses ideas from algebra, analysis, calculus and geometry to study Dirichlet series and sums of squares. In particular, the last chapter gives a concise account of Fermat's Last Theorem, from its origin in the ancient Babylonian and Greek study of Pythagorean triples to its recent proof by Andrew Wiles.
"This book is the first volume of a two-volume textbook for undergraduates and is indeed the crystallization of a course offered by the author at the California Institute of Technology to undergraduates without any previous knowledge of number theory. For this reason, the book starts with the most elementary properties of the natural integers. Nevertheless, the text succeeds

in presenting an enormous amount of material in little more than 300 pages."-—MATHEMATICAL REVIEWS
This practical and versatile text evolved from the author's years of teaching experience and the input of his students. Vanden Eynden strives to alleviate the anxiety that many students experience when approaching any proof-oriented area of mathematics, including number theory. His informal yet straightforward writing style explains the ideas behind the process of proof construction, showing that mathematicians develop theorems and proofs from trial and error and evolutionary improvement, not spontaneous insight. Furthermore, the book includes more computational problems than most other number theory texts to build students' familiarity and confidence with the theory behind the material. The author has devised the content, organization, and writing style so that information is accessible, students can gain self-confidence with respect to mathematics, and the book can be used in a wide range of courses—from those that emphasize history and type A problems to those that are proof oriented.
Through its engaging and unusual problems, this book demonstrates methods of reasoning necessary for learning number

theory. Every technique is followed by problems (as well as detailed hints and solutions) that apply theorems immediately, so readers can solve a variety of abstract problems in a systematic, creative manner. New solutions often require the ingenious use of earlier mathematical concepts - not the memorization of formulas and facts. Questions also often permit experimental numeric validation or visual interpretation to encourage the combined use of deductive and intuitive thinking. The first chapter starts with simple topics like even and odd numbers, divisibility, and prime numbers and helps the reader to solve quite complex, Olympiad-type problems right away. It also covers properties of the perfect, amicable, and figurate numbers and introduces congruence. The next chapter begins with the Euclidean algorithm, explores the representations of integer numbers in different bases, and examines continued fractions, quadratic irrationalities, and the Lagrange Theorem. The last section of Chapter Two is an exploration of different methods of proofs. The third chapter is dedicated to solving Diophantine linear and nonlinear equations and includes different methods of solving Fermat's (Pell's) equations. It also covers Fermat's factorization techniques and methods of solving challenging problems involving

exponent and factorials. Chapter Four reviews the Pythagorean triple and quadruple and emphasizes their connection with geometry, trigonometry, algebraic geometry, and stereographic projection. A special case of Waring's problem as a representation of a number by the sum of the squares or cubes of other numbers is covered, as well as quadratic residuals, Legendre and Jacobi symbols, and interesting word problems related to the properties of numbers. Appendices provide a historic overview of number theory and its main developments from the ancient cultures in Greece, Babylon, and Egypt to the modern day. Drawing from cases collected by an accomplished female mathematician, Methods in Solving Number Theory Problems is designed as a self-study guide or supplementary textbook for a one-semester course in introductory number theory. It can also be used to prepare for mathematical Olympiads. Elementary algebra, arithmetic and some calculus knowledge are the only prerequisites. Number theory gives precise proofs and theorems of an irreproachable rigor and sharpens analytical thinking, which makes this book perfect for anyone looking to build their mathematical confidence.
Quadratic Number Theory: An Invitation to Algebraic Methods in the

Higher Arithmetic
The Prime Number Theorem
Equations and Inequalities
Steps into Analytic Number Theory

This problem book gathers together 15 problem sets on analytic number theory that can be profitably approached by anyone from advanced high school students to those pursuing graduate studies. It emerged from a 5-week course taught by the first author as part of the 2019 Ross/Asia Mathematics Program held from July 7 to August 9 in Zhenjiang, China. While it is recommended that the reader has a solid background in mathematical problem solving (as from training for mathematical contests), no possession of advanced subject-matter knowledge is assumed. Most of the solutions require nothing more than elementary number theory and a good grasp of calculus. Problems touch at key topics like the value-distribution of arithmetic functions, the distribution of prime numbers, the distribution of squares and nonsquares modulo a prime number, Dirichlet's theorem on primes in arithmetic progressions, and more. This book is suitable for any student with a special interest in developing problem-solving skills in analytic number theory. It will be an invaluable aid to lecturers and students as a supplementary text for introductory Analytic Number Theory courses at both the *undergraduate and graduate level.*

