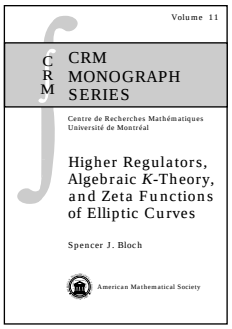
New Publications Offered by the AMS

Algebra and Algebraic Geometry



A Classic

Higher Regulators, Algebraic *K*-Theory, and Zeta Functions of Elliptic Curves

Spencer J. Bloch, *University of Chicago, IL*

This book is the long-awaited publication of the famous Irvine lectures by Spencer Bloch. Delivered in 1978 at the University of California at Irvine, these lectures turned out to be an entry point to several intimately-connected new branches of arithmetic algebraic geometry, such as: regulators and special values of L-functions of algebraic varieties, explicit formulas for them in terms of polylogarithms, the theory of algebraic cycles, and eventually the general theory of mixed motives which unifies and underlies all of the above (and much more). In the 20 years since then, the importance of Bloch's lectures has not diminished. A lucky group of people working in the above areas had the good fortune to possess a copy of old typewritten notes of these lectures. Now everyone can have their own copy of this classic.

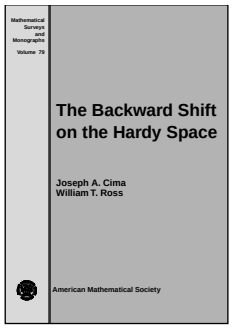
This item will also be of interest to those working in number theory.

Contents: Introduction; Tamagawa numbers; Tamagawa numbers. Continued; Continuous cohomology; A theorem of Borel and its reformulation; The regulator map. I; The dilogarithm function; The regulator map. II; The regulator map and elliptic curves. I; The regulator map and elliptic curves. II; Elements in $K_2(E)$ of an elliptic curve E; A regulator formula; Bibliography; Index.

CRM Monograph Series

June 2000, 97 pages, Hardcover, ISBN 0-8218-2114-8, 2000 *Mathematics Subject Classification*: 19F27; 14G10, 19D50, **All AMS members $19**, List $24, Order code CRMM-BLOCHN

Analysis



The Backward Shift on the Hardy Space

Joseph A. Cima, *University of North Carolina, Chapel Hill*, and **William T. Ross**, *University of Richmond, VA*

Shift operators on Hilbert spaces of analytic functions play an important role in the study of bounded linear operators on Hilbert spaces since they often serve as models for various classes of linear operators. For example, "parts" of direct sums of the backward shift operator on the classical Hardy space H^2 model certain types of contraction operators and potentially have connections to understanding the invariant subspaces of a general linear operator.

This book is a thorough treatment of the characterization of the backward shift invariant subspaces of the well-known Hardy spaces H^p. The characterization of the backward shift invariant subspaces of H^p for $1 < p < \infty$ was done in a 1970 paper of R. Douglas, H. S. Shapiro, and A. Shields, and the $0 < p \leq 1$ was done in a 1979 paper of A. B. Aleksandrov which is not well known in the West. This material is pulled together in this single volume and includes all the necessary background material needed to understand (especially for the $0 < p < 1$ case) the proofs of these results.

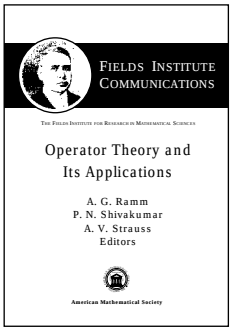
Several proofs of the Douglas-Shapiro-Shields result are provided so readers can get acquainted with different operator theory and theory techniques: applications of these proofs are also provided for understanding the backward shift operator on various other spaces of analytic functions. The results are thoroughly examined. Other features of the volume include a description of applications to the spectral properties of the backward shift operator and a treatment of some general real-variable techniques that are not taught in standard graduate seminars. The book includes references to works by Duren, Garnett, and Stein for proofs, and a bibliography for further exploration in the areas of operator theory and functional analysis.

Contents: Introduction; Classical boundary value results; The Hardy spaces of the disk; The Hardy spaces of the upper-half

plane; The backward shift on H^p for $p \in [1, \infty)$; The backward shift on H^p for $p \in (0, 1)$; Bibliography; Index.

