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## Algebra and Algebraic Geometry
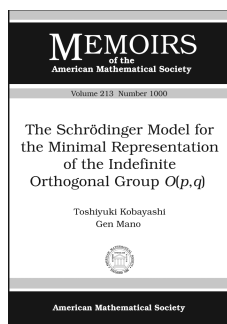
The Schrödinger Model for the Minimal Representation of the Indefinite Orthogonal Group $O(p,q)$

Toshiyuki Kobayashi, *University of Tokyo, Japan*, and **Gen Mano**, *PricewaterhouseCoopers Aarata, Tokyo, Japan*

Contents: Introduction; Two models of the minimal representation of $O(p,q)$; K-finite eigenvectors in the Schrödinger model $L^2(C)$; Radial part of the inversion; Main theorem; Bessel distributions; Appendix: special functions; Bibliography; List of Symbols; Index.

Memoirs of the American Mathematical Society, Volume 213, Number 1000

August 2011, 132 pages, Softcover, ISBN: 978-0-8218-4757-2, 2010 *Mathematics Subject Classification:* 22E30; 22E46, 43A80, **Individual member US$42.60**, List US$71, Institutional member US$56.80, Order code MEMO/213/1000
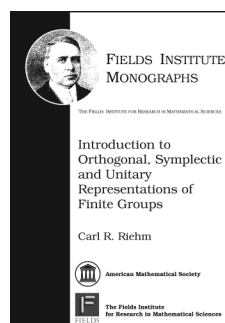
Introduction to Orthogonal, Symplectic and Unitary Representations of Finite Groups

Carl R. Riehm, *McMaster University, Hamilton, ON, Canada, and The Fields Institute, Toronto, ON, Canada*

Orthogonal, symplectic and unitary representations of finite groups lie at the crossroads of two more traditional subjects of mathematics—linear representations of finite groups, and the theory of quadratic, skew symmetric and Hermitian forms—and thus inherit some of the characteristics of both.

This book is written as an introduction to the subject and not as an encyclopaedic reference text. The principal goal is an exposition of the known results on the equivalence theory, and related matters such as the Witt and Witt-Grothendieck groups, over the "classical" fields—algebraically closed, real closed, finite, local and global. A detailed exposition of the background material needed is given in the first chapter.

It was A. Fröhlich who first gave a systematic organization of this subject, in a series of papers beginning in 1969. His paper *Orthogonal and symplectic representations of groups* represents the culmination of his published work on orthogonal and symplectic representations. The author has included most of the work from that paper, extending it to include unitary representations, and also providing new approaches, such as the use of the equivariant Brauer-Wall group in describing the principal invariants of orthogonal representations and their interplay with each other.

This item will also be of interest to those working in number theory.

Titles in this series are co-published with The Fields Institute for Research in Mathematical Sciences (Toronto, Ontario, Canada).

Contents: Background material; Isometry representations of finite groups; Hermitian forms over semisimple algebras; Equivariant Witt-Grothendieck and Witt groups; Representations over finite, local and global fields; Fröhlich's invariant, Clifford algebras and the equivariant Brauer-Wall group; Bibliography; Glossary; Index.

Fields Institute Monographs, Volume 28
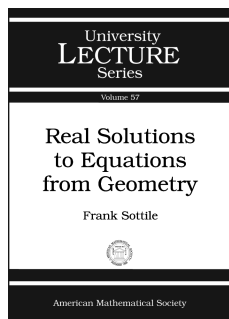
Real Solutions to Equations from Geometry

Frank Sottile, *Texas A&M University, College Station, TX*

Understanding, finding, or even deciding on the existence of real solutions to a system of equations is a difficult problem with many applications outside of mathematics. While it is hopeless to expect much in general, we know a surprising amount about these questions for systems which possess additional structure often coming from geometry.

This book focuses on equations from toric varieties and Grassmannians. Not only is much known about these, but such equations are common in applications. There are three main themes: upper bounds on the number of real solutions, lower bounds on the number of real solutions, and geometric problems that can have all solutions be real. The book begins with an overview, giving background on real solutions to univariate polynomials and the geometry of sparse polynomial systems. The first half of the book concludes with fewnomial upper bounds and with lower bounds to sparse polynomial systems. The second half of the book begins by sampling some geometric problems for which all solutions can be real, before devoting the last five chapters to the Shapiro Conjecture, in which the relevant polynomial systems have only real solutions.

Contents: Overview; Real solutions of univariate polynomials; Sparse polynomial systems; Toric degenerations and Kushnirenko's theorem; Fewnomial upper bounds; Fewnomial upper bounds from Gale dual polynomial systems; Lower bounds for sparse polynomial systems; Some lower bounds for systems of polynomials; Enumerative real algebraic geometry; The Shapiro Conjecture for Grassmannians; The Shapiro Conjecture for rational functions; Proof of the Shapiro Conjecture for Grassmannians; Beyond the Shapiro Conjecture for the Grassmannian; The Shapiro Conjecture beyond the Grassmannian; Bibliography; Index of notation; Index.

University Lecture Series, Volume 57

Analysis
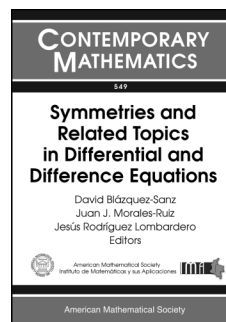
Symmetries and Related Topics in Differential and Difference Equations

David Blázquez-Sanz, *Universidad Sergio Arboleda, Bogatá, Colombia*, **Juan J. Morales-Ruiz**, *Technical University of Madrid, Spain*, and **Jesús Rodríguez Lombardero**, *Universidad de Salamanca, Spain*, Editors

This volume represents the 2009 Jairo Charris Seminar in Symmetries of Differential and Difference Equations, which was held at the Universidad Sergio Arboleda in Bogotá, Colombia.

The papers include topics such as Lie symmetries, equivalence transformations and differential invariants, group theoretical methods in linear equations, namely differential Galois theory and Stokes phenomenon, and the development of some geometrical methods in theoretical physics.

The reader will find new interesting results in symmetries of differential and difference equations, applications in classical and quantum mechanics, two fundamental problems of theoretical mechanics, the mathematical nature of time in Lagrangian mechanics and the preservation of the equations of motion by changes of frame, and discrete Hamiltonian systems arising in geometrical optics and analogous to those of finite quantum mechanics.