Discrete Mathematics and its Applications, Sixth Edition, is intended for one- or two-term introductory discrete mathematics courses taken by students from a wide variety of majors, including computer science, mathematics, and engineering. This renowned best-selling text, which has been used at over 500 institutions around the world, gives a focused introduction to the primary themes in a discrete mathematics course and demonstrates the relevance and practicality of discrete mathematics to a wide a wide variety of real-world applications...from computer science to data networking, to psychology, to chemistry, to engineering, to linguistics, to biology, to business, and to many other important fields.

Taking readers from elementary number theory, via algorithmic, to applied number theory in computer science, this text introduces basic concepts, results, and methods, before going on to discuss their applications in the design of hardware and software, cryptography, and security. Aimed at undergraduates in computing and information technology, and presupposing only high-school math, this book will also interest mathematics students concerned with applications. XXXXXXX Neuer Text This is an essential introduction to number theory for computer scientists. It treats three areas, elementary-, algorithmic-, and applied *number theory in a unified and accessible manner. It introduces basic concepts and methods, and discusses their applications to the design of hardware, software, cryptography, and information security. Aimed at computer scientists, electrical engineers and students the presentation presupposes only an understanding of high-school math.*

*This second edition updates the well-regarded 2001 publication with new short sections on topics like Catalan numbers and their relationship to Pascal's triangle and Mersenne numbers, Pollard rho factorization method, Hoggatt-Hensell identity. Koshy has added a new chapter on continued fractions. The unique features of the first edition like news of recent discoveries, biographical sketches of mathematicians, and applications--like the use of congruence in scheduling of a round-robin tournament--are being refreshed with current information. More challenging exercises are included both in the textbook and in the instructor's manual. Elementary Number Theory with Applications 2e is ideally suited for undergraduate students and is especially appropriate for prospective and in-service math teachers at the high school and middle school levels. * Loaded with pedagogical features including fully worked examples, graded exercises, chapter summaries, and computer exercises * Covers crucial applications of theory like computer security, ISBNs, ZIP codes, and UPC bar codes * Biographical* *sketches lay out the history of mathematics, emphasizing its roots in India and the Middle East*

A Second Course in Elementary Number Theory

Elementary Introduction to Number Theory

An Introductory Course

Elementary Number Theory with Applications

Solutions of equations in integers is the central problem of number theory and is the focus of this book. The amount of material is suitable for a one-semester course. The author has tried to avoid the ad hoc proofs in favor of unifying ideas that work in many situations. There are exercises at the end of almost every section, so that each new idea or proof receives immediate reinforcement.

Elementary Number Theory and Its Applicationsis noted for its outstanding exercise sets, including basic exercises, exercises designed to help students explore key concepts, and challenging exercises. Computational exercises and computer projects are also provided. In addition to years of use and professor feedback, the fifth edition of this text has been thoroughly checked to ensure the quality and accuracy of the mathematical content and the exercises. The blending of classical theory with modern applications is a hallmark feature of the text. The Fifth Edition builds on this strength with new examples and exercises, additional applications and increased cryptology coverage. The author devotes a great deal of attention to making this new edition up-to-date, incorporating new results and discoveries in number theory made in the past few years.

This accessible Third Edition incorporates especially complete & detailed arguments, illustrating definitions, theorems, & subtleties of proof with explicit numerical examples whenever possible.

Undergraduate text uses combinatorial approach to accommodate both math majors and liberal arts students. Covers the basics of number theory, offers an outstanding introduction to partitions, plus chapters on multiplicativity-divisibility, quadratic congruences, additivity, and more

Lectures on Elementary Number Theory

An Algebraic Approach

Elementary Theory of Numbers

Discrete Mathematics and Its Applications

Elementary Number Theory takes an accessible approach to teaching students about the role of number theory in pure mathematics and its important applications to cryptography and other areas. The first chapter of the book explains how to do proofs and includes a brief discussion of lemmas, propositions, theorems, and corollaries. The core of the text covers linear Diophantine equations; unique factorization; congruences; Fermat's, Euler's, and Wilson's theorems; order and primitive roots; and quadratic reciprocity. The authors also discuss numerous cryptographic topics, such as RSA and discrete

logarithms, along with recent developments. The book offers many pedagogical features. The "check your understanding" problems scattered throughout the chapters assess whether students have learned essential information. At the end of every chapter, exercises reinforce an understanding of the material. Other exercises introduce new and interesting ideas while computer exercises reflect the kinds of explorations that number theorists often carry out in their research.

