

# Graduate Texts in Mathematics

Joseph H. Silverman

## The Arithmetic of Elliptic Curves

2nd Edition



 Springer

# Arithmetic Of Elliptic Curves

**B. H. Gross**



## **Arithmetic Of Elliptic Curves:**

The Arithmetic of Elliptic Curves Joseph H. Silverman, 2009-04-20 The theory of elliptic curves is distinguished by its long history and by the diversity of the methods that have been used in its study This book treats the arithmetic approach in its modern formulation through the use of basic algebraic number theory and algebraic geometry Following a brief discussion of the necessary algebro geometric results the book proceeds with an exposition of the geometry and the formal group of elliptic curves elliptic curves over finite fields the complex numbers local fields and global fields Final chapters deal with integral and rational points including Siegel's theorem and explicit computations for the curve  $Y^2 = X^3 + DX$  while three appendices conclude the whole Elliptic Curves in Characteristics 2 and 3 Group Cohomology and an overview of more advanced topics

*The Arithmetic of Elliptic Curves* Joseph H. Silverman, 2009-05-29 The theory of elliptic curves is distinguished by its long history and by the diversity of the methods that have been used in its study This book treats the arithmetic approach in its modern formulation through the use of basic algebraic number theory and algebraic geometry Following a brief discussion of the necessary algebro geometric results the book proceeds with an exposition of the geometry and the formal group of elliptic curves elliptic curves over finite fields the complex numbers local fields and global fields Final chapters deal with integral and rational points including Siegel's theorem and explicit computations for the curve  $Y^2 = X^3 + DX$  while three appendices conclude the whole Elliptic Curves in Characteristics 2 and 3 Group Cohomology and an overview of more advanced topics

**Arithmetic on Elliptic Curves with Complex Multiplication** B.H. Gross, 2006-11-14 Advanced Topics in the Arithmetic of Elliptic Curves Joseph H. Silverman, 2013-12-01 In the introduction to the first volume of The Arithmetic of Elliptic Curves Springer Verlag 1986 I observed that the theory of elliptic curves is rich varied and amazingly vast and as a consequence many important topics had to be omitted I included a brief introduction to ten additional topics as an appendix to the first volume with the tacit understanding that eventually there might be a second volume containing the details You are now holding that second volume it turned out that even those ten topics would not fit Unfortunately into a single book so I was forced to make some choices The following material is covered in this book I Elliptic and modular functions for the full modular group II Elliptic curves with complex multiplication III Elliptic surfaces and specialization theorems IV Neron models Kodaira Neron classification of special fibers Tate's algorithm and Ogg's conductor discriminant formula V Tate's theory of  $q$  curves over  $p$  adic fields VI Neron's theory of canonical local height functions The Arithmetic of Elliptic Curves J. H. Silverman, 1996 *Arithmetic on Elliptic Curves with Complex Multiplication* B. H. Gross, 2014-09-01 **Arithmetic Theory of Elliptic Curves** J. Coates, R. Greenberg, K.A. Ribet, K. Rubin, 1999-10-19 This volume contains the expanded versions of the lectures given by the authors at the C I M E instructional conference held in Cetraro Italy from July 12 to 19 1997 The papers collected here are broad surveys of the current research in the arithmetic of elliptic curves and also contain several new results which cannot be found elsewhere in the literature Owing to clarity and elegance of exposition and to the

background material explicitly included in the text or quoted in the references the volume is well suited to research students as well as to senior mathematicians

*Elliptic Curves* R. V. Gurjar, 2006 These notes constitute a lucid introduction to Elliptic Curves one of the central and vigorous areas of current mathematical research The subject has been studied from diverse viewpoints analytic algebraic and arithmetical These notes offer the reader glimpses of all three aspects and present some of the basic important theorems in all of them The first part introduces a little of the theory of Riemann surfaces and goes on to the study of tori and their projective embeddings as cubics This part ends with a discussion of the identification of the moduli space of complex tori with the quotient of the upper half plane by the modular groups The second part handles the algebraic geometry of elliptic curves It begins with a rapid introduction to some basic algebraic geometry and then focuses on elliptic curves The Riemann-Roch theorem and the Riemann hypothesis for elliptic curves are proved and the structure of the endomorphism ring of an elliptic curve is described The third and last part is on the arithmetic of elliptic curves over  $\mathbb{Q}$  The Mordell-Weil theorem Mazur's theorem on torsion in rational points of an elliptic curve over  $\mathbb{Q}$  and theorems of Thue and Siegel are among the results which are presented There is a brief discussion of theta functions Eisenstein series and cusp forms with an application to representation of natural numbers as sums of squares The notes end with the formulation of the Birch and Swinnerton-Dyer conjectures There is an additional brief chapter Appendix C written in July 2004 by Kirti Joshi describing some developments since the original notes were written up in the present form in 1992

