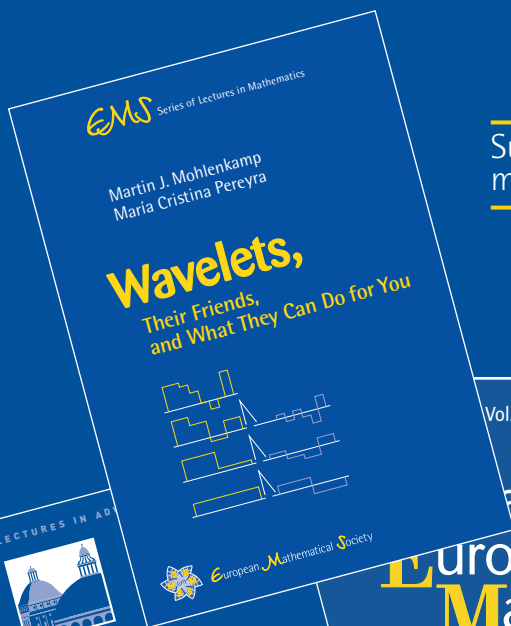


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Vol. 10 / No. 2 / pp. 267–570 / 2008

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IRMA Lectures in Mathematics and Theoretical Physics

Edited by:

Vladimir Turaev

This series is devoted to the publication of research monographs, conferences or workshops originating from the Institut de Recherche Mathématique Avancée (Strasbourg, France). The goal is to promote recent advances in mathematics and theoretical physics and make them accessible to a wide circle of professional and aspiring mathematicians and physicists.

Volumes 1–5 of this series are available from Walter de Gruyter (www.degruyter.de).

Vol. 14

Michel Weber (IRMA, Strasbourg, France)

Dynamical Systems and Processes

ISBN 978-3-03719-046-3

2008. Approx. 800 pages. Hardcover. 17 cm x 24 cm

98.00 Euro

This book presents in a concise and accessible way, as well as in a common setting, various tools and methods arising from spectral theory, ergodic theory and stochastic processes theory, which form the basis of and contribute interactively a great deal to the current research on almost everywhere convergence problems.

Researchers working in dynamical systems and at the crossroads of spectral theory, ergodic theory and stochastic processes will find the tools, methods and results presented in this book of great interest. It is written in a style accessible to graduate students throughout.

Vol. 12

Quantum Groups

Benjamin Enriquez (IRMA, Strasbourg, France), Editor

ISBN 978-3-03719-047-0

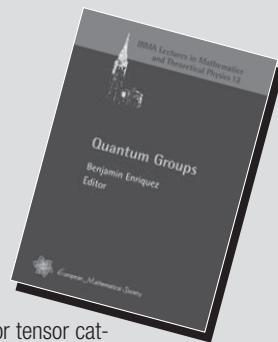
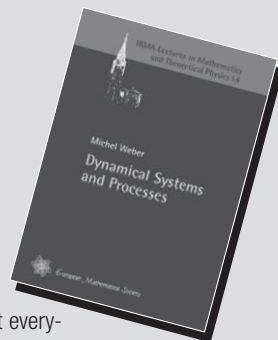
2008. 141 pages. Softcover. 17 x 24 cm

38.00 Euro

The volume starts with a lecture course by P. Etingof on tensor categories (notes by D. Calaque). This course is an introduction to tensor categories, leading to topics of recent research such as realizability of fusion rings, Ocneanu rigidity, module categories, weak Hopf algebras, Morita theory for tensor categories, lifting theory, categorical dimensions, Frobenius–Perron dimensions, and the classification of tensor categories.

The remainder of the book consists of three detailed expositions on associators and the Vassiliev invariants of knots, classical and quantum integrable systems and elliptic algebras, and the groups of algebra automorphisms of quantum groups. The preface sets the results presented in perspective.

Directed at research mathematicians and theoretical physicists as well as graduate students, the volume gives an overview of the ongoing research in the domain of quantum groups, an important subject of current mathematical physics.



IRMA Lectures in Mathematics and Theoretical Physics

Vol. 13

Handbook of Teichmüller Theory, Volume II

Athanase Papadopoulos (IRMA, Strasbourg, France), Editor

ISBN 978-3-03719-055-5

2008. Approx. 800 pages. Hardcover. 17 x 24 cm

98.00 Euro

This multi-volume set deals with Teichmüller theory in the broadest sense, namely, as the study of moduli spaces of geometric structures on surfaces, with methods inspired or adapted from those of classical Teichmüller theory. The aim is to give a complete panorama of generalized Teichmüller theory and of its applications in various fields of mathematics. The volumes consist of chapters, each of them dedicated to a specific topic. The authors are leading experts in the field.

The present second volume has nineteen chapters and is divided into four parts: the metric and the analytic theory (uniformization, Weil–Petersson geometry, holomorphic families of Riemann surfaces, infinite-dimensional Teichmüller spaces, characteristic classes and combinatorial aspects of moduli space); the group theory (mapping class groups: quasi-homomorphisms, measurable rigidity, applications to Lefschetz fibrations, affine groups of flat surfaces, braid groups and Artin groups); representation spaces and geometric structures (trace coordinates, invariant theory, complex projective structures, circle packings and moduli spaces for Lorentz manifolds); the Grothendieck–Teichmüller theory (dessins d'enfants, the reconstruction principle and the solenoid).

This work is an essential reference for graduate students and researchers interested in Teichmüller theory and its ramifications, in particular for mathematicians working in topology, geometry, algebraic geometry, dynamical systems and complex analysis.

Vol. 11

Handbook of Teichmüller Theory, Volume I

Athanase Papadopoulos (IRMA, Strasbourg, France), Editor

ISBN 978-3-03719-029-6

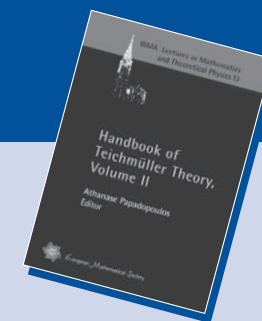
2007. 802 pages. Hardcover. 17 x 24 cm.

98.00 Euro

The Teichmüller space of a surface was introduced by O. Teichmüller in the 1930s. It is a basic tool in the study of Riemann's moduli spaces and of the mapping class groups. These objects are fundamental in several fields of mathematics including algebraic geometry, number theory, topology, geometry, and dynamics.

The original setting of Teichmüller theory is complex analysis. The work of Thurston in the 1970s brought techniques of hyperbolic geometry in the study of Teichmüller space and of its asymptotic geometry. Teichmüller spaces are also studied from the point of view of the representation theory of the fundamental group of the surface in a Lie group G , most notably $G = \mathrm{PSL}(2, \mathbb{R})$ and $G = \mathrm{PSL}(2, \mathbb{C})$. In the 1980s, there evolved an essentially combinatorial treatment of the Teichmüller and moduli spaces involving techniques and ideas from high-energy physics, namely from string theory. The current research interests include the quantization of Teichmüller space, the Weil–Petersson symplectic and Poisson geometry of this space as well as gauge-theoretic extensions of these structures. The quantization theories can lead to new invariants of hyperbolic 3-manifolds.

The purpose of this handbook is to give a panorama of some of the most important aspects of Teichmüller theory. The handbook should be useful to specialists in the field, to graduate students, and more generally to mathematicians who want to learn about the subject. All the chapters are self-contained and have a pedagogical character. They are written by leading experts in the subject.



IRMA Lectures in Mathematics and Theoretical Physics

Vol. 10

Physics and Number Theory

Louise Nyssen (Strasbourg, France), Editor

ISBN 978-3-03719-028-9

2006. 274 pages. Softcover. 17 cm x 24 cm

39.50 Euro

There is a rich and historical relationship between theoretical physics and number theory. This volume presents a selection of problems which are currently in full development and inspire a lot of research going on. Each of the seven contributions starts with an introductory survey which makes it possible even for non-specialists to understand the results and to gain an idea of the great variety of subjects and techniques used. Topics covered are: phase locking in oscillating systems, crystallography, Hopf algebras and renormalisation theory, Zeta-function and random matrices, Kloosterman sums and the local Langlands correspondence.

Intended for research mathematicians and theoretical physicists as well as graduate students, this volume gives an overview of recent developments in an exciting subject crossing several disciplines.

Vol. 9

Differential Equations and Quantum Groups

Andrey A. Bolibrukh Memorial Volume

D. Bertrand (Paris, France), B. Enriquez (Strasbourg, France),
C. Mitschi (Strasbourg, France), C. Sabbah (Palaiseau, France) and
R. Schäfke (Strasbourg, France), Editors

ISBN 978-3-03719-020-3

2006. 302 pages. Softcover. 17 cm x 24 cm

44.50 Euro

This special volume is dedicated to the memory of Andrey A. Bolibrukh. It contains two expository articles devoted to some aspects of Bolibrukh's work, followed by ten refereed research articles.