This item will also be of interest to those working in mathematical physics.

Contents: A. A. Monforte and **J.-A. Weil**, A reduction method for higher order variational equations of Hamiltonian systems; **N. H. Ibragimov**, A survey on integration of parabolic equations by reducing them to the heat equation; **S. Jiménez**, Weil jets, Lie correspondences and applications; **J. Mozo-Fernández**, Some applications of summability: An illustrated survey; **J. M. Díaz**, The structure of time and inertial forces in Lagrangian mechanics; **P J. Olver**, Differential invariant algebras; **J. Sauloy**, The Stokes phenomenon for linear q-difference equations; **K. B. Wolf**, Finite Hamiltonian systems on phase space.

Contemporary Mathematics, Volume 549
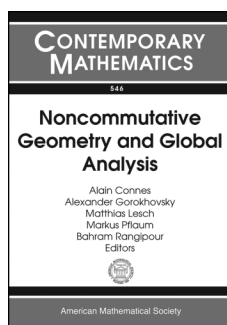
Noncommutative Geometry and Global Analysis

Alain Connes, *College de France, Paris, France*, **Alexander Gorokhovsky**, *University of Colorado, Boulder, CO*, **Matthias Lesch**, *Universität Bonn, Germany*, **Markus Pflaum**, *University of Colorado, Boulder, CO*, and **Bahram Rangipour**, *University of New Brunswick, Fredericton, NB, Canada*, Editors
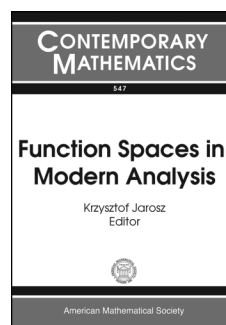
This volume represents the proceedings of the conference on Noncommutative Geometric Methods in Global Analysis, held in honor of Henri Moscovici, from June 29–July 4, 2009, in Bonn, Germany.

Henri Moscovici has made a number of major contributions to noncommutative geometry, global analysis, and representation theory. This volume, which includes articles by some of the leading experts in these fields, provides a panoramic view of the interactions of noncommutative geometry with a variety of areas of mathematics. It focuses on geometry, analysis and topology of manifolds and singular spaces, index theory, group representation theory, connections of noncommutative geometry with number theory and arithmetic geometry, Hopf algebras and their cyclic cohomology.

Contents: D. Barbasch and P. Pandžić, Dirac cohomology and unipotent representations of complex groups; P. Bressler, A. Gorokhovsky, R. Nest, and B. Tsygan, Algebraic index theorem for symplectic deformations of gerbes; J. Brüning, F. W. Kamber, and K. Richardson, Index theory for basic Dirac operators on Riemannian foliations; A. Connes, The Witt construction in characteristic one and quantization; M. Dubois-Violette and G. Landi, Lie prealgebras; N. Higson, On the analogy between complex semisimple groups and their Cartan motion groups; A. Kaygun, A survey on Hopf-cyclic cohomology and Connes-Moscovici characteristic map; M. Khalkhali and A. Pourkia, A super version of the Connes-Moscovici Hopf algebra; V. Mathai and S. Wu, Analytic torsion of $\mathbb{Z}_2$-graded elliptic complexes; B. Monthubert and V. Nistor, The K-groups and the index theory of certain comparison $C*$-algebras; H. Moriyoshi and P. Piazza, Relative pairings and the Atiyah-Patodi-Singer index formula for the Godbillon-Vey cocycle; A. Némethi, Two exact sequences for lattice cohomology; B. Rangipour, Cup products in Hopf cyclic cohomology with coefficients in contramodules; M. Wodzicki, Algebras of p-symbols, noncommutative p-residue, and the Brauer group; G. Yu, Large scale geometry and its applications.

Contemporary Mathematics, Volume 546

July 2011, 315 pages, Softcover, ISBN: 978-0-8218-4944-6, LC 2011008749, 2010 *Mathematics Subject Classification:* 13F35, 14B05, 16E40, 16T05, 19K56, 19D55, 22E46, 58B34, 53C24, 58J42, **AMS members US$84**, List US$105, Order code CONM/546

Function Spaces in Modern Analysis

Krzysztof Jarosz, *Southern Illinois University at Edwardsville, IL*, Editor

This volume contains the proceedings of the Sixth Conference on Function Spaces, which was held from May 18–22, 2010, at Southern Illinois University at Edwardsville.

The papers cover a broad range of topics, including spaces and algebras of analytic functions of one and of many variables (and operators on such spaces), spaces of integrable functions, spaces of Banach-valued functions, isometries of function spaces, geometry of Banach spaces, and other related subjects.

Contents: A. V. Abanin, R. Ishimura, and L. H. Khoi, Exponential-polynomial bases for null spaces of convolution operators in $A^{-\infty}$; M. Abel, Locally m-pseudoconvex algebras; N. Arcozzi, R. Rochberg, E. Sawyer, and B. D. Wick, Distance functions for reproducing kernel Hilbert spaces; H. A. Peimbert and A. G. García, Some properties of families of functions in $C_b(X, \mathbb{C}), \beta)$; R. M. Aron and P. Rueda, p-compact homogeneous polynomials from an ideal point of view; F. Botelho and J. Jamison, Homomorphisms of non-commutative Banach *-algebras of Lipschitz functions; A. E. Cardwell, An extension of a lemma by Phelps to Hilbert spaces; P. H. Enflo and T. M. Smith, Algebraic complements and ranges of linear operators; M. Haralampidou, Wedderburn decomposition of pseudo-H-algebras; O. Hatori, S. Lambert, A. Luttman, T. Miura, T. Tonev, and R. Yates, Spectral preservers in commutative Banach algebras; G. Hirasawa, T. Miura, and H. Takagi, Spectral radii conditions for isomorphisms between unital semisimple commutative Banach algebras; A. J. Izzo, The peak point conjecture and uniform algebras invariant under group actions; K. Jarosz, Function spaces—Selected open problems; R. Kantrowitz, M. M. Neumann, and T. J. Ransford, Regularity, scrambling, and the steady state for stochastic matrices; J. W. D. Mason, A survey of non-complex analogs of uniform algebras; M. Mouattamid, Properties of solution-space of the Lagrange multivariate interpolation problem using translation-invariant Fourier-transformable kernels; S. Mukherjee, F. Jafari, and J. E. McInroy, On the range of composition operators on spaces of entire functions; T. Oikhberg, Reverse monotone approximation property; H. Rahimi, M. Ghahramani, and S. Moayeri, Biprojectivity and weak amenability of some Banach algebras; K. Shamseddine, Nontrivial order preserving automorphisms of non-Archimedean fields; T. Tonev and E. Toneva, Composition operators between subsets of function algebras; J. Wermer, Function theory on certain three-manifolds.

