ELLIPTIC CURVES AND THEIR APPLICATIONS TO CRYPTOGRAPHY
An Introduction

Andreas Enge

Elliptic Curves And Their Applications To Cryptography An Introduction

Mostafa Ezziyyani,Mohamed Bahaj,Faddoul Khoukhi

Elliptic Curves And Their Applications To Cryptography An Introduction:

   Elliptic Curves and Their Applications to Cryptography Andreas Enge,2012-12-06 Since their invention in the late seventies public key cryptosystems have become an indispensable asset in establishing private and secure electronic communication and this need given the tremendous growth of the Internet is likely to continue growing Elliptic curve cryptosystems represent the state of the art for such systems Elliptic Curves and Their Applications to Cryptography An Introduction provides a comprehensive and self contained introduction to elliptic curves and how they are employed to secure public key cryptosystems Even though the elegant mathematical theory underlying cryptosystems is considerably more involved than for other systems this text requires the reader to have only an elementary knowledge of basic algebra The text nevertheless leads to problems at the forefront of current research featuring chapters on point counting algorithms and security issues The Adopted unifying approach treats with equal care elliptic curves over fields of even characteristic which are especially suited for hardware implementations and curves over fields of odd characteristic which have traditionally received more attention Elliptic Curves and Their Applications An Introduction has been used successfully for teaching advanced undergraduate courses It will be of greatest interest to mathematicians computer scientists and engineers who are curious about elliptic curve cryptography in practice without losing the beauty of the underlying mathematics

   Modern Cryptography and Elliptic Curves Thomas R. Shemanske,2017-07-31 This book offers the beginning undergraduate student some of the vista of modern mathematics by developing and presenting the tools needed to gain an understanding of the arithmetic of elliptic curves over finite fields and their applications to modern cryptography This gradual introduction also makes a significant effort to teach students how to produce or discover a proof by presenting mathematics as an exploration and at the same time it provides the necessary mathematical underpinnings to investigate the practical and implementation side of elliptic curve cryptography ECC Elements of abstract algebra number theory and affine and projective geometry are introduced and developed and their interplay is exploited Algebra and geometry combine to characterize congruent numbers via rational points on the unit circle and group law for the set of points on an elliptic curve arises from geometric intuition provided by B zout s theorem as well as the construction of projective space The structure of the unit group of the integers modulo a prime explains RSA encryption Pollard s method of factorization Diffie Hellman key exchange and ElGamal encryption while the group of points of an elliptic curve over a finite field motivates Lenstra s elliptic curve factorization method and ECC The only real prerequisite for this book is a course on one variable calculus other necessary mathematical topics are introduced on the fly Numerous exercises further guide the exploration   *Elliptic Curves* Lawrence C. Washington,2008-04-03 Like its bestselling predecessor Elliptic Curves Number Theory and Cryptography Second Edition develops the theory of elliptic curves to provide a basis for both number theoretic and cryptographic applications With additional exercises this edition offers more comprehensive coverage of the fundamental theory techniques

and application   Information Security and Cryptology Dingyi Pei,2008-07-18 This book constitutes the thoroughly refereed post conference proceedings of the Third SKLOIS State Key Laboratory of Information Security Conference on Information Security and Cryptology Inscrypt 2007 formerly CISC held in Xining China in August September 2007 The 33 revised full papers and 10 revised short papers presented together with 2 invited papers were carefully reviewed and selected from 167 submissions The papers are organized in topical sections on digital signature schemes block cipher key management zero knowledge and secure computation protocols secret sharing stream cipher and pseudorandomness boolean functions privacy and deniability hash functions public key cryptosystems public key analysis application security system security and trusted computing and network security   **Algebraic Curves in Cryptography** San Ling,Huaxiong Wang,Chaoping Xing,2013-06-13 The reach of algebraic curves in cryptography goes far beyond elliptic curve or public key cryptography yet these other application areas have not been systematically covered in the literature Addressing this gap Algebraic Curves in Cryptography explores the rich uses of algebraic curves in a range of cryptographic applications such as secret sh