Topics cover complex linear and nonlinear differential equations as well as quantum groups: monodromy, Fuchsian linear systems, Riemann–Hilbert problem, differential Galois theory, differential algebraic groups, multi-summability, isomonodromy, Painlevé equations, Schlesinger equations, integrable systems, KZ equations, complex reflection groups, root systems.

Vol. 8

AdS/CFT Correspondence: Einstein Metrics and Their Conformal Boundaries

Olivier Biquard (Strasbourg, France), Editor

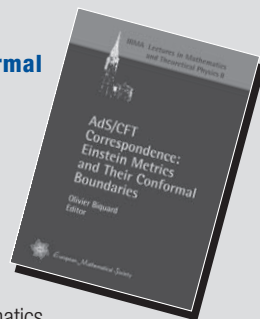
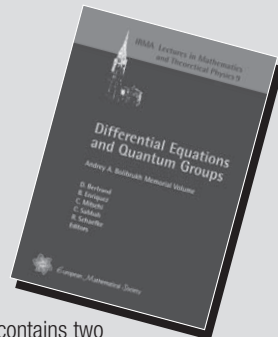
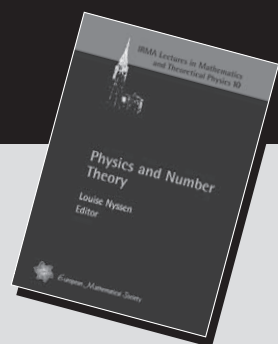
ISBN 978-3-03719-013-5

2005. 259 pages. Softcover. 17 cm x 24 cm

38.00 Euro

Since its discovery in 1997 by Maldacena, AdS/CFT correspondence has become one of the prime subjects of interest in string theory, as well as one of the main meeting points between theoretical physics and mathematics.

Written by leading experts and directed at research mathematicians and theoretical physicists as well as graduate students, this volume gives an overview of this important area both in theoretical physics and in mathematics. It contains survey articles giving a broad overview of the subject and of the main questions, as well as more specialized articles providing new insight both on the Riemannian side and on the Lorentzian side of the theory.



IRMA Lectures in Mathematics and Theoretical Physics

Vol. 7

Numerical Methods for Hyperbolic and Kinetic Problems

Stéphane Cordier (Orléans, France), Thierry Goudon (Lille, France),
Michaël Gutnic (Strasbourg, France) and Eric Sonnendrücker
(Strasbourg, France), Editors

ISBN 978-3-03719-012-8

2005. 367 pages. Softcover. 17 cm x 24 cm

44.50 Euro

Hyperbolic and kinetic equations arise in a large variety of industrial problems. For this reason, the CEMRACS summer research center held at CIRM in Luminy in 2003 was devoted to this topic. During a six-week period, junior and senior researchers worked full time on several projects proposed by industry and academia. Most of this work was completed later on, and the results are now reported in the present book.

The articles address modelling issues as well as the development and comparisons of numerical methods in different situations. The applications include multi-phase flows, plasma physics, quantum particle dynamics, radiative transfer, sprays and aeroacoustics.

The text is aimed at researchers and engineers interested in modelling and numerical simulation of hyperbolic and kinetic problems arising from applications.

Vol. 6

Athanasios Papadopoulos (IRMA, Strasbourg, France)

Metric Spaces, Convexity and Nonpositive Curvature

ISBN 978-3-03719-010-4

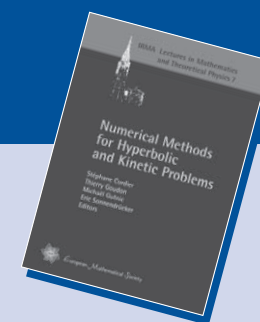
2005. 298 pages. Softcover. 17 cm x 24 cm

48.00 Euro

This book is about metric spaces of nonpositive curvature in the sense of Busemann, that is, metric spaces whose distance function satisfies a convexity condition. It also contains a systematic introduction to the theory of geodesics in metric spaces, as well as a detailed presentation of some facets of convexity theory that are useful in the study of nonpositive curvature. The concepts and the techniques are illustrated by many examples from classical hyperbolic geometry and from the theory of Teichmüller spaces.

The book is useful for students and researchers in geometry, topology and analysis.

... Papadopoulos does a fantastic job of bringing together all sorts of themes in geometry, from introductory material for beginners to intricate properties of moduli spaces of Riemann surfaces. ... The main body of the text is quite systematic, with digressions, examples and notes in various directions, and should prove a valuable resource for students in particular. The historical comments are fascinating. ... Papadopoulos' book is a treasure trove of ideas and examples that many may enjoy. (Bulletin (New Series) of the American Mathematical Society)



Edited by:

Joachim Schwermer and Jakob Yngvasson (both University of Vienna, Austria)

The Erwin Schrödinger International Institute for Mathematical Physics is a meeting place for leading experts in mathematical physics and mathematics, nurturing the development and exchange of ideas in the international community, particularly stimulating intellectual exchange between scientists from Eastern Europe and the rest of the world.

The purpose of the series *ESI Lectures in Mathematics and Physics* is to make selected texts arising from its research programme better known to a wider community and easily available to a worldwide audience. It publishes lecture notes on courses given by internationally renowned experts on highly active research topics. In order to make the series attractive to graduate students as well as researchers, special emphasis is given to concise and lively presentations with a level and focus appropriate to a student's background and at prices commensurate with a student's means.

Boltzmann's Legacy

Giovanni Gallavotti (Università di Roma La Sapienza, Italy), Wolfgang L. Reiter and Jakob Yngvasson (both University of Vienna, Austria), Editors

ISBN 978-3-03719-057-9

2008. Approx. 350 pages. Softcover. 17 cm x 24 cm
58.00 Euro

Ludwig Boltzmann (1844–1906) was an Austrian physicist famous for his founding contributions in the fields of statistical mechanics and statistical thermodynamics. He was one of the most important advocates for atomic theory when that scientific model was still highly controversial. To commemorate the 100th anniversary of his death in Duino, the International Symposium "Boltzmann's Legacy" was held at the Erwin Schrödinger International Institute for Mathematical Physics in June 2006.

This text covers a broad spectrum of topics ranging from equilibrium statistical and nonequilibrium statistical physics, ergodic theory and chaos to basic questions of biology and historical accounts of Boltzmann's work. Besides the lectures presented at the symposium the volume also contains contributions specially written for this occasion. The articles give a broad overview of Boltzmann's legacy to the sciences from the standpoint of some of present day's leading scholars in the field.

The book addresses students and researchers in mathematics, physics and the history of science.

Recent Developments in Pseudo-Riemannian Geometry

Dmitri V. Alekseevsky (University of Edinburgh, UK)
Helga Baum (Humboldt-Universität, Berlin, Germany), Editors

ISBN 978-3-03719-051-7

2008. 549 pages. Softcover. 17 x 24 cm
58.00 Euro

This book provides an introduction to and survey of recent developments in pseudo-Riemannian geometry, including applications in mathematical physics, by leading experts in the field. It is addressed to advanced students as well as to researchers in differential geometry, global analysis, general relativity and string theory. It shows essential differences between the geometry on manifolds with positive definite metrics and on those with indefinite metrics, and highlights the interesting new geometric phenomena, which naturally arise in the indefinite metric case. The reader finds a description of the present state of art in the field as well as open problems, which can stimulate further research.



Christian Bär, Nicolas Ginoux and Frank Pfäffle (University of Potsdam, Germany)
Wave Equations on Lorentzian Manifolds and Quantization

ISBN 978-3-03719-037-1

2007. 202 pages. Softcover. 17 cm x 24 cm
38.00 Euro

This book provides a detailed introduction to linear wave equations on Lorentzian manifolds (for vector-bundle valued fields). After a collection of preliminary material in the first chapter one finds in the second chapter the construction of local fundamental solutions together with their Hadamard expansion. The third chapter establishes the existence and uniqueness of global fundamental solutions on globally hyperbolic spacetimes and discusses Green's operators and well-posedness of the Cauchy problem. The last chapter is devoted to field quantization in the sense of algebraic quantum field theory. The necessary basics on C^* -algebras and CCR-representations are developed in full detail.

The text provides a self-contained introduction to these topics addressed to graduate students in mathematics and physics. At the same time it is intended as a reference for researchers in global analysis, general relativity, and quantum field theory.