Contemporary Mathematics, Volume 547

August 2011, 244 pages, Softcover, ISBN: 978-0-8218-5251-4, LC 2011009108, 2010 *Mathematics Subject Classification:* 46B04, 46E10, 46E15, 46E25, 46E30, 46H05, 46J10, 46J15; 30Hxx, 32Cxx, 47Lxx, **AMS members US$71.20**, List US$89, Order code CONM/547
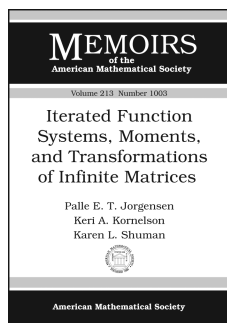
Iterated Function Systems, Moments, and Transformations of Infinite Matrices

Palle E. T. Jorgensen, *University of Iowa, Iowa City, IA*, **Keri A. Kornelson**, *University of Oklahoma, Norman, OK*, and **Karen L. Shuman**, *Grinnell College, IA*

Contents: Notation; The moment problem; A transformation of moment matrices: the affine case; Moment matrix transformation: measurable maps; The Kato-Friedrichs operator; The integral operator of a moment matrix; Boundedness and spectral properties; The moment problem revisited; Acknowledgements; Bibliography.

Memoirs of the American Mathematical Society, Volume 213, Number 1003

August 2011, 105 pages, Softcover, ISBN: 978-0-8218-5248-4, 2010 *Mathematics Subject Classification:* 28A12, 34B45, 42C05, 42A82, 46E22, 47L30, 47L60, 47C10, 47S50, 54E70, 60J10, 60J20, 78M05, 81S30, 81Q15, 81T75, 82B44, 90B15, **Individual member US$42**, List US$70, Institutional member US$56, Order code MEMO/213/1003
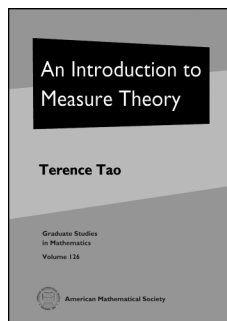
An Introduction to Measure Theory

Terence Tao, *University of California, Los Angeles, CA*

This is a graduate text introducing the fundamentals of measure theory and integration theory, which is the foundation of modern real analysis. The text focuses first on the concrete setting of Lebesgue measure and the Lebesgue integral (which in turn is motivated by the more classical concepts of Jordan measure and the Riemann integral), before moving on to abstract measure and integration theory, including the standard convergence theorems, Fubini's theorem, and the Carathéodory extension theorem. Classical differentiation theorems, such as the Lebesgue and Radamacher differentiation theorems, are also covered, as are connections with probability theory. The material is intended to cover a quarter or semester's worth of material for a first graduate course in real analysis.

There is an emphasis in the text on tying together the abstract and the concrete sides of the subject, using the latter to illustrate and motivate the former. The central role of key principles (such as Littlewood's three principles) as providing guiding intuition to the subject is also emphasized. There are a large number of exercises throughout that develop key aspects of the theory, and are thus an integral component of the text.

As a supplementary section, a discussion of general problem-solving strategies in analysis is also given. The last three sections discuss optional topics related to the main matter of the book.

Contents: Measure theory; Related articles; Bibliography; Index.

Graduate Studies in Mathematics, Volume 126

October 2011, approximately 219 pages, Hardcover, ISBN: 978-0-8218-6919-2, LC 2011018926, 2010 *Mathematics Subject Classification:* 28A20, 28A25, 28A35, **AMS members US$42.40**, List US$53, Order code GSM/126
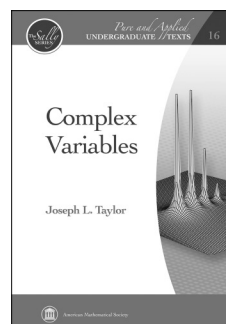
Complex Variables

Joseph L. Taylor, *University of Utah, Salt Lake City, UT*

The text covers a broad spectrum between basic and advanced complex variables on the one hand and between theoretical and applied or computational material on the other hand. With careful selection of the emphasis put on the various sections, examples, and exercises, the book can be used in a one- or two-semester course for undergraduate mathematics majors, a one-semester course for engineering or physics majors, or a one-semester course for first-year mathematics graduate students. It has been tested in all three settings at the University of Utah.

The exposition is clear, concise, and lively. There is a clean and modern approach to Cauchy's theorems and Taylor series expansions, with rigorous proofs but no long and tedious arguments. This is followed by the rich harvest of easy consequences of the existence of power series expansions.

Through the central portion of the text, there is a careful and extensive treatment of residue theory and its application to computation of integrals, conformal mapping and its applications to applied problems, analytic continuation, and the proofs of the Picard theorems.

Chapter 8 covers material on infinite products and zeroes of entire functions. This leads to the final chapter, which is devoted to the Riemann zeta function, the Riemann Hypothesis, and a proof of the Prime Number Theorem.

Contents: The complex numbers; Analytic functions; Power series expansions; The general Cauchy theorems; Residue theory; Conformal mappings; Analytic continuation and the Picard theorems; Infinite products; The gamma and zeta functions; Bibliography; Index.

Pure and Applied Undergraduate Texts, Volume 16

October 2011, approximately 308 pages, Hardcover, ISBN: 978-0-8218-6901-7, 2010 *Mathematics Subject Classification:* 30-01, 30Axx, 30Bxx, 30Dxx, 30Exx, **AMS members US$50.40**, List US$63, Order code AMSTEXT/16
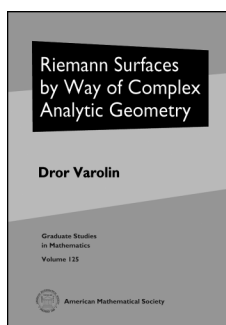
Riemann Surfaces by Way of Complex Analytic Geometry

Dror Varolin, *Stony Brook University, NY*

This book establishes the basic function theory and complex geometry of Riemann surfaces, both open and compact. Many of the methods used in the book are adaptations and simplifications of methods from the theories of several complex variables and complex analytic geometry and would serve as excellent training for mathematicians wanting to work in complex analytic geometry.

