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Algebra and Algebraic Geometry

A Course in Abstract Analysis
John B. Conway, George Washington University, DC

This book covers topics appropriate for a first-year graduate course preparing students for the doctorate degree. The first half of the book presents the core of measure theory, including an introduction to the Fourier transform. This material can easily be covered in a semester. The second half of the book treats basic functional analysis and can also be covered in a semester. After the basics, it discusses linear transformations, duality, the elements of Banach algebras, and C*-algebras. It concludes with a characterization of the unitary equivalence classes of normal operators on a Hilbert space.

The book is self-contained and only relies on a background in functions of a single variable and the elements of metric spaces. Following the author's belief that the best way to learn is to start with the particular and proceed to the more general, it contains numerous examples and exercises.

Contents: Setting the stage; Elements of measure theory; A Hilbert space interlude; A return to measure theory; Linear transformations; Banach spaces; Locally convex spaces; Duality; Operators on a Banach space; Banach algebras and spectral theory; C*-algebras; Appendix; Bibliography; Indexes.

Graduate Studies in Mathematics, Volume 141

Differential Equations

Maximum Principles and Sharp Constants for Solutions of Elliptic and Parabolic Systems
Gershon Kresin, Ariel University Center of Samaria, Israel, and Vladimir Maz’ya, Linköping University, Sweden, and University of Liverpool, England

The main goal of this book is to present results pertaining to various versions of the maximum principle for elliptic and parabolic systems of arbitrary order. In particular, the authors present necessary and sufficient conditions for validity of the classical maximum modulus principles for systems of second order and obtain sharp constants in inequalities of Miranda-Agmon type and in many other inequalities of a similar nature. Somewhat related to this topic are explicit formulas for the norms and the essential norms of boundary integral operators. The proofs are based on a unified approach using, on one hand, representations of the norms of matrix-valued integral operators whose target spaces are linear and finite dimensional, and, on the other hand, on solving certain finite dimensional optimization problems.

This book reflects results obtained by the authors, and can be useful to researchers interested in partial differential equations.

Contents: Introduction; Elliptic equations and systems: Prerequisites on operators acting into finite dimensional spaces; Maximum modulus principle for second order strongly elliptic systems; Sharp constants in the Miranda-Agmon inequalities for solutions of certain systems of mathematical physics; Sharp pointwise estimates for solutions of elliptic systems with boundary data from L^p; Sharp constant in the Miranda-Agmon type inequality for derivatives of solutions to higher order elliptic equation; Sharp pointwise estimates for directional derivatives and Khavinson's type extremal problems for harmonic functions; The norm and the essential norm for double layer vector-valued potentials; Parabolic systems: Maximum modulus principle for parabolic systems; Maximum modulus principle for parabolic systems with zero boundary data; Maximum norm principle for parabolic systems without lower order terms; Maximum norm
which is responsible for many phenomena in complex geometry and
Assuming only a general background from differential topology,
This is the first book which systematically explores this connection,
This book is devoted to the interplay between complex and symplectic
theory; Modifications of J Morse–Smale theory for h complex analysis;
Existence of Stein structures:
Introduction; Contents:
theory, and the interconnections between these subjects.
Many of these results appear here for the first time. The main results of the book are original results of the
h geometry, the theory of functions of several complex variables, symplectic
manifolds. It also contains the first detailed investigation of Weinstein
geometry (the road “back”).
A beautiful and comprehensive introduction to this important field.
—Dusa McDuff, Barnard College, Columbia University
This excellent book gives a detailed, clear, and wonderfully written
treatment of the interplay between the world of Stein manifolds and the more topological and flexible world of Weinstein manifolds. Devoted
to this subject with a long history, the book serves as a superb introduction to this area and also contains the authors’ new results.
—Tomasz Mrowka, MIT
This book is devoted to the interplay between complex and symplectic
gometry in affine complex manifolds. Affine complex (a.k.a. Stein
manifolds have canonically built into them symplectic geometry
which is responsible for many phenomena in complex geometry and
analysis. The goal of the book is the exploration of this symplectic
gometry (the road from “Stein to Weinstein”) and its applications in the
complex geometric world of Stein manifolds (the road “back”).
This is the first book which systematically explores this connection,
thus providing a new approach to the classical subject of Stein
manifolds. It also contains the first detailed investigation of Weinstein
manifolds, the symplectic counterparts of Stein manifolds, which play
an important role in symplectic and contact topology.
Assuming only a general background from differential topology,
the book provides introductions to the various techniques from
the theory of functions of several complex variables, symplectic
gometry, h-principles, and Morse theory that enter the proofs of the
main results. The main results of the book are original results of the
authors, and several of these results appear here for the first time. The
book will be beneficial for all students and mathematicians interested
in geometric aspects of complex analysis, symplectic and contact
topology, and the interconnections between these subjects.
Contents: Introduction; J-convexity: J-convex functions and
hypersurfaces; Smoothing; Shapes for i-convex hypersurfaces; Some
complex analysis; Existence of Stein structures: Symplectic and
contact preliminaries; The h-principles; The existence theorem;
Morse–Smale theory for J-convex functions: Recollections from Morse
theory; Modifications of J-convex Morse functions; From Stein to
Weinstein and back: Weinstein structures; Modifications of Weinstein
structures; Existence revisited; Deformations of flexible Weinstein
structures; Deformations of Stein structures; Stein manifolds and
symplectic topology: Stein manifolds of complex dimension two;
Exotic Stein structures; Some algebraic topology; Obstructions
to formal Legendrian isotopies; Biographical notes on the main
characters; Bibliography; Index.
Colloquium Publications, Volume 59
November 2012, approximately 354 pages, Hardcover, ISBN:
978-0-8218-8533-8, LC 2012019063, 2010 Mathematics Subject
Classification: 32Q28, 53D35, AMS members US$62.40, List US$78,
Order code COLI/59