Proceedings of the Seventh International Conference on Mathematics and Computing Debasis Giri,Kim-Kwang Raymond Choo,Saminathan Ponnusamy,Weizhi Meng,Sedat Akleylek,Santi Prasad Maity,2022-03-05 This book features selected papers from the 7th International Conference on Mathematics and Computing ICMC 2021 organized by Indian Institute of Engineering Science and Technology IIEST Shibpur India during March 2021 It covers recent advances in the field of mathematics statistics and scientific computing The book presents innovative work by leading academics researchers and experts from industry   Algebraic Curves and Their Applications Lubjana Beshaj,Tony Shaska,2019-02-26 This volume contains a collection of papers on algebraic curves and their applications While algebraic curves traditionally have provided a path toward modern algebraic geometry they also provide many applications in number theory computer security and cryptography coding theory differential equations and more Papers cover topics such as the rational torsion points of elliptic curves arithmetic statistics in the moduli space of curves combinatorial descriptions of semistable hyperelliptic curves over local fields heights on weighted projective spaces automorphism groups of curves hyperelliptic curves dessins d enfants applications to Painlev equations descent on real algebraic varieties quadratic residue codes based on hyperelliptic curves and Abelian varieties and cryptography This book will be a valuable resource for people interested in algebraic curves and their connections to other branches of mathematics   **Algebraic Geometry in Coding Theory and Cryptography** Harald Niederreiter,Chaoping Xing,2009-09-21 This textbook equips graduate students and advanced undergraduates with the necessary theoretical tools for applying algebraic geometry to information theory and it covers primary applications in coding theory and cryptography Harald Niederreiter and Chaoping Xing provide the first detailed discussion of the interplay between nonsingular projective curves and algebraic function fields over finite fields This interplay is fundamental to research in the field today yet until now no other textbook has featured complete proofs of it Niederreiter and Xing cover

classical applications like algebraic geometry codes and elliptic curve cryptosystems as well as material not treated by other books including function field codes digital nets code based public key cryptosystems and frameproof codes Combining a systematic development of theory with a broad selection of real world applications this is the most comprehensive yet accessible introduction to the field available Introduces graduate students and advanced undergraduates to the foundations of algebraic geometry for applications to information theory Provides the first detailed discussion of the interplay between projective curves and algebraic function fields over finite fields Includes applications to coding theory and cryptography Covers the latest advances in algebraic geometry codes Features applications to cryptography not treated in other books

APPLIED CRYPTOGRAPHY SINGH, KHUMANTHEM MANGLEM,2025-02-01 Cryptography is often perceived as a highly mathematical subject making it challenging for many learners to grasp Recognizing this the book has been written with a focus on accessibility requiring minimal prerequisites in number theory or algebra The book aims to explain cryptographic principles and how to apply and develop cryptographic algorithms and systems The book comprehensively covers symmetric and asymmetric ciphers hashes digital signatures random number generators authentication schemes secret sharing schemes key distribution elliptic curves and their practical applications To simplify the subject the book begins with an introduction to the essential concepts of number theory tailored for students with little to no prior exposure The content is presented with an algorithmic approach and includes numerous illustrative examples making it ideal for beginners as well as those seeking a refresher Overall the book serves as a practical and approachable guide to mastering the subject KEY FEATURE Includes recent applications of elliptic curves with extensive algorithms and corresponding examples and exercises with detailed solutions Primality testing algorithms such as Miller Rabin Solovay Strassen and Lucas Lehmer for Mersenne integers are described for selecting strong primes Factoring algorithms such as Pollard r 1 Pollard Rho Dixon s Quadratic sieve Elliptic curve factoring algorithms are discussed Paillier cryptosystem and Paillier publicly verifiable secret sharing scheme are described Signcryption scheme that provides both confidentiality and authentication is explained for traditional and elliptic curve based approaches TARGET AUDIENCE B Tech Computer Science and Engineering B Tech Electronics and Communication Engineering   Mathematics in Cyber Research Paul L. Goethals,Natalie M. Scala,Daniel T. Bennett,2022-02-07 In the last decade both scholars and practitioners have sought novel ways to address the problem of cybersecurity Innovative outcomes have included applications such as blockchain as well as creative methods for cyber forensics software development and intrusion prevention Accompanying these technological advancements discussion on cyber matters at national and international levels has focused primarily on the topics of law policy and strategy The objective of these efforts is typically to promote security by establishing agreements among stakeholders on regulatory activities Varying levels of investment in cyberspace however comes with varying levels of risk in some ways this can translate directly to the degree of emphasis for pushing substantial change At the very foundation or root of cyberspace systems and processes