Mathematical Surveys and Monographs

July 2000, 199 pages, Hardcover, ISBN 0-8218-2083-4, 2000 *Mathematics Subject Classification*: 47B38; 46E10, 46E15, **Individual member $29**, List $49, Institutional member $39, Order code SURV-CIMAN



Operator Theory and Its Applications

A. G. Ramm, *Kansas State University, Manhattan*, **P. N. Shivakumar**, *University of Manitoba, Winnipeg, MB, Canada*, and **A. V. Strauss**, *Ul'yanovsk Pedagogical University, Russia*, Editors

This volume contains a selection of papers presented at an international conference on operator theory and its applications held in Winnipeg. The papers chosen for this volume are intended to illustrate that operator theory is the language of modern analysis and its applications. Together with the papers on the abstract operator theory are many papers on the theory of differential operators, boundary value problems, inverse scattering and other inverse problems, and on applications to biology, chemistry, wave propagation, and many other areas.

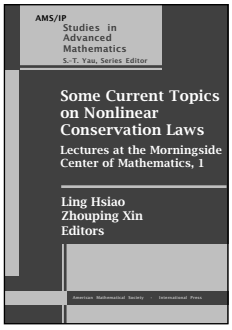
The volume is dedicated to the late A. V. Strauss, whose principal areas of research were spectral theory of linear operators in Hilbert spaces, extension theory for symmetric linear operators, theory of the characteristic functions and functional models of linear operators, and boundary value problems with boundary conditions depending on spectral parameter. The bibliography of publications by A. V. Strauss combined with the papers from the conference provide both historical perspective and contemporary research on the field of operator theory and its applications.

Contents: A. Strauss, Functional models of regular symmetric operators; **A. G. Ramm**, Property C for ODE and applications to inverse problems; **Ya. I. Alber**, Decomposition theorems in Banach spaces; **R. Airapetyan**, On a new statement of inverse problem of quantum scattering theory; **R. G. Airapetyan**, **A. G. Ramm**, and **A. B. Smirnova**, Continuous methods for solving nonlinear ill-posed problems; **D. Alpay** and **Y. Peretz**, Quasi-coisometric realizations of upper triangular matrices; **J. A. Ball**, Linear systems, operator model theory and scattering: Multivariable generalizations; **J. A. Ball** and **N. J. Young**, Problems on the realization of functions; **S. Belyi** and **E. Tsekanovskii**, Multiplication theorems for J-contractive operator-valued functions; **Y. M. Berezansky**, Spectral theory of commutative Jacobi fields: Direct and inverse problems; **G. F. Crosta**, The forward propagation method applied to the inverse obstacle problem of electromagnetics; **J. Eisner** and **M. Kučera**, Spatial patterning in reaction-diffusion systems with nonstandard boundary conditions; **A. Ětkin**, On an abstract boundary value problem with the eigenvalue parameter in the boundary condition; **F. Gesztesy** and **K. A. Makarov**, Some applications of the spectral shift operator; **S. Gutman** and **A. G. Ramm**, Application of the hybrid stochastic-deterministic minimization method to a surface data inverse scattering problem; **W. Jäger** and **P. Rejto**, On a theorem of Mochizuki and Uchiyama about long range oscillating potentials I; **V. Khatskevich** and **V. Senderov**, Basic properties of linear fractional mappings of operator balls: Schroeder's equation; **E. Ya. Khruslov** and **L. S. Pankratov**, Homogenization of the Dirichlet variational problems in Orlicz-Sobolev spaces; **B. V. Loginov**, **D. G. Rakhimov**, and **N. A. Sidorov**, Development of M. K. Gavurin's pseudoperturbation method; **J. López-Gómez**, A bridge between operator theory and mathematical biology; **M. Matvejchuk**, Measures on effects and on projections in spaces with indefinite metric; **T. Nagai**, Concentration behavior of solutions to a chemotaxis system; **R. Plato**, The solution of linear semidefinite ill-posed problems by the conjugate residual method; **A. G. Ramm**, Justification of the limiting absorption principle in $\mathbb{R}^2$; **A. G. Ramm**, Krein's method in inverse scattering; **A. G. Ramm** and **M. Sammartino**, Existence and uniqueness of the scattering solutions in the exterior of rough domains; **S. Ruan** and **J. C. Clements**, Existence and uniqueness of solutions of retarded quasilinear wave equations; **E. I. Shifrin** and **B. Brank**, On solution of elliptical interface crack problem; **A. Shklyar**, Some new effects for complete second order linear differential equations in Hilbert spaces; **V. A. Trenogin**, Abstract boundary value problems for operator equations; **A. V. Tsyganov**, On spectral decompositions of a restriction of a differential operator; **N. N. Voitovich**, **Yu. P. Topolyuk**, and **O. O. Reshnyak**, Approximation of compactly supported functions with free phase by functions with bounded spectrum; **A. Yagola** and **K. Dorofeev**, Sourcewise representation and a Posteriori error estimates for ill-posed problems; **Y. Yamada**, Coexistence states for Lotka-Volterra systems with cross-diffusion; **M. Yamaguchi** and **H. Yoshida**, Nonhomogeneous string problem with periodically moving boundaries.