At first glance the prime numbers appear to be distributed in a very irregular way amongst the integers, but it is possible to produce a simple formula that tells us (in an approximate but well defined sense) how many primes we can expect to find that are less than any integer we might choose. The prime number theorem tells us what this formula is and it is indisputably one of the great classical theorems of mathematics. This textbook gives an introduction to the prime number theorem suitable for advanced undergraduates and beginning graduate students. The author's aim is to show the reader how the tools of analysis can be used in number theory to attack a 'real' problem, and it is based on his own experiences of teaching this material.

The fourth edition of Kenneth Rosen's widely used and successful text, Elementary Number Theory and Its Applications, preserves the strengths of the previous editions, while enhancing the book's flexibility and depth of content coverage.The blending of classical theory with modern applications is a hallmark *feature of the text. The Fourth Edition builds on this strength with new examples, additional applications and increased cryptology coverage. Up-to-date information on the latest discoveries is included.Elementary Number Theory and Its Applications provides a diverse group of exercises, including basic exercises designed to help students develop skills, challenging exercises and computer projects. In addition to years of use and professor feedback, the fourth edition of this text has been thoroughly accuracy checked to ensure the quality of the mathematical content and the exercises.*

This valuable book focuses on a collection of powerful methods of analysis that yield deep number-theoretical estimates. Particular attention is given to counting functions of prime numbers and multiplicative arithmetic functions. Both real variable (?elementary?) and complex variable (?analytic?) methods are employed. The reader is assumed to have knowledge of elementary number theory (abstract algebra will also do) and real and complex analysis. Specialized analytic techniques, including transform and Tauberian methods, are developed as needed.Comments and corrigenda for the book are found at http: //www.math.uiuc.edu/ diamond/

Elements of Number Theory

EBOOK: Elementary Number Theory

Elementary Problems and Theorems in Algebra and Number Theory

Number Theory for Elementary School Teachers

Elementary Number Theory, Gove Effinger, Gary L. Mullen This text is intended to be used as an undergraduate introduction to the theory of numbers. The authors have been immersed in this area of mathematics for many years and hope that this text will inspire students (and instructors) to study, understand, and come to love this truly beautiful subject. Each chapter, after an introduction, develops a new topic clearly broken out in sections which include theoretical material together with numerous examples, each worked out in considerable detail. At the end of each chapter, after a summary of the topic, there are a number of solved problems, also worked out in detail, followed by a set of supplementary problems. These latter problems give students a chance to test their own understanding of the material; solutions to some but not all of them complete the chapter. The first eight chapters discuss some standard material in elementary number theory. The remaining chapters discuss topics which might be considered a bit more advanced. The text closes with a chapter on Open Problems in Number Theory. Students (and of course instructors) are strongly encouraged to study this chapter carefully and fully realize that not all mathematical issues and problems have been resolved! There is still much to be learned and many questions to be

answered in mathematics in general and in number theory in particular. A look at solving problems in three areas of classical elementary mathematics: equations and systems of equations of various kinds, algebraic inequalities, and elementary number theory, in particular divisibility and diophantine equations. In each topic, brief theoretical discussions are followed by carefully worked out examples of increasing difficulty, and by exercises which range from routine to rather more challenging problems. While it emphasizes some methods that are not usually covered in beginning university courses, the book nevertheless teaches techniques and skills which are useful beyond the specific topics covered here. With approximately 330 examples and 760 exercises. Number theory is one of the few areas of mathematics where problems of substantial interest can be fully described to someone with minimal mathematical background. Solving such problems sometimes requires difficult and deep methods. But this is not a universal phenomenon; many engaging problems can be successfully attacked with little more than one's mathematical bare hands. In this case one says that the problem can be solved in an elementary way. Such elementary methods and the problems to which they apply are the subject of this book. Not Always Buried Deep is designed to be read and enjoyed by those who wish to explore elementary *methods in modern number theory. The heart of the book is a thorough introduction to elementary prime number theory, including Dirichlet's theorem on primes in arithmetic progressions, the Brun sieve, and the Erdos-Selberg proof of the prime number theorem. Rather than trying to present a comprehensive treatise, Pollack focuses on topics that are particularly attractive and accessible. Other topics covered include Gauss's theory of cyclotomy and its applications to rational reciprocity laws, Hilbert's solution to Waring's problem, and modern work on perfect numbers. The nature of the material means that little is required in terms of prerequisites: The reader is expected to have prior familiarity with number theory at the level of an undergraduate course and a first course in modern algebra (covering groups, rings, and fields). The exposition is complemented by over 200 exercises and 400 references.*