are tenets and rules governed by principles in mathematics Topics such as encrypting or decrypting file transmissions modeling networks performing data analysis quantifying uncertainty measuring risk and weighing decisions or adversarial courses of action represent a very small subset of activities highlighted by mathematics To facilitate education and a greater awareness of the role of mathematics in cyber systems and processes a description of research in this area is needed Mathematics in Cyber Research aims to familiarize educators and young researchers with the breadth of mathematics in cyber related research Each chapter introduces a mathematical sub field describes relevant work in this field associated with the cyber domain provides methods and tools as well as details cyber research examples or case studies Features One of the only books to bring together such a diverse and comprehensive range of topics within mathematics and apply them to cyber research Suitable for college undergraduate students or educators that are either interested in learning about cyber related mathematics or intend to perform research within the cyber domain The book may also appeal to practitioners within the commercial or government industry sectors Most national and international venues for collaboration and discussion on cyber matters have focused primarily on the topics of law policy strategy and technology This book is among the first to address the underpinning mathematics   Intelligent and Safe Computer Systems in Control and Diagnostics Zdzislaw Kowalczuk,2022-08-31 The main subject matter of the book is related to the demands of research and industrial centers for diagnostics monitoring and decision making systems that result from the increasing complexity of automation and systems the need to ensure the highest level of reliability and safety and continuing research and the development of innovative approaches to fault diagnosis Most welcome are combinations of domains of engineering knowledge for diagnosis including detection isolation localization identification reconfiguration and fault tolerant control This field is open to new challenges including industrial diagnostics diagnostics of computer systems and networks as well as non industrial applications in the form of medical diagnostics especially those based on artificial intelligence and deep neural networks Our community is mainly interested in the following six topics fault detection isolation and identification FDI ii fault tolerant control systems iii process safety quality and reliability iv medical diagnostics as well as v methodologies based on mathematical modeling parameter identification and state estimation qualitative models statistical and signal processing artificial intelligence fuzzy logic and rough sets expert systems neural networks and vi industrial applications of diagnostics in fault tolerant problems safety monitoring and alarming quality control computer systems and networks diagnostic software software reliability medicine and therapy environment protection production control and other industries such as chemistry electronics and power systems The book is divided into six parts I Artificial Intelligence in Medicine II Cybersecurity III Artificial Neural Networks IV Fault Detection V Systems Modeling and VI Adaptive Robust and FTC Systems   *Computational Number Theory and Modern Cryptography* Song Y. Yan,2013-01-29 The only book to provide a unified view of the interplay between computational number theory and cryptography Computational number theory and modern cryptography are two of the most

important and fundamental research fields in information security In this book Song Y Yang combines knowledge of these two critical fields providing a unified view of the relationships between computational number theory and cryptography The author takes an innovative approach presenting mathematical ideas first thereupon treating cryptography as an immediate application of the mathematical concepts The book also presents topics from number theory which are relevant for applications in public key cryptography as well as modern topics such as coding and lattice based cryptography for post quantum cryptography The author further covers the current research and applications for common cryptographic algorithms describing the mathematical problems behind these applications in a manner accessible to computer scientists and engineers Makes mathematical problems accessible to computer scientists and engineers by showing their immediate application Presents topics from number theory relevant for public key cryptography applications Covers modern topics such as coding and lattice based cryptography for post quantum cryptography Starts with the basics then goes into applications and areas of active research Geared at a global audience classroom tested in North America Europe and Asia Incudes exercises in every chapter Instructor resources available on the book s Companion Website Computational Number Theory and Modern Cryptography is ideal for graduate and advanced undergraduate students in computer science communications engineering cryptography and mathematics Computer scientists practicing cryptographers and other professionals involved in various security schemes will also find this book to be a helpful reference   **Interactive Theorem Proving** Gerwin Klein,Ruben Gamboa,2014-06-28 This book constitutes the proceedings of the 5th International Conference on Interactive Theorem Proving ITP 2014 Held as Part of the Vienna Summer of Logic VSL 2014 in Vienna Austria in July 2014 The 35 papers presented in this volume were carefully reviewed and selected from 59 submissions The topics range from theoretical foundations to implementation aspects and applications in program verification security and formalization of mathematics   **Applied Number Theory** Harald Niederreiter,Arne Winterhof,2015-09-01 This textbook effectively builds a bridge from basic number theory to recent advances in applied number theory It presents the first unified account of the four major areas of application where number theory plays a fundamental role namely cryptography coding theory quasi Monte Carlo methods and pseudorandom number generation allowing the authors to delineate the manifold links and interrelations between these areas Number theory which Carl Friedrich Gauss famously dubbed the queen of mathematics has always been considered a very beautiful field of mathematics producing lovely results and elegant proofs While only very few real life applications were known in the past today number theory can be found in everyday life in supermarket bar code scanners in our cars GPS systems in online banking etc Starting with a brief introductory course on number theory in Chapter 1 which makes the book more accessible for undergraduates the authors describe the four main application areas in Chapters 2 5 and offer a glimpse of advanced results that are presented without proofs and require more advanced mathematical skills In the last chapter they review several further applications of number theory ranging from check digit systems to quantum computation and the