Werner Ballmann (University of Bonn, Germany)

Lectures on Kähler Manifolds

ISBN 978-3-03719-025-8

2006. 182 pages. Softcover. 17 cm x 24 cm
38.00 Euro

This book is an introduction to Kähler geometry from the differential point of view. Besides the preliminaries, it covers the cohomology of Kähler manifolds (Hodge and Lefschetz decompositions, formality), the Calabi conjecture and Kähler-Einstein metrics of negative scalar curvature, Kähler-hyperbolic spaces and, finally, the Kodaira embedding theorem.

The book is concise, yet gives a thorough introduction to several areas of active research.

Moreover, despite its short length it contains many interesting examples and asides. (Mathematical Reviews)

Arkady Onishchik (Yaroslavl State University, Russia)

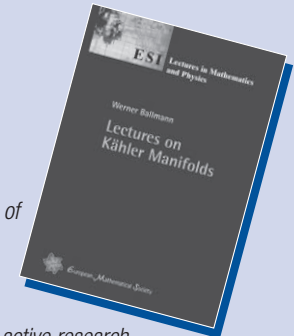
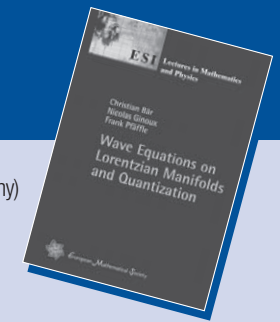
Lectures on Real Semisimple Lie Algebras and Their Representations

ISBN 978-3-03719-002-9

2004. 95 pages. Softcover. 17 cm x 24 cm
24.00 Euro

The author's primary goal is to provide an introduction to real semisimple Lie algebras and their representations. This is a welcome addition to the literature, given that this material, in addition to being interesting in its own right, is prerequisite for understanding orbit structure of homogeneous spaces and the associated realizations of real semisimple Lie group representations... (Zentralblatt für Mathematik)

These notes are a very clear and concise exposition of the classification of real simple Lie groups and of the theory of finite dimensional representations of real semisimple Lie algebras and real semisimple Lie groups... (Mathematical Reviews)



Zurich Lectures in Advanced Mathematics

Mathematics in Zurich has a long and distinguished tradition, in which the writing of lecture notes volumes and research monographs play a prominent part. The *Zurich Lectures in Advanced Mathematics* series aims to make some of these publications better known to a wider audience. Moderately priced, concise and lively in style, the volumes of this series will appeal to researchers and students alike, who seek an informed introduction to important areas of current research.

Michael Farber (Durham University, UK)
Invitation to Topological Robotics

ISBN 978-3-03719-054-8
2008. Approx. 144 pages. Softcover. 17 cm x 24 cm
32.00 Euro

The book discusses several selected topics of a new emerging area of research lying on the interface between topology and engineering. The first main topic of the book is topology of configuration spaces of mechanical linkages. These manifolds arise in various fields of mathematics and in other sciences, e.g. engineering, statistics, molecular biology. To compute Betti numbers of these configuration spaces we apply a new technique of Morse theory in the presence of an involution. A significant result of topology of linkages presented in the book is a solution of a conjecture of Kevin Walker which states that the relative sizes of bars of a linkage are determined, up to certain equivalence, by the cohomology algebra of the linkage configuration space. The book also describes a new probabilistic approach to topology of linkages which treats the bar lengths as random variables and studies mathematical expectations of Betti numbers. The second main topic of the book is topology of configuration spaces associated to polyhedra. The book gives an account of a beautiful work of S.R. Gal suggesting an explicit formula for the generating function encoding Euler characteristics of these spaces. Next we study the knot theory of a robot arm focusing on a recent important result of R. Connelly, E. Demain and G. Rote. Finally, the book investigates topological problems arising in the theory of robot motion planning algorithms and studies the homotopy invariant $TC(X)$ measuring navigational complexity of configuration spaces.

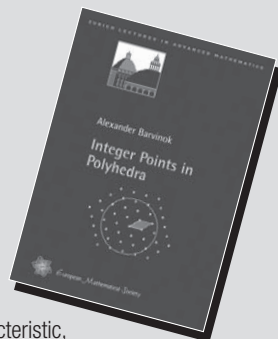
The book serves as an appetizer and will introduce any mathematician to some fascinating topological problems motivated by engineering.

Alexander Barvinok (University of Michigan, Ann Arbor, USA)
Integer Points in Polyhedra

ISBN 978-3-03719-052-4
2008. Approx. 200 pages. Softcover. 17 cm x 24 cm
34.00 Euro

This is a self-contained exposition of several core aspects of the theory of rational polyhedra with a view towards algorithmic applications to efficient counting of integer points, a problem arising in many areas of pure and applied mathematics. The approach is based on the consistent development and application of the apparatus of generating functions and the algebra of polyhedra. Topics range from classical, such as the Euler characteristic, continued fractions, Ehrhart polynomial, Minkowski Convex Body Theorem, and the Lenstra–Lenstra–Lovász lattice reduction algorithm, to recent advances such as the Berline–Vergne local formula.

The text is intended for graduate students and researchers with some general mathematical maturity and a modest background in linear algebra and analysis. Numerous figures, exercises of varying degree of difficulty as well as references to the literature and publicly available software make the text suitable for a graduate course.



Zurich Lectures in Advanced Mathematics

Paul Seidel (Massachusetts Institute of Technology, Cambridge, USA)
Fukaya Categories and Picard–Lefschetz Theory
A geometric approach

ISBN 978-3-03719-063-0
2008. 336 pages. Softcover. 17 cm x 24 cm
46.00 Euro

The central objects in the book are Lagrangian submanifolds and their invariants, such as Floer homology and its multiplicative structures, which together constitute the Fukaya category. The relevant aspects of pseudo-holomorphic curve theory are covered in some detail, and there is also a self-contained account of the necessary homological algebra.

Generally, the emphasis is on simplicity rather than generality. The last part discusses applications to Lefschetz fibrations, and contains many previously unpublished results.

The book will be of interest to graduate students and researchers in symplectic geometry and mirror symmetry.

Alexander H.W. Schmitt (Freie Universität Berlin, Germany)
Geometric Invariant Theory and Decorated Principal Bundles

ISBN 978-3-03719-065-4
2008. Approx. 400 pages. Softcover. 17 cm x 24 cm
48.00 Euro

The book starts with an introduction to Geometric Invariant Theory (GIT). The fundamental results of Hilbert and Mumford are exposed as well as more recent topics such as the instability flag, the finiteness of the number of quotients, and the variation of quotients.

In the second part, GIT is applied to solve the classification problem of decorated principal bundles on a compact Riemann surface. The solution is a quasi-projective moduli scheme which parameterizes those objects that satisfy a semistability condition originating from gauge theory. The moduli space is equipped with a generalized Hitchin map. The book concludes with a brief discussion of generalizations of these findings to higher dimensional base varieties, positive characteristic, and parabolic bundles.

The text is fairly self-contained (e.g., the necessary background from the theory of principal bundles is included) and features numerous examples and exercises. It addresses students and researchers with a working knowledge of elementary algebraic geometry.

Camillo De Lellis (University of Zürich, Switzerland)
Rectifiable Sets, Densities, and Tangent Measures

ISBN 978-3-03719-044-9
2008. 133 pages. Softcover. 17 x 24 cm
26.00 Euro

The characterization of rectifiable sets through the existence of densities is a pearl of geometric measure theory. The difficult proof, due to Preiss, relies on many beautiful and deep ideas and novel techniques. Some of them have already proven useful in other contexts, whereas others have not yet been exploited.

These notes give a simple and short presentation of the former, and provide some perspective of the latter. The aim is to provide a self-contained reference for anyone interested in an overview of this fascinating topic.



Demetrios Christodoulou (ETH Zürich, Switzerland)

Mathematical Problems of General Relativity I

ISBN 978-3-03719-005-0

2008. 157 pages. Softcover. 17 x 24 cm

28.00 Euro

General Relativity is a theory proposed by Einstein in 1915 as a unified theory of space, time and gravitation. It is based on and extends Newton's theory of gravitation as well as Newton's equations of motion. It is thus fundamentally rooted in classical mechanics. The theory can be seen as a development of Riemannian geometry, itself an extension of Gauss' intrinsic theory of curved surfaces in Euclidean space. The domain of application of the theory is astronomical systems.

One of the mathematical methods analyzed and exploited in the present volume is an extension of Noether's fundamental principle connecting symmetries to conserved quantities. This is involved at a most elementary level in the very definition of the notion of hyperbolicity for an Euler–Lagrange system of partial differential equations. Another method is the study and systematic use of foliations by characteristic (null) hypersurfaces, and is in the spirit of the approach of Roger Penrose in his incompleteness theorem. The methods have applications beyond general relativity to problems in fluid mechanics and, more generally, to the mechanics and electrodynamics of continuous media.

The book is intended for advanced students and researchers seeking an introduction into the methods and applications of general relativity.