Geometry and Topology

From Stein to Weinstein and Back
Symplectic Geometry of Affine Complex Manifolds
Kai Cieliebak, Ludwig-Maximilians-Universität, München, Germany,
and Yakov Eliashberg, Stanford University, CA

Number Theory

Number Theory 3
Iwasawa Theory and Modular Forms
Nobushige Kurokawa, Tokyo Institute of Technology, Japan,
Masato Kurihara, Keio University, Yokohama, Japan,
and Takeshi Saito, University of Tokyo, Japan

This is the third of three related volumes on number theory. (The first two volumes were also published in the Iwanami Series in Modern Mathematics, as volumes 186 and 240.)
The two main topics of this book are Iwasawa theory and modular
forms. The presentation of the theory of modular forms starts with
several important relations discovered by Ramanujan and leads to
a discussion of several important ingredients, including the
zeta-regularized products, Kronecker’s limit formula, and the Selberg
trace formula. The presentation of Iwasawa theory focuses on the
Iwasawa main conjecture, which establishes far-reaching relations
between a p-adic analytic zeta function and a determinant defined
from a Galois action on some ideal class groups. This book also
contains a short exposition on the arithmetic of elliptic curves and the
proof of Fermat’s last theorem by Wiles.
Together with the first two volumes, this book is a good resource for
anyone learning or teaching modern algebraic number theory.
Contents: Modular forms; Iwasawa theory; Modular forms II; Elliptic
curves II; Bibliography; Answers to questions; Answers to exercises; Index.
Translations of Mathematical Monographs (Iwanami Series in
Modern Mathematics), Volume 242
October 2012, approximately 240 pages, Softcover, ISBN: 978-0-
8218-2095-7, LC 99-33556, 2010 Mathematics Subject Classification:
11-01; 11Mxx, 11R23, 11Rxx, 11Sxx, 11G05, 11Fxx, AMS members
US$42.40, List US$53, Order code MMONO/242
This volume contains the proceedings of the 10th International Congress on Finite Fields and their Applications (Fq 10), held July 11–15, 2011, in Ghent, Belgium.

Research on finite fields and their practical applications continues to flourish. This volume’s topics, which include finite geometry, finite semifields, bent functions, polynomial theory, designs, and function fields, show the variety of research in this area and prove the tremendous importance of finite field theory.

Contents: J. Bamberg and N. Durante, Low dimensional models of the finite split Cayley hexagon; G. Bhowmik and J.-C. Schlage-Puchta, Davenport’s constant for groups with large exponent; M. V. Budrevich and A. E. Guterman, Permanent has less zeros than determinant over finite fields; I. Cardinali and A. Pasini, On a series of modules for the symplectic group in characteristic 2; F. N. Castro, R. Figueroa, and L. A. Medina, Exact divisibility of exponential sums and some consequences; Z. Chen and A. Winterhof, Additive character sums of polynomial quotients; J. de la Cruz and W. Willems, S-designs related to binary extremal self-dual codes of length 24m; Y. Hamahata, Sequences of Dedekind sums in function fields; T. Helleseth, A. Kholosha, and S. Mesnager, Niho bent functions and Subiaco hyperovals; M. Homma, A bound on the number of points of a curve in a projective space over a finite field; M. Kiermaier and I. Landjev, Designs in projective Hjelmslev spaces; G. Marino and O. Polverino, On the nuclei of a finite semifield; G. L. Matthews and J. D. Peache, Small-bias sets from extended norm-trace codes; A. Ostafe, D. Thomson, and A. Winterhof, On the Waring problem with multivariate Dickson polynomials; M. Rosen, Polynomials modulo p and the theory of Galois sets; D. Schipani and M. Elia, Additive decompositions induced by multiplicative characters over finite fields; S. Ugolini, Graphs associated with the map \( x \mapsto x + x^{-1} \) in finite fields of characteristic two.