Fields Institute Communications, Volume 25

May 2000, 574 pages, Hardcover, ISBN 0-8218-1990-9, 2000 *Mathematics Subject Classification*: 47–02, 35–02, 34–02, 81–02, **Individual member $78**, List $130, Institutional member $104, Order code FIC/25N

Differential Equations



Some Current Topics on Nonlinear Conservation Laws

Lectures at the Morningside Center of Mathematics, 1

Ling Hsiao, *Institute of Mathematics, Academia Sinica, Beijing, People's Republic of China*, and **Zhouping Xin**, *New York University, Courant Institute, NY*, Editors

This volume resulted from a year-long program at the Morningside Center of Mathematics at the Academia Sinica in Beijing. It presents an overview of nonlinear conversation laws and introduces developments in this expanding field. Zhouping Xin's introductory overview of the subject is followed by lecture notes of leading experts who have made fundamental contributions to this field of research. A. Bressan's theory of L^1-well-posedness for entropy weak solutions to systems of

nonlinear hyperbolic conversation laws in the class of viscosity solutions is one of the most important results in the past two decades; G. Chen discusses weak convergence methods and various applications to many problems; P. Degond details mathematical modelling of semi-conductor devices; B. Perthame describes the theory of asymptotic equivalence between conservation laws and singular kinetic equations; Z. Xin outlines the recent development of the vanishing viscosity problem and nonlinear stability of elementary wave—a major focus of research in the last decade; and the volume concludes with Y. Zheng's lecture on incompressible fluid dynamics.

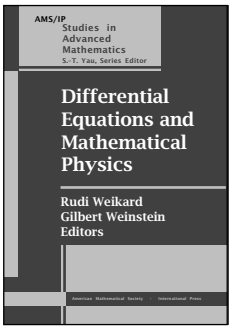
This collection of lectures represents previously unpublished expository and research results of experts in nonlinear conservation laws and is an excellent reference for researchers and advanced graduate students in the areas of nonlinear partial differential equations and nonlinear analysis.

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

Contents: A. Bressan, Stability of entropy solutions to n x n conservation laws; **G.-Q. Chen**, Compactness methods and nonlinear hyperbolic conservation laws; **P. Degond**, Mathematical modelling of microelectronics semiconductor devices; **B. Perthame**, Lecture notes on kinetic formulation of conservation laws; **Z. Xin**, Theory of viscous conservation laws; **Y. Zheng**, Some problems of incompressible fluid dynamics.

AMS/IP Studies in Advanced Mathematics, Volume 15

May 2000, 226 pages, Softcover, ISBN 0-8218-1965-8, LC 00-025164, 2000 *Mathematics Subject Classification*: 35–02, 35L65, 35L67; 35L60, 35L80, 76N10, 76P05, 46N20, 35Q30, **All AMS members $34**, List $42, Order code AMSIP/15N



Differential Equations and Mathematical Physics

Rudi Weikard and **Gilbert Weinstein**, *University of Alabama, Birmingham*, Editors

This volume contains the proceedings of the 1999 International Conference on Differential Equations and Mathematical Physics. The contributions selected for this volume represent some of the most important presentations by scholars from around the world on developments in this area of research. The papers cover topics in the general area of linear and nonlinear differential equations and their relation to mathematical physics, such as multiparticle Schrödinger operators, stability of matter, relativity theory, fluid dynamics, spectral and scattering theory including inverse problems.