Guus Balkema (University of Amsterdam, The Netherlands)

Paul Embrechts (ETH Zürich, Switzerland)

High Risk Scenarios and Extremes

A geometric approach

ISBN 978-3-03719-035-7

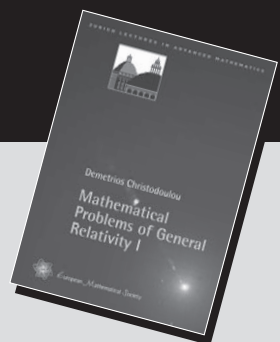
2007. 388 pages. Softcover. 17 cm x 24 cm

48.00 Euro

Quantitative Risk Management (QRM) has become a field of research of considerable importance to numerous areas of application, including insurance, banking, energy, medicine, reliability. Mainly motivated by examples from insurance and finance, we develop a theory for handling multivariate extremes. The approach borrows ideas from portfolio theory and aims at an intuitive approach in the spirit of the Peaks over Thresholds method. The point of view is geometric. It leads to a probabilistic description of what in QRM language may be referred to as a high risk scenario: the conditional behaviour of risk factors given that a large move on a linear combination (portfolio, say) has been observed. The theoretical models which describe such conditional extremal behaviour are characterized and their relation to the limit theory for coordinatewise maxima is explained.

The first part is an elegant exposition of coordinatewise extreme value theory; the second half develops the more basic geometric theory. Besides a precise mathematical deduction of the main results, the text yields numerous discussions of a more applied nature. A twenty page preview introduces the key concepts; the extensive introduction provides links to financial mathematics and insurance theory.

The book is based on a graduate course on point processes and extremes. It could form the basis for an advanced course on multivariate extreme value theory or a course on mathematical issues underlying risk. Students in statistics and finance with a mathematical, quantitative background are the prime audience. Actuaries and risk managers involved in data based risk analysis will find the models discussed in the book stimulating. The text contains many indications for further research.



Pavel Etingof (Massachusetts Institute of Technology, Cambridge, USA)

Calogero–Moser systems and representation theory

ISBN 978-3-03719-034-0

2007. 101 pages. Softcover. 17 cm x 24 cm

28.00 Euro

Calogero–Moser systems, which were originally discovered by specialists in integrable systems are currently at the crossroads of many areas of mathematics and within the scope of interests of many mathematicians. More specifically, these systems and their generalizations turned out to have intrinsic connections with such fields as algebraic geometry (Hilbert schemes of surfaces), representation theory (double affine Hecke algebras, Lie groups, quantum groups), deformation theory (symplectic reflection algebras), homological algebra (Koszul algebras), Poisson geometry, etc. The goal of the present lecture notes is to give an introduction to the theory of Calogero–Moser systems, highlighting their interplay with these fields. Since these lectures are designed for non-experts, we give short introductions to each of the subjects involved, and provide a number of exercises.

The book will be suitable for mathematics graduate students and researchers in the areas of representation theory, noncommutative algebra, algebraic geometry, and related areas.

Sergei B. Kuksin (Heriot-Watt University, Edinburgh, UK)

Randomly forced nonlinear PDEs and statistical hydrodynamics in 2 space dimensions

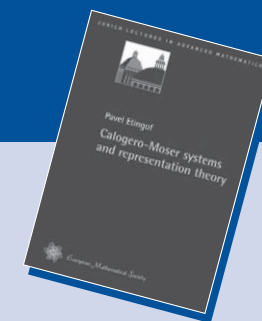
ISBN 978-3-03719-021-0

2006. 102 pages. Softcover. 17 cm x 24 cm

28.00 Euro

The book gives an account of recent achievements in the mathematical theory of two-dimensional turbulence, described by the 2D Navier–Stokes equation, perturbed by a random force. The main results presented here were obtained during the last five to ten years and, up to now, have been available only in papers in the primary literature. Their summary and synthesis here, beginning with some preliminaries on partial differential equations and stochasticity, make the book a self-contained account that will appeal to readers with a general background in analysis.

After laying the groundwork, the author goes on to recent results on ergodicity of random dynamical systems, which the randomly forced Navier–Stokes equation defines in the function space of divergence-free vector fields, including a Central Limit Theorem. The physical meaning of these results is discussed as well as their relations with the theory of attractors. Next, the author studies the behaviour of solutions when the viscosity goes to zero. In the final section these dynamical methods are used to derive the so-called balance relations – the infinitely many algebraical relations satisfied by the solutions.



Zurich Lectures in Advanced Mathematics

Yakov Pesin (Pennsylvania State University, USA)

Lectures on partial hyperbolicity and stable ergodicity

ISBN 978-3-03719-003-6

2004. 128 pages. Softcover. 17 cm x 24 cm

28.00 Euro

This book is an introduction to the modern theory of partial hyperbolicity with applications to stable ergodicity theory of smooth dynamical systems. It provides a systematic treatment of the theory and describes all the basic concepts and major results that have been obtained in the area since its creation around the early 1970s. It can be used as a textbook for a graduate student course and is also of interest to professional mathematicians working in the field of dynamical systems and their applications.

...The text would be ideal for an intermediate-level graduate dynamical systems topics course.
(Mathematical Reviews)

Sun-Yung Alice Chang (Princeton University, USA)

Non-linear Elliptic Equations in Conformal Geometry

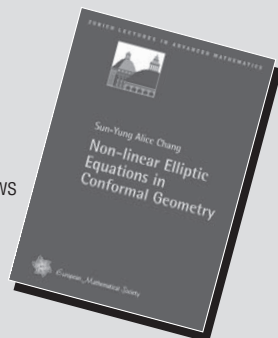
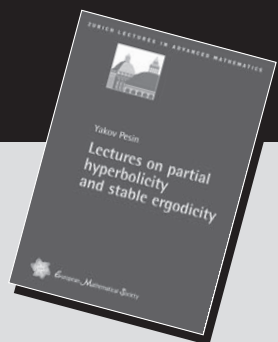
ISBN 978-3-03719-006-7

2004. 100 pages. Softcover. 17 cm x 24 cm

24.00 Euro

In these lectures, starting from the background material, the author reviews the problem of prescribing Gaussian curvature on compact surfaces. She then develops the analytic tools (e.g. higher order conformal invariant operators, Sobolev inequalities, blow-up analysis) in order to solve a fully nonlinear equation in prescribing the Chern–Gauss–Bonnet integrand on compact manifolds of dimension four.

...This book is a lovely introduction to the subject and contains an excellent bibliographic introduction to the subject comprising approximately 100 entries.
(Zentralblatt für Mathematik)



EMS Series of Lectures in Mathematics

Edited by Andrew Ranicki (University of Edinburgh, U.K.)

EMS Series of Lectures in Mathematics is a book series aimed at students, professional mathematicians and scientists. It publishes polished notes arising from seminars or lecture series in all fields of pure and applied mathematics, including the reissue of classic texts of continuing interest. The individual volumes are intended to give a rapid and accessible introduction into their particular subject, guiding the audience to topics of current research and the more advanced and specialized literature.

Martin J. Mohlenkamp (Ohio University, Athens, USA)

María Cristina Pereyra (University of New Mexico, Albuquerque, USA)

Wavelets, Their Friends, and What They Can Do for You

ISBN 978-3-03719-018-0

2008. 119 pages. Softcover. 17 x 24 cm

24.00 Euro

So what is all the fuss about wavelets?

You can find out by reading these notes. They will introduce you to the central concepts surrounding wavelets and their applications. By focusing on the essential ideas and arguments, they enable you to get to the heart of the matter as quickly as possible. They then point you to the appropriate places in the literature for detailed proofs and real applications, so you can continue your study.

They begin with the notion of time-frequency analysis, present the multiresolution analysis and basic wavelet construction, introduce you to the many friends, relatives and mutations of wavelets, and finally give a selection of applications.

They are suitable for beginning graduate students and above. A preliminary chapter containing some of the prerequisite concepts and definitions is included for reference.

S.E. Payne (University of Colorado, Denver, USA)

J.A. Thas (University of Gent, Belgium)

Finite Generalized Quadrangles, second edition

ISBN 978-3-03719-066-1

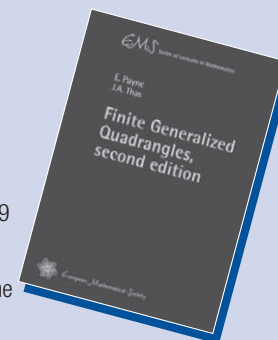
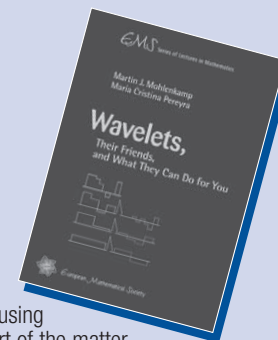
2008. Approx. 300 pages. Softcover. 17 x 24 cm

40.00 Euro

Generalized quadrangles (GQ) were formally introduced by J. Tits in 1959 in order to describe geometric properties of simple groups of Lie type of rank 2. Since its appearance in 1984, "Finite Generalized Quadrangles" (FGQ) quickly became the standard reference for finite GQ. It presents the whole story of the subject from the very beginning in a book of modest length.