A highly successful presentation of the fundamental concepts of number theory and computer programming Bridging an existing gap between mathematics and programming, Elementary Number Theory with Programming provides a unique introduction to elementary number theory with fundamental coverage of computer programming. Written by highly-qualified experts in the fields of computer science and mathematics, the book features accessible coverage for readers with various levels of

experience and explores number theory in the context of programming without relying on advanced prerequisite knowledge and concepts in either area. Elementary Number Theory with Programming features comprehensive coverage of the methodology and applications of the most well-known theorems, problems, and concepts in number theory. Using standard mathematical applications within the programming field, the book presents modular arithmetic and prime decomposition, which are the basis of the public-private key system of cryptography. In addition, the book includes: Numerous examples, exercises, and research challenges in each chapter to encourage readers to work through the discussed concepts and ideas Select solutions to the chapter exercises in an appendix Plentiful sample computer programs to aid comprehension of the presented material for readers who have either never done any programming or need to improve their existing skill set A related website with links to select exercises An Instructor's Solutions Manual available on a companion website Elementary Number Theory with Programming is a useful textbook for undergraduate and graduate-level students majoring in mathematics or computer science, as well as an excellent supplement for teachers and students who would like to better understand and appreciate number theory and computer programming. The book is also an ideal reference for

computer scientists, programmers, and researchers interested in the mathematical applications of programming.

Introduction to Analytic Number Theory

Elementary Number Theory with Programming

Elementary Methods in Number Theory

Elementary Number Theory: Primes, Congruences, and Secrets

Elementary Number Theory, Seventh Edition, is written for the one-semester undergraduate number theory course taken by math majors, secondary education majors, and computer science students. This contemporary text provides a simple account of classical number theory, set against a historical background that shows the subject's evolution from antiquity to recent research. Written in David Burton ’ s engaging style, Elementary Number Theory reveals the attraction that has drawn leading mathematicians and amateurs alike to number theory over the course of history.

Number theory is an important research field of mathematics. In mathematical competitions, problems of elementary number theory occur frequently. These problems use little knowledge and have many variations. They are flexible and diverse. In this book, the author introduces some basic concepts and methods in elementary number theory via problems in mathematical competitions. Readers are encouraged to try to solve the problems by themselves before they read the given solutions of examples. Only in this way can they truly appreciate the tricks of problem-solving.

In response to concerns about teacher retention, especially among teachers in their first to fourth year in the classroom, we offer future teachers a series of brief guides full of practical advice that they can refer to in both their student teaching and in their first years on the job. Number Theory for Elementary School Teachers is designed for preservice candidates in early and/or elementary education. The text complements traditional Math Methods courses and provides deep content knowledge for prospective and first year teachers.

DIVBasic treatment, incorporating language of abstract algebra and a history of the discipline. Unique factorization and the GCD, quadratic residues, sums of squares, much more. Numerous problems. Bibliography. 1977 edition. /div

Number Theory

250 Problems in Elementary Number Theory

Not Always Buried Deep

A Pathway Into Number Theory

This book leads readers from simple number work to the point where they can prove the classical results of elementary number theory for themselves.

These notes serve as course notes for an undergraduate course in number theory. Most if not all universities worldwide offer introductory courses in number theory for math majors and in many cases as an elective course. The notes contain a useful introduction to important topics that need to be addressed in a course in number theory. Proofs of basic theorems are presented in an interesting and comprehensive way that can be read and understood even by non-majors with the exception in the last three chapters where a background in analysis, measure theory and abstract algebra is required. The exercises are carefully chosen to broaden the understanding of the concepts. Moreover, these notes shed light on analytic number theory, a subject that is rarely seen or approached by undergraduate students. One of the unique characteristics of these notes is the careful choice of topics and its importance in the theory of numbers. The freedom is given in the last two chapters because of the advanced nature of the topics that are presented.