After three introductory chapters, the book embarks on its central, and certainly most novel, goal of studying Hermitian holomorphic line bundles and their sections. Among other things, finite-dimensionality of spaces of sections of holomorphic line bundles of compact Riemann surfaces and the triviality of holomorphic line bundles over Riemann surfaces are proved, with various applications. Perhaps the main result of the book is Hörmander's Theorem on the square-integrable solution of the Cauchy-Riemann equations. The crowning application is the proof of the Kodaira and Narasimhan Embedding Theorems for compact and open Riemann surfaces.

The intended reader has had first courses in real and complex analysis, as well as advanced calculus and basic differential topology (though the latter subject is not crucial). As such, the book should appeal to a broad portion of the mathematical and scientific community.

This book is the first to give a textbook exposition of Riemann surface theory from the viewpoint of positive Hermitian line bundles and Hörmander $\bar{\partial}$ estimates. It is more analytical and PDE oriented than prior texts in the field, and is an excellent introduction to the methods used currently in complex geometry, as exemplified in J. P. Demailly's online but otherwise unpublished book "Complex analytic and differential geometry." I used it for a one quarter course on Riemann surfaces and found it to be clearly written and self-contained. It not only fills a significant gap in the large textbook literature on Riemann surfaces but is also rather indispensible for those who would like to teach the subject from a differential geometric and PDE viewpoint.

—Steven Zelditch

This item will also be of interest to those working in algebra and algebraic geometry.

Contents: Complex analysis; Riemann surfaces; Functions on Riemann surfaces; Complex line bundles; Complex differential forms; Calculus on line bundles; Potential theory; Solving $\bar{\partial}$ with smooth data; Harmonic forms; Uniformization; Hörmander's Theorem; Embedding Riemann surfaces; The Riemann-Roch Theorem; Abel's Theorem; Bibliography; Index.

Graduate Studies in Mathematics, Volume 125

September 2011, 236 pages, Hardcover, ISBN: 978-0-8218-5369-6, LC 2011014621, 2010 *Mathematics Subject Classification:* 30F10, 30F15, 30F30, 30F45, 30F99, 30G99, 31A05, 31A99, 32W05, **AMS members US$50.40**, List US$63, Order code GSM/125

Discrete Mathematics and Combinatorics
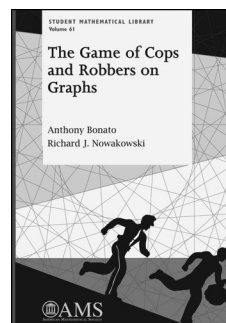
The Game of Cops and Robbers on Graphs

Anthony Bonato, *Ryerson University, Toronto, ON, Canada*, and **Richard J. Nowakowski**, *Dalhousie University, Halifax, NS, Canada*

This book is the first and only one of its kind on the topic of Cops and Robbers games, and more generally, on the field of vertex pursuit games on graphs. The book is written in a lively and highly readable fashion, which should appeal to both senior undergraduates and experts in the field (and everyone in between). One of the main goals of the book is to bring together the key results in the field; as such, it presents structural, probabilistic, and algorithmic results on Cops and Robbers games. Several recent and new results are discussed, along with a comprehensive set of references. The book is suitable for self-study or as a textbook, owing in part to the over 200 exercises. The reader will gain insight into all the main directions of research in the field and will be exposed to a number of open problems.

This item will also be of interest to those working in applications.

Contents: Introduction; Characterizations; Meyniel's conjecture; Graph products and classes; Algorithms; Random graphs; Infinite graphs; Variants of Cops and Robbers; Good guys versus bad guys; Bibliography; Index.

Student Mathematical Library, Volume 61

September 2011, approximately 267 pages, Softcover, ISBN: 978-0-8218-5347-4, 2010 *Mathematics Subject Classification:* 05C57, 91A43, 05C75, 05C80, 05C63, 05C85, **AMS members US$36**, List US$45, Order code STML/61
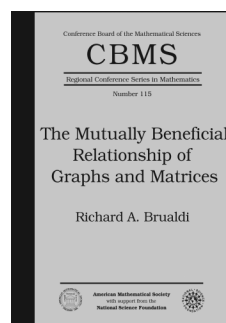
The Mutually Beneficial Relationship of Graphs and Matrices

Richard A. Brualdi, *University of Wisconsin, Madison, WI*

Graphs and matrices enjoy a fascinating and mutually beneficial relationship. This interplay has benefited both graph theory and linear algebra. In one direction, knowledge about one of the graphs that can be associated with a matrix can be used to illuminate matrix properties and to get better information about the matrix. Examples include the use of digraphs to obtain strong results on diagonal dominance and eigenvalue inclusion regions and the use of the Rado-Hall theorem to deduce properties of special classes of matrices. Going the other way, linear algebraic properties of one of the matrices associated with a graph can be used to obtain useful combinatorial information about the graph.

The adjacency matrix and the Laplacian matrix are two well-known matrices associated to a graph, and their eigenvalues encode important information about the graph. Another important linear algebraic invariant associated with a graph is the Colin de Verdière number, which, for instance, characterizes certain topological properties of the graph.

This book is not a comprehensive study of graphs and matrices. The particular content of the lectures was chosen for its accessibility, beauty, and current relevance, and for the possibility of enticing the audience to want to learn more.

A co-publication of the AMS and CBMS.

Contents: Some fundamentals; Eigenvalues of graphs; Rado-Hall theorem and applications; Colin de Verdière number; Classes of matrices of zeros and ones; Matrix sign patterns; Eigenvalue inclusion and diagonal products; Tournaments; Two matrix polytopes; Digraphs and eigenvalues of (0,1)-matrices; Index.