This second edition is essentially a reprint of the first edition. It is a careful rendering into LaTeX of the original (with corrections of typos), along with an appendix that brings to the attention of the reader those major new results pertaining to GQ, especially in those areas to which the authors of this work have made a contribution.

The first edition being out of print for many years, the new edition makes again available this classical reference in the rapidly increasing field of finite geometries.



EMS Series of Lectures in Mathematics

Iskander A. Taimanov
(Sobolev Institute of Mathematics, Novosibirsk, Russia)
Lectures on Differential Geometry

ISBN 978-3-03719-050-0
2008. 219 pages. Softcover. 17 x 24 cm
34.00 Euro

Differential geometry studies geometrical objects using analytical methods. Like modern analysis itself, differential geometry originates in classical mechanics. For instance, geodesics and minimal surfaces are defined via variational principles and the curvature of a curve is easily interpreted as the acceleration with respect to the path length parameter. Modern differential geometry in its turn strongly contributed to modern physics.

This book gives an introduction to the basics of differential geometry, keeping in mind the natural origin of many geometrical quantities, as well as the applications of differential geometry and its methods to other sciences.

The text is divided into three parts. The first part covers the basics of curves and surfaces, while the second part is designed as an introduction to smooth manifolds and Riemannian geometry. In particular, Chapter 5 contains short introductions to hyperbolic geometry and geometrical principles of special relativity theory. Here, only a basic knowledge of algebra, calculus and ordinary differential equations is required. The third part is more advanced and introduces into matrix Lie groups and Lie algebras, representation theory of groups, symplectic and Poisson geometry, and applications of complex analysis in surface theory.

The book is based on lectures the author held repeatedly at Novosibirsk State University. It is addressed to students as well as to anyone who wants to learn the basics of differential geometry.

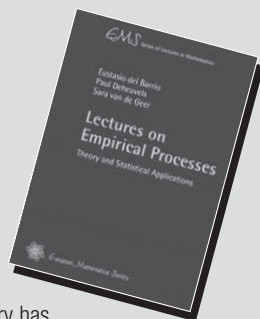
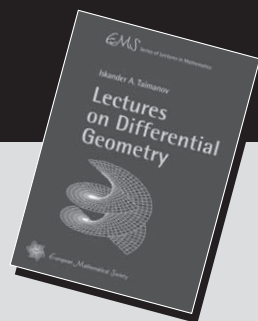
Eustasio del Barrio (Universidad de Valladolid, Spain)
Paul Deheuvels (Université de Paris VI, France)
Sara van de Geer (ETH Zürich, Switzerland)
Lectures on Empirical Processes
Theory and Statistical Applications

ISBN 978-3-03719-027-2
2007. 263 pages. Softcover. 17 cm x 24 cm
39.50 Euro

The theory of empirical processes constitutes the mathematical toolbox of asymptotic statistics. Its growth was accelerated by the 1950s work on the Functional Central Limit Theorem and the Invariance Principle. The theory has developed in parallel with statistical methodologies, and has been successfully applied to a large diversity of problems related to the asymptotic behaviour of statistical procedures.

The three sets of lecture notes in the book offer a wide panorama of contemporary empirical processes theory. Techniques are developed in the framework of probability in Banach spaces, Hungarian-style strong approximations, using tools from general stochastic process theory. Other tools appear in this text in connection with historical as well as modern applications, such as goodness-of-fit tests, density estimation or general M-estimators.

...This book gives an excellent overview on the broad scope of the theory of empirical processes. It can be recommended for students and researchers interested in an advanced and well-documented approach to the selected topics. (Zentralblatt für Mathematik)



EMS Series of Lectures in Mathematics

Sergey V. Matveev (Chelyabinsk State University, Russia)
Lectures on Algebraic Topology

ISBN 978-3-03719-023-4
2006. 106 pages. Softcover. 17 cm x 24 cm
28.00 Euro

Algebraic topology is the study of global properties of topological spaces by means of algebra. It is an important branch of modern mathematics with a wide degree of applicability to other fields, including geometric topology, differential geometry, functional analysis, differential equations, algebraic geometry, number theory, and theoretical physics.

This book provides an introduction to the basic concepts and methods of algebraic topology for the beginner. It presents elements of both homology theory and homotopy theory, and includes various applications.

The author's intention is to rely on the geometric approach by appealing to the reader's own intuition to help understanding. The numerous illustrations in the text also serve this purpose. Two features make the text different from the standard literature: first, special attention is given to providing explicit algorithms for calculating the homology groups and for manipulating the fundamental groups. Second, the book contains many exercises, all of which are supplied with hints or solutions. This makes the book suitable for both classroom use and for independent study.

... There are many exercises in both parts of the book. At the end there is a section "Answers, hints, solutions". The intention of the author is seemingly not so much to present detailed proofs but to give the reader an idea about what is going on, referring to some other places in the literature for further reading and deeper insights. (Zentralblatt für Mathematik)

Joseph C. Várilly (Universidad de Costa Rica)
An Introduction to Noncommutative Geometry

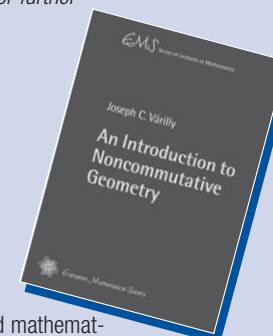
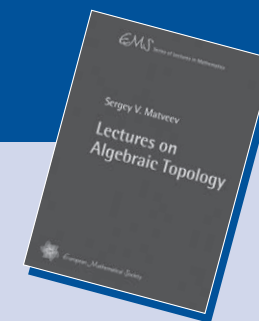
ISBN 978-3-03719-024-1
2006. 121 pages. Softcover. 17 cm x 24 cm
28.00 Euro

Noncommutative geometry, inspired by quantum physics, describes singular spaces by their noncommutative coordinate algebras, and metric structures by Dirac-like operators. Such metric geometries are described mathematically by Connes' theory of spectral triples. These lectures, delivered at an EMS Summer School on noncommutative geometry and its applications, provide an overview of spectral triples based on examples.

This introduction is aimed at graduate students of both mathematics and theoretical physics. It deals with Dirac operators on spin manifolds, noncommutative tori, Moyal quantization and tangent groupoids, action functionals, and isospectral deformations. The structural framework is the concept of a noncommutative spin geometry; the conditions on spectral triples which determine this concept are developed in detail. The emphasis throughout is on gaining understanding by computing the details of specific examples.

The book provides a middle ground between a comprehensive text and a narrowly focused research monograph. It is intended for self-study, enabling the reader to gain access to the essentials of noncommutative geometry. New features since the original course are an expanded bibliography and a survey of more recent examples and applications of spectral triples.

This excellent introduction to noncommutative geometry gives a precise 'current state of affairs' of the subject. Ever since the invention of noncommutative geometry by Alain Connes in the 1980s, more and more applications of it have been found in both mathematics and physics. In this book, the author succeeds in giving the reader a broad and accessible overview of these. In the meanwhile, the book remains within the scope of the EMS lecture series by giving a rapid introduction to the subject and providing an extensive guide to the more advanced literature... (Mathematical Reviews)



EMS Series of Lectures in Mathematics

Reto Müller (ETH Zürich, Switzerland)

Differential Harnack Inequalities and the Ricci Flow

ISBN 978-3-03719-030-2

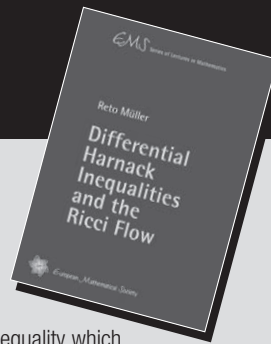
2006. 99 pages. Softcover. 17 cm x 24 cm. 28.00 Euro

In 2002, Grisha Perelman presented a new kind of differential Harnack inequality which involves both the (adjoint) linear heat equation and the Ricci flow. This led to a completely new approach to the Ricci flow that allowed interpretation as a gradient flow which maximizes different entropy functionals.