Contemporary Mathematics, Volume 579


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**Theory and Applications of Finite Fields**

Michel Lavrauw, Università Degli Studi di Padova, Vicenza, Italy, Gary L. Mullen, Pennsylvania State University, State College, PA, Svetla Nikova, K.U. Leuven, Leuven-Heverlee, Belgium, Daniel Panario, Carleton University, Ottawa, Ontario, Canada, and Leo Storme, Ghent University, Belgium, Editors

**Numbers and Functions**

From a classical-experimental mathematician’s point of view

Victor H. Moll, Tulane University, New Orleans, LA

New mathematics often comes about by probing what is already known. Mathematicians will change the parameters in a familiar calculation or explore the essential ingredients of a classic proof. Almost magically, new ideas emerge from this process. This book examines elementary functions, such as those encountered in calculus courses, from this point of view of experimental mathematics. The focus is on exploring the connections between these functions and topics in number theory and combinatorics. There is also an emphasis throughout the book on how current mathematical software can be used to discover and prove interesting properties of these functions.

The book provides a transition between elementary mathematics and more advanced topics, trying to make this transition as smooth as possible. Many topics occur in the book, but they are all part of a bigger picture of mathematics. By delving into a variety of them, the reader will develop this broad view. The large collection of problems is an essential part of the book. The problems vary from routine verifications of facts used in the text to the exploration of open questions.

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

Contents: The number systems; Factorials and binomial coefficients; The Fibonacci numbers; Polynomials; Binomial sums; Catalan numbers; The Stirling numbers of the second kind; Rational functions; Wallis' formula; Farey fractions; The exponential function; Trigonometric functions; Bernoulli polynomials; A sample of classical polynomials: Legendre, Chebyshev, and Hermite; Landen transformations; Three special functions: \( \Gamma, \psi, \) and \( \zeta \); Bibliography; Index.

Student Mathematical Library, Volume 65

Probability and Statistics

This volume is a collection of lecture notes for six of the ten courses given in Búzios, Brazil by prominent probabilists at the 2010 Clay Mathematics Institute Summer School, "Probability and Statistical Physics in Two and More Dimensions", and at the XIV Brazilian School of Probability.

In the past ten to fifteen years, various areas of probability theory related to statistical physics, disordered systems and combinatorics have undergone intensive development. A number of these developments deal with two-dimensional random structures at their critical points, and provide new tools and ways of coping with at least some of the limitations of Conformal Field Theory that had been so successfully developed in the theoretical physics community to understand phase transitions of two-dimensional systems.

Included in this selection are detailed accounts of all three foundational courses presented at the Clay school—Schramm-Loewner Evolution and other Conformally Invariant Objects, Noise Sensitivity and Percolation, Scaling Limits of Random Trees and Planar Maps—together with contributions on Fractal and Multifractal properties of SLE and Conformal Invariance of Lattice Models. Finally, the volume concludes with extended articles based on the courses on Random Polymers and Self-Avoiding Walks given at the Brazilian School of Probability during the final week of the school.

Together, these notes provide a panoramic, state-of-the-art view of probability theory and statistical physics that should also find much of interest.

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

Titles in this series are co-published with the Clay Mathematics Institute (Cambridge, MA).


Analysis

Arrangements of Hyperplanes—Sapporo 2009

Hiroaki Terao, Hokkaido University, Japan, and Sergey Yuzvinsky, University of Oregon, Eugene, Editors

His book is the proceedings of the conference on Arrangements of Hyperplanes, held in August 2009 as the 2nd Mathematical Society of Japan Seasonal Institute.

The modern study of arrangements of hyperplanes started in the early 1980s. Since the object of study is simple (just a finite set of hyperplanes), there are various mathematical approaches to arrangements including algebra, topology, combinatorics, singularities, integral systems, hypergeometric functions, and statistics. Since numerous world-renowned experts gave talks at the 2nd MSJ-SI, this book covers many pioneering approaches and new topics in the theory of arrangements as well as indispensable classical results.

The book is recommended to any researcher or graduate student interested in arrangements of hyperplanes.