CBMS Regional Conference Series in Mathematics, Number 115

July 2011, 96 pages, Softcover, ISBN: 978-0-8218-5315-3, LC 2011014290, 2010 *Mathematics Subject Classification:* 05C50; 05B35, 05C20, 15A15, 15A18, 15B35, **AMS members US$27.20**, **All Individuals US$27.20**, List US$34, Order code CBMS/115
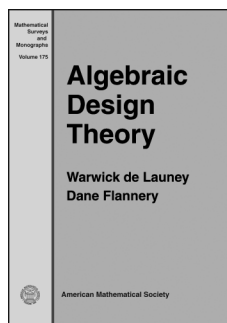
Algebraic Design Theory

Warwick de Launey, and **Dane Flannery**, *National University of Ireland, Galway, Ireland*

Combinatorial design theory is a source of simply stated, concrete, yet difficult discrete problems, with the Hadamard conjecture being a prime example. It has become clear that many of these problems are essentially algebraic in nature. This book provides a unified vision of the algebraic themes which have developed so far in design theory. These include the applications in design theory of matrix algebra, the automorphism group and its regular subgroups, the composition of smaller designs to make larger designs, and the connection between designs with regular group actions and solutions to group ring equations. Everything is explained at an elementary level in terms of orthogonality sets and pairwise combinatorial designs—new and simple combinatorial notions which cover many of the commonly studied designs. Particular attention is paid to how the main themes apply in the important new context of cocyclic development. Indeed, this book contains a comprehensive account of cocyclic Hadamard matrices. The book was written to inspire researchers, ranging from the expert to the beginning student, in algebra or design theory, to investigate the fundamental algebraic problems posed by combinatorial design theory.

Contents: Overview; Many kinds of pairwise combinatorial designs; A primer for algebraic design theory; Orthogonality; Modeling Λ-equivalence; The Grammian; Transposability; New designs from old; Automorphism groups; Group development and regular actions on arrays; Origins of cocyclic development; Group extensions and cocycles; Cocyclic pairwise combinatorial designs; Centrally regular actions; Cocyclic associates; Special classes of cocyclic designs; The Paley matrices; A large family of cocyclic Hadamard matrices; Substitution schemes for cocyclic Hadamard matrices; Calculating cocyclic development rules;

Cocyclic Hadamard matrices indexed by elementary abelian groups; Cocyclic concordant systems of orthogonal designs; Asymptotic existence of cocyclic Hadamard matrices; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 175

August 2011, 298 pages, Hardcover, ISBN: 978-0-8218-4496-0, LC 2011014837, 2010 *Mathematics Subject Classification:* 05-02, 05Bxx, 05E18, 16B99, 20Dxx; 05-04, 15A24, 16S99, 20B20, 20J06, **AMS members US$75.20**, List US$94, Order code SURV/175

General Interest
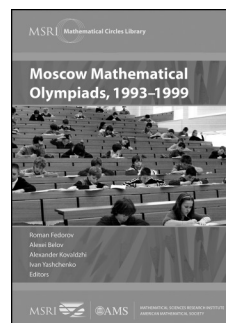
Moscow Mathematical Olympiads, 1993–1999

Roman Fedorov, *Max Planck Institute for Mathematics, Bonn, Germany*, **Alexei Belov**, *Moscow Institute of Open Education, Russia, and Shanghai University, People's Republic of China*, **Alexander Kovaldzhi**, *"Second School" Lyceum, Moscow, Russia*, and **Ivan Yashchenko**, *Moscow Center for Continuous Mathematical Education, Russia*, Editors

The Moscow Mathematical Olympiad has been challenging high-school students with stimulating, original problems of different degrees of difficulty for over 75 years. The problems are nonstandard; solving them takes wit, thinking outside the box, and, sometimes, hours of contemplation. Some are within the reach of most mathematically competent high-school students, while others are difficult even for a mathematics professor. Many mathematically inclined students have found that tackling these problems, or even just reading their solutions, is a great way to develop mathematical insight.

In 2006 the Moscow Center for Continuous Mathematical Education began publishing a collection of problems from the Moscow Mathematical Olympiads, providing for each an answer (and sometimes a hint) as well as one or more detailed solutions. This volume represents the years 1993–1999.

The problems and the accompanying material are well suited for math circles. They are also appropriate for problem-solving classes and practice for regional and national mathematics competitions.

Titles in this series are co-published with the Mathematical Sciences Research Institute (MSRI).

Contents: Problems; Answers; Hints; Solutions; Reference facts; Postscript by V. M. Tikhomirov: Reflections on the Moscow Mathematical Olympiads; Bibliography; Problem authorship.

MSRI Mathematical Circles Library, Volume 4

August 2011, 220 pages, Softcover, ISBN: 978-0-8218-5363-4, LC 2011013244, 2010 *Mathematics Subject Classification:* 00A07, 97-01, 97D50, 00A08, **AMS members US$31.20**, List US$39, Order code MCL/4
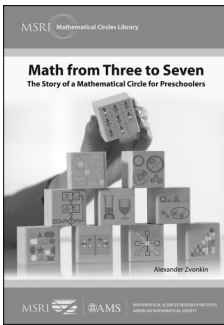
Math from Three to Seven

The Story of a Mathematical Circle for Preschoolers

Alexander Zvonkin, *Université Bordeaux I, Talence, France*

This book is a captivating account of a professional mathematician's experiences conducting a math circle for preschoolers in his apartment in Moscow in the 1980s. As anyone who has taught or raised young children knows, mathematical education for little kids is a real mystery. What are they capable of? What should they learn first? How hard should they work? Should they even "work" at all? Should we push them, or just let them be? There are no correct answers to these questions, and the author deals with them in classic math-circle style: he doesn't ask and then answer a question, but shows us a problem—be it mathematical or pedagogical—and describes to us what happened. His book is a narrative about what he did, what he tried, what worked, what failed, but most important, what the kids experienced.

This book does not purport to show you how to create precocious high achievers. It is just one person's story about things he tried with a half-dozen young children. Mathematicians, psychologists, educators, parents, and everybody interested in the intellectual development in young children will find this book to be an invaluable, inspiring resource.

Titles in this series are co-published with the Mathematical Sciences Research Institute (MSRI).

Contents: Introduction; The first session: Narrative and reflections; The boys' math circle, year one; Children and $\binom{5}{2}$: The story of one problem; The boys' math circle, year two; Notation, abstraction, mathematics, and language; The boys' math circle, year three; The boys' math circle, final six months; At home and in school; The girls' math circle, year one; The girls' math circle, year two; This is not an epilogue; Index of math, pedagogy, and psychology.