The goal of this book is to explain this analytic tool in full detail for the two examples of the linear heat equation and the Ricci flow. It begins with the original Li–Yau result, presents Hamilton’s Harnack inequalities for the Ricci flow, and ends with Perelman’s entropy formulas and space-time geodesics. The book is a self-contained, modern introduction to the Ricci flow and the analytic methods to study it. It is primarily addressed to students who have a basic introductory knowledge of analysis and of Riemannian geometry and who are attracted to further study in geometric analysis. No previous knowledge of differential Harnack inequalities or the Ricci flow is required.

The very interesting book under review is a revised and extended version of the author’s diploma thesis written in the winter semester 2004/05 at ETH Zürich under the guidance of Michael Struwe. Its main goal is to explain some of the theory of Perelman’s first Ricci flow paper as well as its thematic context, presenting in details the underlying analytic methods to non-experts or students who are new to the subject... The book is very well written and self-contained. Highly recommended text! (Zentralblatt für Mathematik)

This book is a nice introduction to the Ricci flow, with a focus on differential Harnack inequalities, entropy formulas and G. Perelman’s reduced volume functional. The author makes many comparisons with the standard heat equation on a fixed manifold and relates results to Ricci solitons where appropriate. The book is a very readable starting point for exploration of this exciting area of current research in nonlinear PDE and differential geometry... (Mathematical Reviews)



EMS Series of Lectures in Mathematics

Torsten Ekedahl (Stockholm University, Sweden)

One Semester of Elliptic Curves

ISBN 978-3-03719-015-9.

2006. 138 pages. Softcover. 17 cm x 24 cm
32.00 Euro

These lecture notes grew out of a one semester introductory course on elliptic curves given to an audience of computer science and mathematics students, and assume only minimal background knowledge. After having covered the basic analytic and algebraic aspects, putting special emphasis on explaining the interplay between algebraic and analytic formulas, they go on to some more specialized topics. These include the j -function from an algebraic and analytic perspective, a discussion of the elliptic curves over finite fields, derivation of the recursion formulas for the division polynomials, the algebraic structure of the torsion points of an elliptic curve, complex multiplication, and modular forms.

In an effort to motivate the basic problems the book starts very slowly, but considers some aspects such as modular forms of higher level which are not usually covered. It presents more than 100 exercises and a Mathematica (TM) notebook that treats a number of calculations involving elliptic curves.

The book is aimed at students of mathematics and computer science interested in the cryptographic aspects of elliptic curves.

... Overall, this is a very nice introduction to elliptic curves; although the approach is analytic, it is useful also for computer scientists interested in cryptographic applications because techniques needed for point counting (division polynomials) or for constructing curves with certain properties (complex multiplication) are discussed here. (Zentralblatt für Mathematik)

Katrin Wehrheim (Massachusetts Institute of Technology, Cambridge, USA)

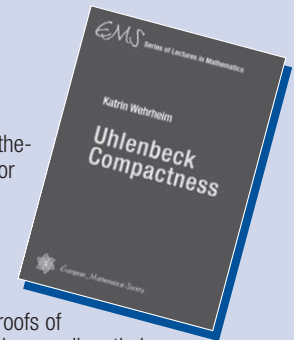
Uhlenbeck Compactness

ISBN 978-3-03719-004-3

2004. 219 pages. Softcover. 17 cm x 24 cm
39.50 Euro

This book gives a detailed account of the analytic foundations of gauge theory – Uhlenbeck’s compactness theorems for general connections and for Yang–Mills connections. It intends to guide graduate students into the analysis of Yang–Mills theory as well as to serve as a reference for researchers in the field. The book is largely self-contained. It contains a number of appendices (e.g. on Sobolev spaces of maps between manifolds) and an introductory part covering the L^p -regularity theory for the inhomogenous Neumann problem. The two main parts contain the full proofs of Uhlenbeck’s weak and strong compactness theorems on closed manifolds as well as their generalizations to manifolds with boundary and noncompact manifolds. These parts include a number of useful analytic tools such as general patching constructions and local slice theorems.

... Given the analytical subject, one cannot expect this book to be leisure reading. But it is getting quite close. An excellent introduction provides a good guideline through the book; ideas are always explained before the actual proofs; and the proofs are complete without being overly technical. This book should become the standard future reference for Uhlenbeck compactness. (Jahresbericht DMV)



EMS Textbooks in Mathematics

EMS Textbooks in Mathematics is a book series aimed at students or professional mathematicians seeking an introduction into a particular field. The individual volumes are intended to provide not only relevant techniques, results and their applications, but afford insight into the motivations and ideas behind the theory. Suitably designed exercises help to master the subject and prepare the reader for the study of more advanced and specialized literature.

Tammo tom Dieck (University of Göttingen, Germany)
Algebraic Topology

ISBN 978-3-03719-048-7
2008. Approx. 580 pages. Hardcover. 16.5 x 23.5 cm
58.00 Euro

This book is written as a textbook on algebraic topology which covers the material for introductory courses (homotopy and homology), background material (manifolds, cell complexes, fibre bundles), and more advanced applications of the basic tools and concepts (duality, characteristic classes, homotopy groups of spheres, bordism). A special feature is the rich supply of nearly 500 exercises and problems at the end of each section. The book recommends to start an introductory course with homotopy theory. For this purpose, basic classical results are presented with new simplified elementary proofs. Alternatively, one could start more traditionally with singular homology. Later chapters include material which has not appeared before in textbooks as well as new simplified proofs for some more advanced results.

Prerequisites are basic point set topology (as recalled in the first chapter), some acquaintance with basic algebra (modules, tensor product), and some terminology from category theory. The aim of the book is to introduce advanced undergraduate and graduate (masters) students to the basic tools, concepts and results of algebraic topology. Sufficient background material from geometry and algebra is included.

Mauro C. Beltrametti, Ettore Carletti, Dionisio Gallarati,
Giacomo Monti Bragadin (all Università di Genova, Italy)
Lectures on Curves, Surfaces and Projective Varieties

A Classical View of Algebraic Geometry
Translated from the Italian by Francis Sullivan

ISBN 978-3-03719-064-7
2008. Approx. 500 pages. Hardcover. 16.5 x 23.5 cm
58.00 Euro

This book offers a wide-ranging introduction to algebraic geometry along classical lines. It consists of lectures on topics in classical algebraic geometry, including the basic properties of projective algebraic varieties, linear systems of hypersurfaces, algebraic curves (with special emphasis on rational curves), linear series on algebraic curves, Cremona transformations, rational surfaces, and notable examples of special varieties like the Segre, Grassmann, and Veronese varieties. An integral part and special feature of the presentation is the inclusion of many exercises, not easy to find in the literature and almost all with complete solutions. The text is aimed at students of the last two years of an undergraduate program in mathematics.

The prerequisites for understanding the material in this book have been deliberately limited to knowledge of only the basic elements of projective geometry and abstract algebra. Thus, for example, some knowledge of the geometry of subspaces and properties of fields is assumed.

The book will be welcomed by teachers and students of algebraic geometry who are seeking a clear and panoramic path leading from the basic facts about linear subspaces, conics and quadrics to a systematic discussion of classical algebraic varieties and the tools needed to study them. The ideal use for this text could well be to provide a solid preliminary course to be mastered before approaching more advanced and abstract books.

EMS Textbooks in Mathematics

Marek Jarnicki (Jagiellonian University, Kraków, Poland)
Peter Pflug (University of Oldenburg, Germany)
**First Steps in Several Complex Variables:
Reinhardt Domains**

ISBN 978-3-03719-049-4
2008. 367 pages. Hardcover. 16.5 x 23.5 cm
58.00 Euro

This book provides a comprehensive introduction to the field of several complex variables in the setting of a very special but basic class of domains, the so-called Reinhardt domains. In this way the reader may learn much about this area without encountering too many technical difficulties.

Chapter 1 describes the fundamental notions and the phenomenon of simultaneous holomorphic extension. Chapter 2 presents a fairly complete discussion of biholomorphisms of bounded (complete) Reinhardt domains in the two dimensional case. The third chapter gives a classification of Reinhardt domains of existence for the most important classes of holomorphic functions. The last chapter deals with invariant functions and gives explicit calculations of many of them on certain Reinhardt domains. Numerous exercises are included to help the readers with their understanding of the material. Further results and open problems are added which may be useful as seminar topics.

The primary aim of this book is to introduce students or non-experts to some of the main research areas in several complex variables. The book provides a friendly invitation to this field as the only prerequisite is a basic knowledge of analysis.