organization of raster graphics memory Upper level undergraduates graduates and researchers in the field of number theory will find this book to be a valuable resource **Advanced Information Technology, Services and Systems** Mostafa Ezziyyani,Mohamed Bahaj,Faddoul Khoukhi,2017-11-10 This book includes the proceedings of the International Conference on Advanced Information Technology Services and Systems AIT2S 17 held on April 14 15 2017 in Tangier Morocco Presenting the latest research in the field it stimulates debate discusses new challenges and provides insights into the field in order to promote closer interaction and interdisciplinary collaboration between researchers and practitioners Intended for researchers and practitioners in advanced information technology management and networking the book is also of interest to those in emergent fields such as data science and analytics big data Internet of Things smart networked systems artificial intelligence and expert systems pattern recognition and cloud computing **Elliptic Curves** Lawrence C. Washington,2003-05-28 Elliptic curves have played an increasingly important role in number theory and related fields over the last several decades most notably in areas such as cryptography factorization and the proof of Fermat s Last Theorem However most books on the subject assume a rather high level of mathematical sophistication and few are truly accessible to senior undergraduate or beginning graduate students Assuming only a modest background in elementary number theory groups and fields Elliptic Curves Number Theory and Cryptography introduces both the cryptographic and number theoretic sides of elliptic curves interweaving the theory of elliptic curves with their applications The author introduces elliptic curves over finite fields early in the treatment leading readers directly to the intriguing cryptographic applications but the book is structured so that readers can explore the number theoretic aspects independently if desired By side stepping algebraic geometry in favor an approach based on basic formulas this book clearly demonstrates how elliptic curves are used and opens the doors to higher level studies Elliptic Curves offers a solid introduction to the mathematics and applications of elliptic curves that well prepares its readers to tackle more advanced problems in cryptography and number theory

Applied Algebra, Algebraic Algorithms and Error-Correcting Codes Marc Fossorier,Hideki Imai,Shu Lin,Alain Poli,2003-07-31 This book constitutes the refereed proceedings of the 19th International Symposium on Applied Algebra Algebraic Algorithms and Error Correcting Codes AAECC 13 held in Honolulu Hawaii USA in November 1999 The 42 revised full papers presented together with six invited survey papers were carefully reviewed and selected from a total of 86 submissions The papers are organized in sections on codes and iterative decoding arithmetic graphs and matrices block codes rings and fields decoding methods code construction algebraic curves cryptography codes and decoding convolutional codes designs decoding of block codes modulation and codes Gr bner bases and AG codes and polynomials *Security in IoT-Enabled Spaces* Fadi Al-Turjman,2019-02-07 Security and smart spaces are among the most significant topics in IoT nowadays The implementation of secured smart spaces is at the heart of this concept and its development is a key issue in the next generation IoT This book addresses major security aspects and challenges in realizing smart spaces and sensing

platforms in critical Cloud and IoT applications The book focuses on both the design and implementation aspects of security models and strategies in smart that are enabled by wireless sensor networks and RFID systems It mainly examines seamless data access approaches and encryption and decryption aspects in reliable IoT systems **Mathematical Modelling for Next-Generation Cryptography** Tsuyoshi Takagi,Masato Wakayama,Keisuke Tanaka,Noboru Kunihiro,Kazufumi Kimoto,Dung Hoang Duong,2017-07-25 This book presents the mathematical background underlying security modeling in the context of next generation cryptography By introducing new mathematical results in order to strengthen information security while simultaneously presenting fresh insights and developing the respective areas of mathematics it is the first ever book to focus on areas that have not yet been fully exploited for cryptographic applications such as representation theory and mathematical physics among others Recent advances in cryptanalysis brought about in particular by quantum computation and physical attacks on cryptographic devices such as side channel analysis or power analysis have revealed the growing security risks for state of the art cryptographic schemes To address these risks high performance next generation cryptosystems must be studied which requires the further development of the mathematical background of modern cryptography More specifically in order to avoid the security risks posed by adversaries with advanced attack capabilities cryptosystems must be upgraded which in turn relies on a wide range of mathematical theories This book is suitable for use in an advanced graduate course in mathematical cryptography while also offering a valuable reference guide for experts

Cybercryptography: Applicable Cryptography for Cyberspace Security Song Y. Yan,2018-12-04 This book provides the basic theory techniques and algorithms of modern cryptography that are applicable to network and cyberspace security It consists of the following nine main chapters Chapter 1 provides the basic concepts and ideas of cyberspace and cyberspace security Chapters 2 and 3 provide an introduction to mathematical and computational preliminaries respectively Chapters 4 discusses the basic ideas and system of secret key cryptography whereas Chapters 5 6 and 7 discuss the basic ideas and systems of public key cryptography based on integer factorization discrete logarithms and elliptic curves respectively Quantum safe cryptography is presented in Chapter 8 and offensive cryptography particularly cryptovirology is covered in Chapter 9 This book can be used as a secondary text for final year undergraduate students and first year postgraduate students for courses in Computer Network and Cyberspace Security Researchers and practitioners working in cyberspace security and network security will also find this book useful as a reference

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