MSRI Mathematical Circles Library, Volume 5

August 2011, 300 pages, Softcover, ISBN: 978-0-8218-6873-7, LC 2011016999, 2010 *Mathematics Subject Classification:* 00A08, 00A09, 00A35, 97A20, 97A80, 97C30, 97U60, **AMS members US$39.20**, List US$49, Order code MCL/5

Geometry and Topology
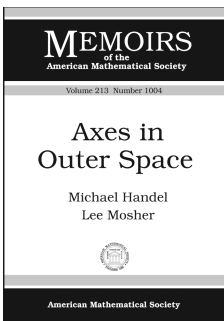
Axes in Outer Space

Michael Handel, *CUNY, Herbert H. Lehman College, Bronx, NY*, and **Lee Mosher**, *Rutgers University, Newark, NJ*

Contents: Introduction; Preliminaries; The ideal Whitehead graph; Cutting and pasting local stable Whitehead graphs; Weak train tracks; Topology of the axis bundle; Fold lines; Bibliography.

Memoirs of the American Mathematical Society, Volume 213, Number 1004

August 2011, 104 pages, Softcover, ISBN: 978-0-8218-6927-7, 2010 *Mathematics Subject Classification:* 20-XX; 57-XX, **Individual member US$42**, List US$70, Institutional member US$56, Order code MEMO/213/1004
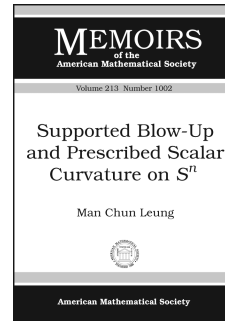
Supported Blow-Up and Prescribed Scalar Curvature on S^n

Man Chun Leung, *National University of Singapore, Republic of Singapore*

Contents: Introduction; The subcritical approach; Simple, towering, aggregated and clustered blow-ups; Supported and collapsed blow-ups; Toward isolated blow-ups; Toward supported blow-up for $\Delta \tilde{K}(0) > 0$—excluding simple blow-up; Excluding collapsed isolated blow-up ($\mathrm{Hess}_o \tilde{K}(0)$ positive definite); Close up; Single simple blow-up and the proof of the Main Theorem; Bibliography.

Memoirs of the American Mathematical Society, Volume 213, Number 1002

August 2011, 99 pages, Softcover, ISBN: 978-0-8218-5337-5, 2010 *Mathematics Subject Classification:* 35J60; 53C21, **Individual member US$41.40**, List US$69, Institutional member US$55.20, Order code MEMO/213/1002
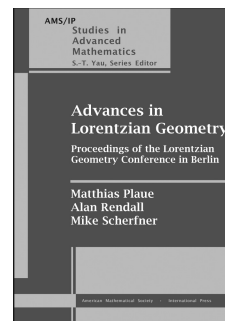
Advances in Lorentzian Geometry

Proceedings of the Lorentzian Geometry Conference in Berlin

Matthias Plaue, *Technische Universität Berlin, Germany*, **Alan Rendall**, *Max-Planck-Institut für Gravitationsphysik, Potsdam, Germany*, and **Mike Scherfner**, *Technische Universität Berlin, Germany*, Editors

This volume offers deep insight into the methods and concepts of a very active field of mathematics that has many connections with physics. Researchers and students will find it to be a useful source for their own investigations, as well as a general report on the latest topics of interest.

Presented are contributions from several specialists in differential geometry and mathematical physics, collectively demonstrating the wide range of applications of Lorentzian geometry, and ranging in character from research papers to surveys to the development of new ideas.

This volume consists mainly of papers drawn from the conference "New Developments in Lorentzian Geometry" (held in November 2009 in Berlin, Germany), which was organized with the help of the

DFG Collaborative Research Center's "SFB 647 Space-Time-Matter" group, the Berlin Mathematical School, and Technische Universität Berlin.

This item will also be of interest to those working in mathematical physics.

Titles in this series are co-published with International Press, Cambridge, MA.

Contents: R. Bartolo, **A. M. Candela**, and **E. Caponio**, An Avez-Seifert type theorem for orthogonal geodesics on a stationary spacetime; **M. Caballero** and **R. M. Rubio**, Calabi-Bernstein problems for spacelike slices in certain generalized Robertson-Walker spacetimes; **Y. Choquet-Bruhat** and **J. M. Martín-García**, A geometric energy estimate for data on a characteristic cone; **R. Deszcz**, **M. Głogowska**, **M. Hotloś**, and **K. Sawicz**, A survey on generalized Einstein metric conditions; **F. Dobarro** and **B. Ünal**, Non-rotating killing vector fields on standard static space-times; **R. Geroch**, Faster than light?; **G. Hall**, Projective structure in space-times; **P. G. LeFloch**, Einstein spacetimes with weak regularity; **E. Minguzzi**, Time functions as utility functions; **M. Sánchez**, Recent progress on the notion of global hyperbolicity; **S. Suhr**, Homologically maximizing geodesics in conformally flat tori.

AMS/IP Studies in Advanced Mathematics, Volume 49

June 2011, 143 pages, Softcover, ISBN: 978-0-8218-5352-8, LC 2011010875, 2010 *Mathematics Subject Classification:* 53-02, 53B30, 83C05, **AMS members US$47.20**, List US$59, Order code AMSIP/49
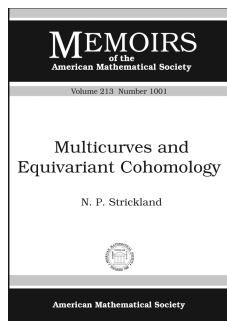
Multicurves and Equivariant Cohomology

N. P. Strickland, *University of Sheffield, England*

Contents: Introduction; Multicurves; Differential forms; Equivariant projective spaces; Equivariant orientability; Simple examples; Formal groups from algebraic groups; Equivariant formal groups of product type; Equivariant formal groups over rational rings; Equivariant formal groups of pushout type; Equivariant Morava *E*-theory; A completion theorem; Equivariant formal group laws and complex cobordism; A counterexample; Divisors; Embeddings; Symmetric powers of multicurves; Classification of divisors; Local structure of the scheme of divisors; Generalised homology of Grassmannians; Thom isomorphisms and the projective bundle theorem; Duality; Further theory of infinite Grassmannians; Transfers and the Burnside ring; Generalisations; Bibliography; Index.