Oleg Bogopolski (TU Dortmund, Germany)
Introduction to Group Theory

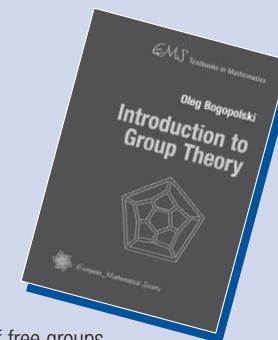
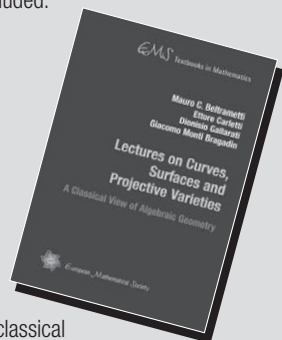
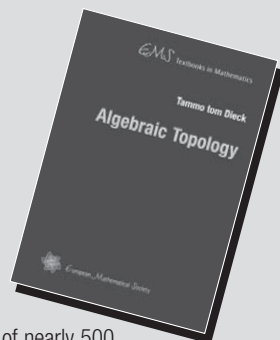
ISBN 978-3-03719-041-8
2008. 187 pages. Hardcover. 16.5 x 23.5 cm
38.00 Euro

This book quickly introduces beginners to general group theory and then focuses on three main themes:

- finite group theory, including sporadic groups;
- combinatorial and geometric group theory, including the Bass–Serre theory of groups acting on trees;
- the theory of train tracks by Bestvina and Handel for automorphisms of free groups.

With its many examples, exercises, and full solutions to selected exercises, this text provides a gentle introduction that is ideal for self-study and an excellent preparation for applications. A distinguished feature of the presentation is that algebraic and geometric techniques are balanced. The beautiful theory of train tracks is illustrated by two nontrivial examples.

Presupposing only a basic knowledge of algebra, the book is addressed to anyone interested in group theory: from advanced undergraduate and graduate students to specialists.



EMS Textbooks in Mathematics

Thomas Timmermann (University of Münster, Germany)
An Invitation to Quantum Groups and Duality
From Hopf Algebras to Multiplicative Unitaries and Beyond

ISBN 978-3-03719-043-2
2008. 427 pages. Hardcover. 16.5 x 23.5 cm
58.00 Euro

This book provides an introduction to the theory of quantum groups with emphasis on their duality and on the setting of operator algebras.

Part I of the text presents the basic theory of Hopf algebras, Van Daele's duality theory of algebraic quantum groups, and Woronowicz's compact quantum groups, staying in a purely algebraic setting. Part II focuses on quantum groups in the setting of operator algebras. Woronowicz's compact quantum groups are treated in the setting of C^* -algebras, and the fundamental multiplicative unitaries of Baaj and Skandalis are studied in detail. An outline of Kustermans' and Vaes' comprehensive theory of locally compact quantum groups completes this part. Part III leads to selected topics, such as coactions, Baaj–Skandalis-duality, and approaches to quantum groupoids in the setting of operator algebras.

The book is addressed to graduate students and non-experts from other fields. Only basic knowledge of (multi-)linear algebra is required for the first part, while the second and third part assume some familiarity with Hilbert spaces, C^* -algebras, and von Neumann algebras.

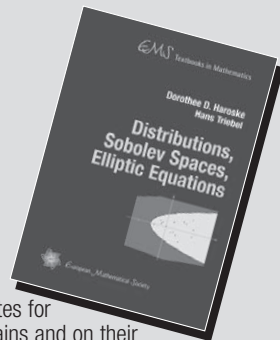
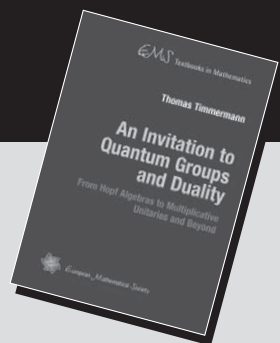
Dorothee D. Haroske (University of Jena, Germany)
Hans Triebel (University of Jena, Germany)
Distributions, Sobolev spaces, Elliptic equations

ISBN 978-3-03719-042-5
2007. 303 pages. Hardcover. 16.5 x 23.5 cm
48.00 Euro

It is the main aim of this book to develop at an accessible, moderate level an L_2 theory for elliptic differential operators of second order on bounded smooth domains in Euclidean n -space, including a priori estimates for boundary-value problems in terms of (fractional) Sobolev spaces on domains and on their boundaries, together with a related spectral theory.

The presentation is preceded by an introduction to the classical theory for the Laplace–Poisson equation, and some chapters providing required ingredients such as the theory of distributions, Sobolev spaces and the spectral theory in Hilbert spaces.

The book grew out of two-semester courses the authors have given several times over a period of ten years at the Friedrich Schiller University of Jena. It is addressed to graduate students and mathematicians who have a working knowledge of calculus, measure theory and the basic elements of functional analysis (as usually covered by undergraduate courses) and who are seeking an accessible introduction to some aspects of the theory of function spaces and its applications to elliptic equations.



EMS Textbooks in Mathematics

Peter Kunkel (University of Leipzig, Germany)
Volker Mehrmann (TU Berlin, Germany)
Differential-Algebraic Equations
Analysis and Numerical Solution

ISBN 978-3-03719-017-3
2006. 385 pages. Hardcover. 16.5 cm x 23.5 cm
58.00 Euro

Differential-algebraic equations are a widely accepted tool for the modeling and simulation of constrained dynamical systems in numerous applications, such as mechanical multibody systems, electrical circuit simulation, chemical engineering, control theory, fluid dynamics and many others.

This is the first comprehensive textbook that provides a systematic and detailed analysis of initial and boundary value problems for differential-algebraic equations. The analysis is developed from the theory of linear constant coefficient systems via linear variable coefficient systems to general nonlinear systems. Further sections on control problems, generalized inverses of differential-algebraic operators, generalized solutions, and differential equations on manifolds complement the theoretical treatment of initial value problems. Two major classes of numerical methods for differential-algebraic equations (Runge–Kutta and BDF methods) are discussed and analyzed with respect to convergence and order. A chapter is devoted to index reduction methods that allow the numerical treatment of general differential-algebraic equations. The analysis and numerical solution of boundary value problems for differential-algebraic equations is presented, including multiple shooting and collocation methods. A survey of current software packages for differential-algebraic equations and a short outlook on current research topics complete the text.

The book is addressed to graduate students and researchers in mathematics, engineering and sciences, as well as practitioners in industry. A prerequisite is a standard course on the numerical solution of ordinary differential equations. Numerous examples and exercises make the book suitable as a course textbook or for self-study.

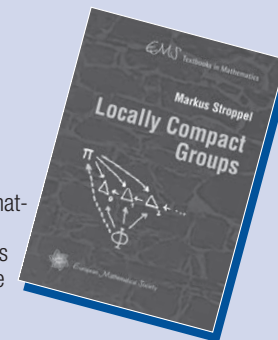
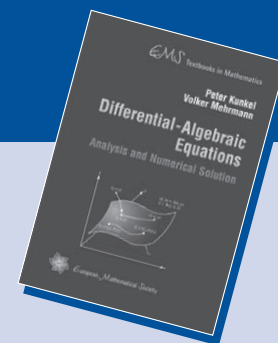
Markus Stroppel (University of Stuttgart, Germany)
Locally Compact Groups

ISBN 978-3-03719-016-6
2006. 312 pages. Hardcover. 16.5 cm x 23.5 cm
52.00 Euro

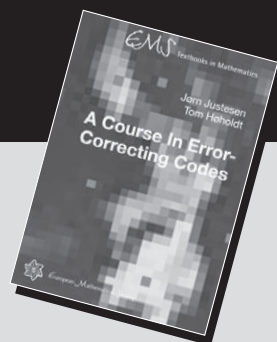
Locally compact groups play an important role in many areas of mathematics as well as in physics. The class of locally compact groups admits a strong structure theory, which allows to reduce many problems to groups constructed in various ways from the additive group of real numbers, the classical linear groups and from finite groups. The book gives a systematic and detailed introduction to the highlights of that theory.

In the beginning, a review of fundamental tools from topology and the elementary theory of topological groups and transformation groups is presented. Completions, Haar integral, applications to linear representations culminating in the Peter–Weyl Theorem are treated. Pontryagin duality for locally compact Abelian groups forms a central topic of the book. Applications are given, including results about the structure of locally compact Abelian groups, and a structure theory for locally compact rings leading to the classification of locally compact fields. Topological semigroups are discussed in a separate chapter, with special attention to their relations to groups. The last chapter reviews results related to Hilbert's Fifth Problem, with the focus on structural results for non-Abelian connected locally compact groups that can be derived using approximation by Lie groups.

The book is self-contained and is addressed to advanced undergraduate or graduate students in mathematics or physics. It can be used for one-semester courses on topological groups, on locally compact Abelian groups, or on topological algebra. Suggestions on course design are given in the preface. Each chapter is accompanied by a set of exercises that have been tested in classes.