**Handbook of Elliptic and Hyperelliptic Curve Cryptography** Henri Cohen, Gerhard Frey, Roberto Avanzi, Christophe Doche, Tanja Lange, Kim Nguyen, Frederik Vercauteren, 2005-07-19 The discrete logarithm problem based on elliptic and hyperelliptic curves has gained a lot of popularity as a cryptographic primitive The main reason is that no subexponential algorithm for computing discrete logarithms on small genus curves is currently available except in very special cases Therefore curve based cryptosystems require much smaller key sizes than RSA to attain the same security level This makes them particularly attractive for implementations on memory restricted devices like smart cards and in high security applications The Handbook of Elliptic and Hyperelliptic Curve Cryptography introduces the theory and algorithms involved in curve based cryptography After a very detailed exposition of the mathematical background it provides ready to implement algorithms for the group operations and computation of pairings It explores methods for point counting and constructing curves with the complex multiplication method and provides the algorithms in an explicit manner It also surveys generic methods to compute discrete logarithms and details index calculus methods for hyperelliptic curves For some special curves the discrete logarithm problem can be transferred to an easier one the consequences are explained and suggestions for good choices are given The authors present applications to protocols for discrete logarithm based systems including bilinear structures and explain the use of elliptic and hyperelliptic curves in factorization and primality proving Two chapters explore their design and efficient implementations in smart cards Practical and theoretical aspects of side channel attacks and

countermeasures and a chapter devoted to pseudo random number generation round off the exposition The broad coverage of all important areas makes this book a complete handbook of elliptic and hyperelliptic curve cryptography and an invaluable reference to anyone interested in this exciting field

*Elliptic Functions and Elliptic Integrals* Viktor Vasil\_ovich Prasolov,I Uri\_ Pavlovich Solov\_ev,1997-09-16 This book is devoted to the geometry and arithmetic of elliptic curves and to elliptic functions with applications to algebra and number theory It includes modern interpretations of some famous classical algebraic theorems such as Abel s theorem on the lemniscate and Hermite s solution of the fifth degree equation by means of theta functions Suitable as a text the book is self contained and assumes as prerequisites only the standard one year courses of algebra and analysis

**Arithmetic Algebraic Geometry** Brian David Conrad, The articles in this volume are expanded versions of lectures delivered at the Graduate Summer School and at the Mentoring Program for Women in Mathematics held at the Institute for Advanced Study Park City Mathematics Institute The theme of the program was arithmetic algebraic geometry The choice of lecture topics was heavily influenced by the recent spectacular work of Wiles on modular elliptic curves and Fermat s Last Theorem The main emphasis of the articles in the volume is on elliptic curves Galois representations and modular forms One lecture series offers an introduction to these objects The others discuss selected recent results current research and open problems and conjectures The book would be a suitable text for an advanced graduate topics course in arithmetic algebraic geometry

**Arithmetic Moduli of Elliptic Curves** Nicholas M. Katz,Barry Mazur,1985-02-21 This work is a comprehensive treatment of recent developments in the study of elliptic curves and their moduli spaces The arithmetic study of the moduli spaces began with Jacobi s *Fundamenta Nova* in 1829 and the modern theory was erected by Eichler Shimura Igusa and Deligne Rapoport In the past decade mathematicians have made further substantial progress in the field This book gives a complete account of that progress including not only the work of the authors but also that of Deligne and Drinfeld

**Elliptic Curves** J. S. Milne,2006 This book uses the beautiful theory of elliptic curves to introduce the reader to some of the deeper aspects of number theory It assumes only a knowledge of the basic algebra complex analysis and topology usually taught in advanced undergraduate or first year graduate courses

Reviews Indeed the book is affordable in fact the most affordable of all references on the subject but also a high quality work and a complete introduction to the rich theory of the arithmetic of elliptic curves with numerous examples and exercises for the reader many interesting remarks and an updated bibliography

Mathematical Reviews Ivaro Lozano Robledo J S Milne s lecture notes on elliptic curves are already well known The book under review is a rewritten version of just these famous lecture notes from 1996 which appear here as a compact and inexpensive paperback that is now available worldwide