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.

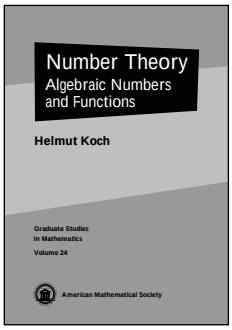
Contents: A. A. Balinsky and **W. D. Evans**, On the Brown-Ravenhall relativistic Hamiltonian and the stability of matter; **R. Bartnik**, Assessing accuracy in a numerical Einstein solver; **R. D. Benguria** and **M. C. Depassier**, Variational principle for the limit cycle of Rayleigh's equation; **B. K. Berger**, Approach to the singularity in spatially inhomogeneous cosmologies; **M. Sh. Birman** and **T. A. Suslina**, On the absolute continuity of the periodic Schrödinger and Dirac operators with magnetic potential; **T. Bodineau** and **B. Helffer**, Correlations, spectral gap and log-Sobolev inequalities for unbounded spins systems; **R. Brummelhuis**, **M. B. Ruskai**, and **E. Werner**, One dimensional regularizations of the Coulomb potential with application to atoms in strong magnetic fields; **D. Chae** and **O. Yu. Imanuvilov**, Construction of a solution to the semilinear elliptic equation in Chern-Simons gauge theory; **M. Christ**, **A. Kiselev**, and **Y. Last**, Approximate eigenvectors and spectral theory; **D. Christodoulou**, The initial value problem in the large and spacetime singularities; **L. Erdős** and **J. P. Solovej**, On the kernel of $Spin^c$ Dirac operators on $\mathbb{S}^3$ and $\mathbb{R}^3$; **R. Froese** and **I. Herbst**, Realizing holonomic constraints in classical and quantum mechanics; **F. Gesztesy** and **H. Holden**, A combined sine-Gordon and modified Korteweg-de Vries hierarchy and its algebro-geometric solutions; **M. Griesemer**, A minimax principle for eigenvalues in spectral gaps; **G. A. Hagedorn** and **A. Joye**, Semiclassical dynamics and exponential asymptotics; **R. Hempel** and **K. Lienau**, Genericity of the band-gap structure of periodic media in the large coupling limit; **A. M. Hinz**, Distribution of eigenvalues in the dense point spectrum of Schrödinger operators; **P. D. Hislop**, On the distribution of scattering resonances for asymptotically hyperbolic manifolds; **T. Hupfer**, **H. Leschke**, and **S. Warzel**, The multiformity of Lifshits tails caused by random Landau Hamiltonians with repulsive impurity potentials of different decay at infinity; **W. Karwowski** and **V. Koshmanenko**, Schrödinger operator perturbed by dynamics of lower dimension; **Y. V. Kurylev** and **M. Lassas**, Hyperbolic inverse problem with data on a part of the boundary; **Y. Li**, Best Sobolev inequalities on Riemannian manifolds; **E. H. Lieb** and **M. Loss**, Self-energy of electrons in non-perturbative QED; **E. H. Lieb** and **J. Yngvason**, The ground state energy of a dilute Bose gas; **M. Ohmiya**, Trace formulae and completely integrable Hamiltonians; **Y. Pinchover**, On the maximum and anti-maximum principles; **T. C. Sideris**, The null condition and global existence of nonlinear elastic waves; **H. Siedentop**, The Hartree-Fock approximation in quantum electrodynamics–Positivity of the energy; **J. A. Smoller** and **J. B. Temple**, Shock-wave cosmology; **S. B. Sontz**, On some reverse inequalities in the Segal-Bargmann space; **G. Teschl**, On the initial value problem of the Toda and Kac-van Moerbeke hierarchies; **V. Tkachenko**, A class of non-selfadjoint Hill's operators with analytic potentials; **M. M. Tom**, Regularized long wave-KP models; **C. Tretter**, Spectral issues for block operator matrices; **J. A. Viaclovsky**, Some fully nonlinear equations in conformal geometry; **R. Weder**, $L^p - L^{\dot{p}}$ estimates for the Schrödinger equation and inverse scattering; **G. Wolanski**, Stationary states of Vlasov system.