This text provides a simple account of classical number theory, as well as some of the historical background in which the subject evolved. It is intended for use in a one-semester, undergraduate number theory course taken primarily by mathematics majors and students preparing to be secondary school teachers. Although the text was written with this readership in mind, very few formal prerequisites are required. Much of the text can be read by students with a sound background in high school mathematics.

This basic introduction to number theory is ideal for those with no previous knowledge of the subject. The main topics of divisibility, congruences, and the distribution of prime numbers are covered. Of particular interest is the inclusion of a proof for one of the most famous results in mathematics, the prime number theorem. With many examples and exercises, and only requiring knowledge of a little calculus and algebra, this book will suit individuals with imagination and interest in following a mathematical argument to its conclusion.

Number Theory for Computing

Elementary Number Theory and Its Applications

An Introductory Course in Elementary Number Theory

Analytic Number Theory

"With almost a thousand imaginative exercises and problems, this book stimulates curiosity about numbers and their properties."

This is a book about prime numbers, congruences, secret messages, and elliptic curves that you can read cover to cover. It grew out of undergr- uate courses that the author taught at Harvard, UC San Diego, and the University of Washington. The systematic study of number theory was initiated around 300B. C. when Euclid proved that there are in?nitely many prime numbers, and also cleverly deduced the fundamental theorem of arithmetic, which asserts that every positive integer factors uniquely as a product of primes. Over a thousand years later (around 972A. D.) Arab mathematicians formulated the congruent number problem that asks for a way to decide whether or not a given positive integer n is the area of a right triangle, all three of whose sides are rational numbers. Then another thousand years later (in 1976), Di?e and Hellman introduced the ?rst ever public-key cryptosystem, which enabled two people to communicate secretely over a public communications channel with no predetermined secret; this invention and

the ones that followed it revolutionized the world of digital communication. In the 1980s and 1990s, elliptic curves revolutionized number theory, providing striking new insights into the congruent number problem, primality testing, publ- key cryptography, attacks on public-key systems, and playing a central role in Andrew Wiles' resolution of Fermat's Last Theorem.

This book explains clearly and in detail the basic concepts and methods of calculations of the elementary theory of numbers. It consists of 7 chapters illustrated by numerous examples and exercises. Answers together with some hints to the exercises are given at the end of the book. It may be used as a textbook for undergraduate students.

Quadratic Number Theory is an introduction to algebraic number theory for readers with a moderate knowledge of elementary number theory and some familiarity with the terminology of abstract algebra. By restricting attention to questions about squares the author achieves the dual goals of making the presentation accessible to undergraduates and reflecting the historical roots of the subject. The representation of integers by quadratic forms is emphasized throughout the text. Lehman introduces an innovative notation for ideals of a quadratic domain that greatly facilitates computation and he uses this to particular effect. The text has an unusual focus on actual computation. This focus, and this notation, serve the author's historical purpose as well; ideals can be seen as number-like objects, as Kummer and Dedekind conceived of them. The notation can be adapted to quadratic forms and provides insight into the connection

between quadratic forms and ideals. The computation of class groups and continued fraction representations are featured—the author's notation makes these computations particularly illuminating. Quadratic Number Theory, with its exceptionally clear prose, hundreds of exercises, and historical motivation, would make an excellent textbook for a second undergraduate course in number theory. The clarity of the exposition would also make it a terrific choice for independent reading. It will be exceptionally useful as a fruitful launching pad for undergraduate research projects in algebraic number theory.

Fundamentals of Number Theory

A Computational Approach

Methods of Solving Number Theory Problems

Second Edition

This book serves as a one-semester introductory course in number theory. Throughout the book, Tattersall adopts a historical perspective and gives emphasis to some of the subject's applied aspects, highlighting the field of cryptography. At the heart of the book are the major number theoretic accomplishments of Euclid, Fermat, Gauss, Legendre, and Euler, and to fully illustrate the properties of numbers and concepts developed in the text, a wealth of exercises has been included. The reader should have "pencil in hand" and ready access to a calculator or computer. For students new to number theory, whatever their background, this is a stimulating and entertaining introduction to the subject.

A Problem-Based Introduction

Problems of Number Theory in Mathematical Competitions

Elementary Number Theory

Elementary Number Theory in Nine Chapters