Zentralblatt MATH Werner Kleinert

[Elliptic Curves](#) Henry McKean,Victor Moll,Victor H. Moll,1999-08-13 The subject of elliptic curves is one of the jewels of nineteenth century mathematics originated by Abel Gauss Jacobi and Legendre This 1997 book presents an introductory account of the subject in the style of the original discoverers with references to and

comments about more recent and modern developments It combines three of the fundamental themes of mathematics complex function theory geometry and arithmetic After an informal preparatory chapter the book follows an historical path beginning with the work of Abel and Gauss on elliptic integrals and elliptic functions This is followed by chapters on theta functions modular groups and modular functions the quintic the imaginary quadratic field and on elliptic curves Requiring only a first acquaintance with complex function theory this book is an ideal introduction to the subject for graduate students and researchers in mathematics and physics with many exercises with hints scattered throughout the text Elliptic Curves and Arithmetic Invariants Haruzo Hida, 2013-06-13 This book contains a detailed account of the result of the author's recent Annals paper and JAMS paper on arithmetic invariant including invariant L invariant and similar topics This book can be regarded as an introductory text to the author's previous book p Adic Automorphic Forms on Shimura Varieties Written as a down to earth introduction to Shimura varieties this text includes many examples and applications of the theory that provide motivation for the reader Since it is limited to modular curves and the corresponding Shimura varieties this book is not only a great resource for experts in the field but it is also accessible to advanced graduate students studying number theory Key topics include non triviality of arithmetic invariants and special values of L functions elliptic curves over complex and p adic fields Hecke algebras scheme theory elliptic and modular curves over rings and Shimura curves **Elliptic Functions and Elliptic Integrals** Viktor Prasolov, Yuri Solovyev, 1997-09-16 This book is devoted to the geometry and arithmetic of elliptic curves and to elliptic functions with applications to algebra and number theory It includes modern interpretations of some famous classical algebraic theorems such as Abel's theorem on the lemniscate and Hermite's solution of the fifth degree equation by means of theta functions Suitable as a text the book is self contained and assumes as prerequisites only the standard one year courses of algebra and analysis **Elliptic Curves** Dale Husemöller, 2004 First Edition sold over 2500 copies in the Americas New Edition contains three new chapters and two new appendices Rational Points on Elliptic Curves Joseph H. Silverman, John T. Tate, 2015-06-02 The theory of elliptic curves involves a pleasing blend of algebra geometry analysis and number theory This volume stresses this interplay as it develops the basic theory thereby providing an opportunity for advanced undergraduates to appreciate the unity of modern mathematics At the same time every effort has been made to use only methods and results commonly included in the undergraduate curriculum This accessibility the informal writing style and a wealth of exercises make Rational Points on Elliptic Curves an ideal introduction for students at all levels who are interested in learning about Diophantine equations and arithmetic geometry Most concretely an elliptic curve is the set of zeroes of a cubic polynomial in two variables If the polynomial has rational coefficients then one can ask for a description of those zeroes whose coordinates are either integers or rational numbers It is this number theoretic question that is the main subject of Rational Points on Elliptic Curves Topics covered include the geometry and group structure of elliptic curves the Nagell Lutz theorem describing points of finite order the Mordell Weil theorem on the finite

generation of the group of rational points the Thue Siegel theorem on the finiteness of the set of integer points theorems on counting points with coordinates in finite fields Lenstra's elliptic curve factorization algorithm and a discussion of complex multiplication and the Galois representations associated to torsion points Additional topics new to the second edition include an introduction to elliptic curve cryptography and a brief discussion of the stunning proof of Fermat's Last Theorem by Wiles et al via the use of elliptic curves

**Arithmetic Geometry, Number Theory, and Computation** Jennifer S.

Balakrishnan, Noam Elkies, Brendan Hassett, Bjorn Poonen, Andrew V. Sutherland, John Voight, 2022-03-15 This volume contains articles related to the work of the Simons Collaboration Arithmetic Geometry Number Theory and Computation The papers present mathematical results and algorithms necessary for the development of large scale databases like the L functions and Modular Forms Database LMFDB The authors aim to develop systematic tools for analyzing Diophantine properties of curves surfaces and abelian varieties over number fields and finite fields The articles also explore examples important for future research Specific topics include algebraic varieties over finite fields the Chabauty Coleman method modular forms rational points on curves of small genus S unit equations and integral points

**Treating Child and Adolescent Aggression Through Bibliotherapy** Zipora Shechtman, 2008-11-06 Antisocial acts by children and teens are on the rise from verbal abuse to physical bullying to cyber threats to weapons in schools Strictly punitive responses to aggressive behaviour may even escalate a situation leaving peers parents and teachers feeling helpless This unique volume conceptualizes aggression as a symptom of underlying behavioural and emotional problems and examines the psychology of perpetrators and the power dynamics that foster intentionally hurtful behaviour in young people It details for readers how bibliotherapy offers relevant innovative and flexible treatment as a standalone intervention or as a preventive method in conjunction with other forms of treatment and can be implemented with individuals and groups parents teachers and even rivals This unique must have resource is essential reading for school psychologists school counselors social workers and clinical child psychologists and any allied educational and mental health professionals who work with troubled youth

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