AMS/IP Studies in Advanced Mathematics, Volume 16

May 2000, approximately 472 pages, Softcover, ISBN 0-8218-2157-1, 2000 *Mathematics Subject Classification*: 34–06, 35–06, **All AMS members $47**, List $59, Order code AMSIP/16N

Number Theory

Recommended Text



Number Theory
Algebraic Numbers and Functions

Helmut Koch, *Humboldt-University, Berlin, Germany*

Algebraic number theory is one of the most refined creations in mathematics. It has been developed by some of the leading mathematicians of this and previous centuries. The primary goal of this book is to present the essential elements of algebraic number theory, including the theory of normal extensions up through a glimpse of class field theory. Following the example set for us by Kronecker, Weber, Hilbert and Artin, algebraic functions are handled here on an equal footing with algebraic numbers. This is done on the one hand to demonstrate the analogy between number fields and function fields, which is especially clear in the case where the ground field is a finite field. On the other hand, in this way one obtains an introduction to the theory of 'higher congruences' as an important element of 'arithmetic geometry'.

Early chapters discuss topics in elementary number theory, such as Minkowski's geometry of numbers, public-key cryptography and a short proof of the Prime Number Theorem, following Newman and Zagier. Next, some of the tools of algebraic number theory are introduced, such as ideals, discriminants and valuations. These results are then applied to obtain results about function fields, including a proof of the Riemann-Roch Theorem and, as an application of cyclotomic fields, a proof of the first case of Fermat's Last Theorem. There are a detailed exposition of the theory of Hecke L-series, following Tate, and explicit applications to number theory, such as the Generalized Riemann Hypothesis. Chapter 9 brings together the earlier material through the study of quadratic number fields. Finally, Chapter 10 gives an introduction to class field theory.

The book attempts as much as possible to give simple proofs. It can be used by a beginner in algebraic number theory who wishes to see some of the true power and depth of the subject. The book is suitable for two one-semester courses, with the first four chapters serving to develop the basic material. Chapters 6 through 9 could be used on their own as a second semester course.

Contents: Introduction; The geometry of numbers; Dedekind's theory of ideals; Valuations; Algebraic functions of one variable; Normal extensions; L-series; Applications to Hecke L-series; Quadratic number fields; What next?; Divisibility theory; Trace, norm, different, and discriminant; Harmonic analysis on locally compact abelian groups; References; Index.

Graduate Studies in Mathematics

June 2000, approximately 392 pages, Hardcover, ISBN 0-8218-2054-0, LC 00-022320, 2000 *Mathematics Subject Classification*: 11Rxx, 11Sxx, 11Mxx, **All AMS members $47**, List $59, Order code GSM-KOCHN

Previously Announced Publications

Recommended Text

Large Deviations

Frank den Hollander, *Nijmegen University, Netherlands*

This volume offers an introduction to large deviations. It is divided into two parts: theory and applications. Basic large deviation theorems are presented for i.i.d. sequences, Markov sequences, and sequences with moderate dependence. The rate function is computed explicitly. The theory is explained without too much emphasis on technicalities. Also included is an outline of general definitions and theorems. The goal is to expose the unified theme that gives large deviation theory its overall structure, which can be made to work in many concrete cases. The section on applications focuses on recent work in statistical physics and random media.

This book contains 60 exercises (with solutions) that should elucidate the content and engage the reader. Prerequisites for the book are a strong background in probability and analysis and some knowledge of statistical physics. It would make an excellent textbook for a special topics course in large deviations.

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

Fields Institute Monographs, Volume 14

February 2000, 143 pages, Hardcover, ISBN 0-8218-1989-5, LC 99-058913, 2000 *Mathematics Subject Classification*: 60–01, 60F10, 60K35; 82B31, 82B44, **All AMS members $39**, List $49, Order code FIM/14RT005

Independent Study

An Introduction to the Theory of Local Zeta Functions

Jun-ichi Igusa, *Johns Hopkins University, Baltimore, MD*

This book is an introductory presentation to the theory of local zeta functions. As distributions, and mostly in the archimedian case, local zeta functions are called complex powers.