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

Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

Contents: K. Aomoto, Hypersphere arrangement and imaginary cycles for hypergeometric integrals; G. Denham and M. Schulze, Complexes, duality and Chern classes of logarithmic forms along hyperplane arrangements; A. Deza, H. Miyata, S. Moriyama, and F. Xie, Hyperplane arrangements with large average diameter: A computational approach; D. C. Cohen, G. Denham, M. Falk, and A. Varchenko, Vanishing products of one-forms and critical points of master functions; Y. Haraoka, Middle convolution for completely integrable systems with logarithmic singularities along hyperplane arrangements; H. Kimura, On a problem of arrangements related to the hypergeometric integrals of confluent type; T. Kohno, Hyperplane arrangements, local system homology and iterated integrals; A. Libgober, On combinatorial invariance of the cohomology of the Milnor fiber of arrangements and the Catalan equation over function fields; E. Looijenga, The KZ system via polydifferentials; K. Mimachi, Solutions for some families of Fuchsian differential equations free from accessory parameters in terms of the integral of Euler
type; J. V. Pereira, Resonance webs of hyperplane arrangements; F. Mori and M. Salvetti, Discrete topological methods for subspace arrangements; H. Schenck, Hyperplane arrangements: Computations and conjectures; A. I. Suciu, Resonance varieties and Dwyer-Fried invariants; H. Kamiya, A. Takeamura, and N. Tokushige, Application of arrangement theory to unfolding models; D. Tamaki, On the homology of configuration spaces associated to centers of mass; T. Terasoma, Varieties of lines on Fermat hypersurfaces; E. Mukhin, V. Tarasov, and A. Varchenko, Three sides of the geometric Langlands correspondence for $gl_n$ Gaudin model and Bethe vector averaging maps; A. K. Singh and U. Walther, A note on Bockstein homomorphisms in local cohomology; M. Yoshinaga, Arrangements, multiderivations, and adjoint quotient map of type ADE; S. Yuzvinsky, Resonance varieties of arrangement complements.

Advanced Studies in Pure Mathematics, Volume 62


Differential Equations

Reputation from Resonances

Dmitry Dolgopyat, University of Maryland, College Park, MD

The author considers slow-fast systems with periodic fast motion and integrable slow motion in the presence of both weak and strong resonances. Assuming that the initial phases are random and that appropriate non-degeneracy assumptions are satisfied, he proves that the effective evolution of the adiabatic invariants is given by a Markov process. This Markov process consists of the motion along the trajectories of a vector field with occasional jumps. The generator of the limiting process is computed from the dynamics of the system near strong resonances.

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

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; The proof; A. Asymptotics of the Poincaré map; B. Derivatives of the Poincaré map. Outline of the proof; A. Asymptotics of the Poincaré map; B. Derivatives of the Poincaré map; C. Derivatives of the inner map; D. Derivatives of the outer map; E. Dynamics near the separatrix; F. Captured points; G. Examples; H. Distortion bound; Bibliography.

Mémoires de la Société Mathématique de France, Number 128


Geometry and Topology

String Topology for Stacks

Kai Behrend, University of British Columbia, Vancouver, BC, Canada, Grégory Ginot, Université Paris 13, Cachan, France, Behrang Noohi, Max Planck Institut für Mathematik, Bonn, Germany, and Ping Xu, Pennsylvania State University, University Park, PA

The authors establish the general machinery of string topology for differentiable stacks. This machinery allows them to treat on equal footing free loops in stacks and hidden loops. They construct a bivariable (in the sense of Fulton and MacPherson) theory for topological stacks: it gives them a flexible theory of Gysin maps, which are automatically compatible with pullback, pushforward and products. Then the authors prove an excess formula in this context.

The authors introduce oriented stacks, generalizing oriented manifolds, which are stacks on which they can do string topology. They prove that the homology of the free loop stack of an oriented stack and the homology of hidden loops (sometimes called ghost loops) are Frobenius algebras which are related by a natural morphism of Frobenius algebras. They also prove that the homology of the free loop stack has a natural structure of BV-algebra which, together with the Frobenius structure, fits into homological conformal field theories with closed positive boundaries. They also use their constructions to study an analogue of the loop product for stacks of maps of $(n$-dimensional) spheres to oriented stacks and compatible power maps in their homology.

Using their general machinery, the authors construct an intersection pairing for (not necessarily compact) almost complex orbifolds which is in the same relation to the intersection pairing for manifolds as Chen-Ruan orbifold cup-product is to ordinary cup-product of manifolds. They show that the hidden product of almost complex orbifolds is isomorphic to the orbifold intersection pairing twisted by a canonical class. Finally they gave some examples, including the case of the classifying stacks $[S/G]$ of a compact Lie group.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Topological stacks; Homotopy type of a topological stack; Vector bundles on stacks; Thom isomorphism; Loop stacks; Bounded proper morphisms of topological stacks; Bivariant theory for topological stacks; Regular embeddings, submersions, and normally nonsingular morphisms; Gysin maps; The loop product; Hidden loop product for family of groups over a stack; Frobenius algebra structures; The BV-algebra on the homology of free loop stack; Homological conformal field theory and free loop stacks; Remarks on brane topology for stacks; Orbifold intersection pairing; Examples; Bibliography.

Astérisque, Number 343