Memoirs of the American Mathematical Society, Volume 213, Number 1001

August 2011, 117 pages, Softcover, ISBN: 978-0-8218-4901-9, 2010 *Mathematics Subject Classification:* 55N20, 55N22, 55N91, 14L05, **Individual member US$42**, List US$70, Institutional member US$56, Order code MEMO/213/1001

Mathematical Physics

Chern-Simons Gauge Theory: 20 Years After

Jørgen E. Andersen, *Aarhus University, Denmark*, **Hans U. Boden**, *McMaster University, Hamilton, ON, Canada*, **Atle Hahn**, *Universidade de Lisboa, Portugal*, and **Benjamin Himpel**, *Universität Bonn, Germany*, Editors
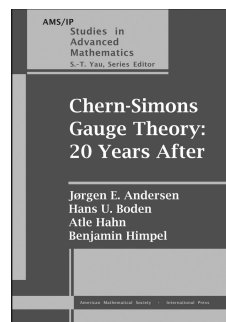
In 1989, Edward Witten discovered a deep relationship between quantum field theory and knot theory, and this beautiful discovery created a new field of research called Chern-Simons theory. This field has the remarkable feature of intertwining a large number of diverse branches of research in mathematics and physics, among them low-dimensional topology, differential geometry, quantum algebra, functional and stochastic analysis, quantum gravity, and string theory.

The 20-year anniversary of Witten's discovery provided an opportunity to bring together researchers working in Chern-Simons theory for a meeting, and the resulting conference, which took place during the summer of 2009 at the Max Planck Institute for Mathematics in Bonn, included many of the leading experts in the field. This volume documents the activities of the conference and presents several original research articles, including another monumental paper by Witten that is sure to stimulate further activity in this and related fields. This collection will provide an excellent overview of the current research directions and recent progress in Chern-Simons gauge theory.

This item will also be of interest to those working in geometry and topology.

Titles in this series are co-published with International Press, Cambridge, MA.

Contents: C. Beasley, Remarks on Wilson loops and Seifert loops in Chern-Simons theory; **T. Dimofte** and **S. Gukov**, Quantum field theory and the volume conjecture; **J. Dubois**, Computational aspects in Reidemeister torsion and Chern-Simons theories; **E. Guadagnini**, Functional integration and abelian link invariants; **M. Hedden** and **P. Kirk**, Chern-Simons invariants, SO(3) instantons, and $\mathbb{Z}/2$ homology cobordism; **C. M. Herald**, Extending the $SU(3)$ Casson invariant to rational homology 3-spheres; **K. Hikami**, Decomposition of Witten-Reshetikhin-Turaev invariant: Linking pairing and modular forms; **K. Hikami** and **H. Murakami**, Representations and the colored Jones polynomial of a torus knot; **L. Jeffrey** and **B. McLellan**, Eta-invariants and anomalies in $U/1$ Chern-Simons theory; **R. M. Kashaev**, Delta-groupoids and ideal triangulations; **C. Lescop**, Invariants of knots and 3-manifolds derived from the equivariant linking pairing; **M. Mariño**, Chern-Simons theory, the $1/N$ expansion, and string theory; **C. Meusburger**, Global Lorentzian geometry from lightlike geodesics: What does an observer in (2+1)-gravity see?; **A. Miković** and **J. F. Martins**, Spin foam state sums and Chern-Simons theory; **R. C. Penner**, Representations of the Ptolemy groupoid, Johnson homomorphisms, and finite type invariants; **A. N. Sengupta**,

Yang-Mills in two dimensions and Chern-Simons in three; **G. Thompson**, Intersection pairings on spaces of connections and Chern-Simons theory on Seifert manifolds; **J. Weitsman**, Fermionization and convergent perturbation expansions in Chern-Simons gauge theory; **E. Witten**, Analytic continuation of Chern-Simons theory.

AMS/IP Studies in Advanced Mathematics, Volume 50

July 2011, 446 pages, Softcover, ISBN: 978-0-8218-5353-5, LC 2011012166, 2010 *Mathematics Subject Classification:* 11F23, 14E20, 16S10, 19L10, 20C20, 20F99, 20L05, 30F60, 32G15, 46E25, 53C50, 53D20, 53D99, 54C40, 55R80, 57M25, 57M27, 57M50, 57M60, 57N05, 57N10, 57R56, 58D27, 58D30, 58E09, 58J28, 58J30, 58J52, 58Z05, 70S15, 81T08, 81T13, 81T25, 81T30, 81T45, 83C80, **AMS members US$104**, List US$130, Order code AMSIP/50

Number Theory
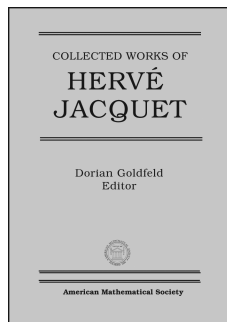
Collected Works of Hervé Jacquet

Dorian Goldfeld, *Columbia University, New York, NY*, Editor

Hervé Jacquet is one of the founders of the modern theory of automorphic representations and their associated *L*-functions. This volume represents a selection of his most influential papers not already available in book form. The volume contains papers on the *L*-function attached to a pair of representations of the general linear group. Thus, it completes Jacquet's papers on the subject (joint with Shalika and Piatetski-Shapiro) that can be found in the volume of selected works of Piatetski-Shapiro. In particular, two often quoted papers of Jacquet and Shalika on the classification of automorphic representations and a historically important paper of Gelbart and Jacquet on the functorial transfer from $GL(2)$ to $GL(3)$ are included. Another series of papers pertains to the relative trace formula introduced by Jacquet. This is a variant of the standard trace formula which is used to study the period integrals of automorphic forms. Nearly complete results are obtained for the period of an automorphic form over a unitary group.

This item will also be of interest to those working in algebra and algebraic geometry.

Contents: with **J. A. Shalika**, A non-vanishing theorem for zeta functions of GL_n; with **S. Gelbart**, A relation between automorphic representations of $GL(2)$ and $GL(3)$; with **I. I. Piatetski-Shapiro and J. Shalika**, Conducteur des représentations du groupe linéaire; with **J. A. Shalika**, On Euler products and the classification of automorphic representations. I; with **J. A. Shalika**, On Euler products and the classification of automorphic forms. II; with **K. F. Lai**, A relative trace formula; with **J. A. Shalika**, A lemma on highly ramified ε-factors; Sur un résultat de Waldspurger; Représentations distinguées pour le groupe orthogonal; with **K. F. Lai and S. Rallis**, A trace formula for symmetric spaces; Factorization of period integrals; with **N. Chen**, Positivity of quadratic base change *L*-functions; Facteurs de transfert pour les intégrales de Kloosterman; Smooth transfer of Kloosterman integrals; Kloosterman identities over a quadratic extension. II.