The volume contains major results on complex powers by Atiyah, Bernstein, I. M. Gelfand, and S. I. Gelfand. Also included are related results by Sato. The section on p-adic local zeta functions presents Serre's structure theorem, a rationality theorem and many examples by the author. It concludes with theorems by Denef and Meuser.

Prerequisites for understanding the text include basic courses in algebra, calculus, complex analysis, and general topology. The book follows the usual pattern of progress in mathematics: examples are given, conjectures follow, conjectures are developed into theorems.

This book is accessible and self-contained. Results illustrate the unity of mathematics by gathering important theorems from algebraic geometry and singularity theory, number theory, algebra, topology, and analysis. The ideas are then employed in essential ways to prove the theorems.

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

AMS/IP Studies in Advanced Mathematics, Volume 14

February 2000, 232 pages, Hardcover, ISBN 0-8218-2015-X, LC 99-087031, 2000 *Mathematics Subject Classification*: 11Sxx, 11S40, 11Mxx, 11Gxx, 14Gxx, **All AMS members $36**, List $45, Order code AMSIP/14RT005

Supplementary Reading

Problems in Mathematical Analysis I
Real Numbers, Sequences and Series

W. J. Kaczor and **M. T. Nowak**, *Marie Curie–Skłodowska University, Lublin, Poland*

We learn by doing. We learn mathematics by doing problems. This book is the first volume of a series of books of problems in mathematical analysis. It is mainly intended for students studying the basic principles of analysis. However, given its organization, level, and selection of problems, it would also be an ideal choice for tutorial or problem-solving seminars, particularly those geared toward the Putnam exam. The volume is also suitable for self-study.

Each section of the book begins with relatively simple exercises, yet may also contain quite challenging problems. Very often several consecutive exercises are concerned with different aspects of one mathematical problem or theorem. This presentation of material is designed to help student comprehension and to encourage them to ask their own questions and to start research. The collection of problems in the book is also intended to help teachers who wish to incorporate the problems into lectures. Solutions for all the problems are provided.

The book covers three topics: real numbers, sequences, and series, and is divided into two parts: exercises and/or problems, and solutions. Specific topics covered in this volume include the following: basic properties of real numbers, continued fractions, monotonic sequences, limits of sequences, Stolz's theorem, summation of series, tests for convergence, double series, arrangement of series, Cauchy product, and infinite products.

Student Mathematical Library, Volume 4

April 2000, 380 pages, Softcover, ISBN 0-8218-2050-8, LC 99-087039, 2000 *Mathematics Subject Classification*: 00A07; 40–01, **All AMS members $31**, List $39, Order code STML/4RT005

Dynamical Properties of Diffeomorphisms of the Annulus and of the Torus

Patrice Le Calvez, *University of Paris, Villetaneuse, France*

The first chapter of this monograph presents a survey of the theory of monotone twist maps of the annulus. First, the author covers the conservative case by presenting a short survey of Aubry-Mather theory and Birkhoff theory, followed by some criteria for existence of periodic orbits without the area-preservation property. These are applied in the area-decreasing case, and the properties of Birkhoff attractors are discussed. A diffeomorphism of the closed annulus which is isotopic to the identity can be written as the composition of monotone twist maps.

The second chapter generalizes some aspects of Aubry-Mather theory to such maps and presents a version of the Poincaré-Birkhoff theorem in which the periodic orbits have the same braid type as in the linear case. A diffeomorphism of the torus isotopic to the identity is also a composition of twist maps, and it is possible to obtain a proof of the Conley-Zehnder theorem with the same kind of conclusions about the braid type, in the case of periodic orbits. This result leads to an equivariant version of the Brouwer translation theorem which permits new proofs of some results about the rotation set of diffeomorphisms of the torus.

This is the English translation of a volume previously published as volume 204 in the Astérisque series.

SMF members are entitled to AMS member discounts.

SMF/AMS Texts and Monographs, Volume 4

March 2000, 105 pages, Softcover, ISBN 0-8218-1943-7, LC 99-087060, 2000 *Mathematics Subject Classification*: 58–XX, **All AMS members $17**, List $21, Order code SMFAMS/4RT005