Collected Works, Volume 23

September 2011, 597 pages, Hardcover, ISBN: 978-0-8218-5356-6, 2010 *Mathematics Subject Classification:* 11F67, 11F70, 11F72, 11R39, 22E55, **AMS members US$109.60**, List US$137, Order code CWORKS/23
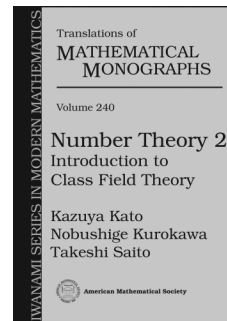
Number Theory 2
Introduction to Class Field Theory

Kazuya Kato, *University of Chicago, IL*, **Nobushige Kurokawa**, *Tokyo Institute of Technology, Japan*, and **Takeshi Saito**, *University of Tokyo, Japan*

This book, the second of three related volumes on number theory, is the English translation of the original Japanese book. Here, the idea of class field theory, a highlight in algebraic number theory, is first described with many concrete examples. A detailed account of proofs is thoroughly exposited in the final chapter. The authors also explain the local-global method in number theory, including the use of ideles and adeles. Basic properties of zeta and *L*-functions are established and used to prove the prime number theorem and the Dirichlet theorem on prime numbers in arithmetic progressions. With this book, the reader can enjoy the beauty of numbers and obtain fundamental knowledge of modern number theory.

The translation of the first volume was published as *Number Theory 1: Fermat's Dream*, Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), vol. 186, American Mathematical Society, 2000.

Contents: What is class field theory?; Local and global fields; ζ (II); Class field theory (II); Appendix B. Galois theory; Appendix C. Lights of places; Appendix. Answers to questions; Appendix. Answers to exercises; Index.

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 240

September 2011, approximately 231 pages, Softcover, ISBN: 978-0-8218-1355-3, LC 99033556, 2010 *Mathematics Subject Classification:* 11-01; 11Mxx, 11Rxx, 11Sxx, **AMS members US$39.20**, List US$49, Order code MMONO/240

Probability and Statistics
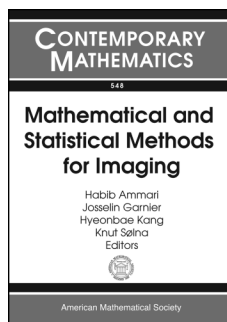
Mathematical and Statistical Methods for Imaging

Habib Ammari, *Ecole Normale Supérieure, Paris, France*, **Josselin Garnier**, *Université Paris VII, France*, **Hyeonbae Kang**, *Inha University, Incheon, Korea*, and **Knut Sølna**, *University of California, Irvine, CA*, Editors

This volume contains the proceedings of the NIMS Thematic Workshop on Mathematical and Statistical Methods for Imaging, which was held from August 10–13, 2010, at Inha University, Incheon, Korea.

The goal of this volume is to give the reader a deep and unified understanding of the field of imaging and of the analytical and statistical tools used in imaging. It offers a good overview of the current status of the field and of directions for further research. Challenging problems are addressed from analytical, numerical, and statistical perspectives. The articles are devoted to four main areas: analytical investigation of robustness; hypothesis testing and resolution analysis, particularly for anomaly detection; new efficient imaging techniques; and the effects of anisotropy, dissipation, or attenuation in imaging.

Contents: **J. Garnier**, Use of random matrix theory for target detection, localization, and reconstruction; **P. Garapon**, Resolution limits in source localization and small inclusion imaging; **S. Gdoura** and **L. G. Bustos**, Transient wave imaging of anomalies: A numerical study; **G. Bao**, **J. Lin**, and **F. Triki**, Numerical solution of the inverse source problem for the Helmholtz equation with multiple frequency data; **M. Lim** and **S. Yu**, Reconstruction of the shape of an inclusion from elastic moment tensors; **J. C. Schotland**, Path integrals and optical tomography; **K. Jeon** and **C.-O. Lee**, Denoising of B_z data for conductivity reconstruction in magnetic resonance electrical impedance tomography (MREIT); **D. G. Alfaro Vigo** and **K. Sølna**, Time reversal for inclusion detection in one-dimensional randomly layered media; **E. Bretin** and **A. Wahab**, Some anisotropic viscoelastic Green functions; **H. Ammari**, **E. Bretin**, **J. Garnier**, and **A. Wahab**, Time reversal in attenuating acoustic media.

Contemporary Mathematics, Volume 548

August 2011, 163 pages, Softcover, ISBN: 978-0-8218-5289-7, LC 2011011086, 2010 *Mathematics Subject Classification:* 35R30, 35A20, 35B40, 44A12, 78M05, 78M25, 78A45, **AMS members US$55.20,** List US$69, Order code CONM/548

New AMS-Distributed Publications

Algebra and Algebraic Geometry
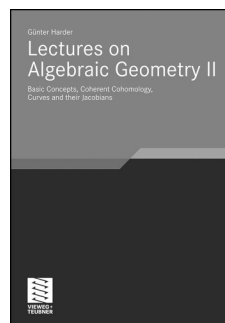
Lectures on Algebraic Geometry II

Basic Concepts, Coherent Cohomology, Curves and Their Jacobians

Günter Harder, *Max Planck Institute for Mathematics, Bonn, Germany*

This second volume introduces the concept of schemes, reviews some commutative algebra, and introduces projective schemes. The finiteness theorem for coherent sheaves is proved; here again the techniques of homological algebra and sheaf cohomology are needed. In the last two chapters, projective curves over an arbitrary ground field are discussed, the theory of Jacobians is developed, and the existence of the Picard scheme is proved.

Finally, the author explores further developments—for instance, étale cohomology—and states some fundamental theorems.

A publication of Vieweg+Teubner. The AMS is exclusive distributor in North America. Vieweg+Teubner Publications are available worldwide from the AMS outside of Germany, Switzerland, Austria, and Japan.

Contents: Basic concepts of the theory of schemes; Some commutative algebra; Projective schemes; Curves and the theorem of Riemann–Roch; The Picard functor for curves and Jacobians.

Vieweg Aspects of Mathematics, Volume 41

April 2011, 365 pages, Hardcover, ISBN: 978-3-8348-0432-7, 2010 *Mathematics Subject Classification:* 14-XX, **AMS members US$80.95,** List US$89.95, Order code VWAM/41