EMS Textbooks in Mathematics



Jørn Justesen (Technical University of Denmark)

Tom Høholdt (Technical University of Denmark)

A Course in Error-Correcting Codes

ISBN 978-3-03719-001-2

2004. 201 pages. Hardcover. 16.5 cm x 23.5 cm

39.50 Euro

This book is written as a text for a course aimed at 3rd or 4th year students. Only some familiarity with elementary linear algebra and probability is directly assumed, but some maturity is required. The students may specialize in discrete mathematics, computer science, or communication engineering. The book is also a suitable introduction to coding theory for researchers from related fields or for professionals who want to supplement their theoretical basis. The book gives the coding basics for working on projects in any of the above areas, but material specific to one of these fields has not been included. The chapters cover the codes and decoding methods that are currently of most interest in research, development, and application. They give a relatively brief presentation of the essential results, emphasizing the interrelations between different methods and proofs of all important results. A sequence of problems at the end of each chapter serves to review the results and give the student an appreciation of the concepts. In addition, some problems and suggestions for projects indicate direction for further work. The presentation encourages the use of programming tools for studying codes, implementing decoding methods, and simulating performance. Specific examples of programming exercises are provided on the book's home page.

... *The fact that both authors work actively within the research area is visible in the book thus describing relevant classical problems in a modern language and dealing with a number of topics of great current interest. The authors' wide range of experience has made it possible for them to write a book that is both appealing to students studying coding theory within mathematics as well as engineering.*

Justesen and Høholdt have made efforts to use just the absolute necessary amount of mathematics when introducing the subjects to avoid a theoretical jungle that would block the view of most readers.

As an example we can mention that a finite field has been successfully described almost without using abstract algebra, and that Hermitian codes, with a background in algebraic geometry, are primarily handled by using linear algebra.

The presentation of cyclic codes and information frames leads to a very successful and unorthodox treatment of convolutional codes and their decoding... (Newsletter *Matilde* no. 22 of the Danish Mathematical Society)

... *The book material is illustrated with a set of example problems and their solutions. All of this makes the book a useful compendium of fundamentals on error-correcting codes.* (Zentralblatt für Mathematik)

EMS Monographs in Mathematics

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EMS Monographs in Mathematics is a book series aimed at mathematicians and scientists. It publishes research monographs and graduate level textbooks from all fields of mathematics. The individual volumes are intended to give a reasonably comprehensive and self-contained account of their particular subject. They present mathematical results that are new or have not been accessible previously in the literature.

Demetrios Christodoulou (ETH Zürich, Switzerland)

The Formation of Shocks in 3-Dimensional Fluids

ISBN 978-3-03719-031-9

2007. 1000 pages. Hardcover. 16.5 cm x 23.5 cm

148.00 Euro

The equations describing the motion of a perfect fluid were first formulated by Euler in 1752. These equations were among the first partial differential equations to be written down, but, after a lapse of two and a half centuries, we are still far from adequately understanding the observed phenomena which are supposed to lie within their domain of validity.

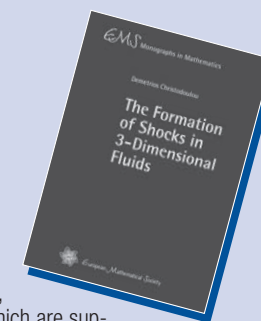
These phenomena include the formation and evolution of shocks in compressible fluids, the subject of the present monograph. The first work on shock formation was done by Riemann in 1858. However, his analysis was limited to the simplified case of one space dimension. Since then, several deep physical insights have been attained and new methods of mathematical analysis invented. Nevertheless, the theory of the formation and evolution of shocks in real three-dimensional fluids has remained up to this day fundamentally incomplete.

This monograph considers the relativistic Euler equations in three space dimensions for a perfect fluid with an arbitrary equation of state. We consider initial data for these equations which outside a sphere coincide with the data corresponding to a constant state. Under suitable restriction on the size of the initial departure from the constant state, we establish theorems that give a complete description of the maximal classical development. In particular, it is shown that the boundary of the domain of the maximal classical development has a singular part where the inverse density of the wave fronts vanishes, signalling shock formation. The theorems give a detailed description of the geometry of this singular boundary and a detailed analysis of the behavior of the solution there. A complete picture of shock formation in three-dimensional fluids is thereby obtained. The approach is geometric, the central concept being that of the acoustical spacetime manifold.

The monograph will be of interest to people working in partial differential equations in general and in fluid mechanics in particular.

... *This is a well written monograph which contains valuable information on shock waves; it should be of interest to anyone interested on shock formation in a nonlinear medium.* (Zentralblatt für Mathematik)

... *an amazing "tour de force"...* (Mathematical Reviews)



EMS Monographs in Mathematics

Sergei Buyalo (Steklov Institute, St. Petersburg, Russia)
Viktor Schroeder (University of Zürich, Switzerland)
Elements of Asymptotic Geometry

ISBN 978-3-03719-036-4
2007. 212 pages. Hardcover. 16.5 cm x 23.5 cm
58.00 Euro

Asymptotic geometry is the study of metric spaces from a large scale point of view, where the local geometry does not come into play. An important class of model spaces are the hyperbolic spaces (in the sense of Gromov), for which the asymptotic geometry is nicely encoded in the boundary at infinity.

In the first part of this book, in analogy with the concepts of classical hyperbolic geometry, the authors provide a systematic account of the basic theory of Gromov hyperbolic spaces. These spaces have been studied extensively in the last twenty years, and have found applications in group theory, geometric topology, Kleinian groups, as well as dynamics and rigidity theory. In the second part of the book, various aspects of the asymptotic geometry of arbitrary metric spaces are considered. It turns out that the boundary at infinity approach is not appropriate in the general case, but dimension theory proves useful for finding interesting results and applications.

The text leads concisely to some central aspects of the theory. Each chapter concludes with a separate section containing additional comments and historical remarks. Here the theory is also illustrated with numerous examples as well as relations to the neighboring fields of comparison geometry and geometric group theory.

The book is based on lectures the authors presented at the Steklov Institute in St. Petersburg and the University of Zurich. It is addressed to graduate students and researchers working in geometry, topology, and geometric group theory.

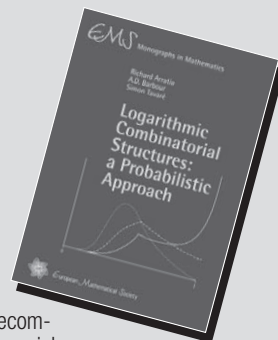
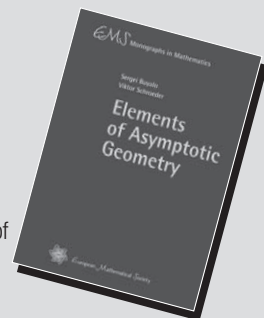
...In view of the new ideas and the activity in this area, the book is a timely one and the authors are to be complimented for bringing together major threads of the subject in a very readable account. (Zentralblatt für Mathematik)

Richard Arratia (University of Southern California, USA)
Andrew Barbour (University of Zürich, Switzerland)
Simon Tavaré (University of Southern California, USA)
**Logarithmic Combinatorial Structures:
a Probabilistic Approach**

ISBN 978-3-03719-000-5
2004. 374 pages. Hardcover. 16.5 cm x 23.5 cm
69.00 Euro

The elements of many classical combinatorial structures can be naturally decomposed into components. Permutations can be decomposed into cycles, polynomials over a finite field into irreducible factors, mappings into connected components. In all of these examples, and in many more, there are strong similarities between the numbers of components of different sizes that are found in the decompositions of 'typical' elements of large size. For instance, the total number of components grows logarithmically with the size of the element, and the size of the largest component is an appreciable fraction of the whole.

This book explains the similarities in asymptotic behaviour as the result of two basic properties shared by the structures: the conditioning relation and the logarithmic condition. The discussion is conducted in the language of probability, enabling the theory to be developed under rather general and explicit conditions; for the finer conclusions, Stein's method emerges as the key ingredient. The book is thus of particular interest to graduate students and researchers in both combinatorics and probability theory.



EMS Tracts in Mathematics

Vol. 7
Hans Triebel (University of Jena, Germany)
Function Spaces and Wavelets on Domains

ISBN 978-3-03719-019-7
2008. Approx. 270 pages. Hardcover. 17 x 24 cm
58.00 Euro

Wavelets have emerged as an important tool in analyzing functions containing discontinuities and sharp spikes. They were developed independently in the fields of mathematics, quantum physics, electrical engineering, and seismic geology. Interchanges between these fields during the last ten years have led to many new wavelet applications such as image compression, turbulence, human vision, radar, earthquake prediction, and pure mathematics applications such as solving partial differential equations.

This book develops a theory of wavelet bases and wavelet frames for function spaces on various types of domains such as Euclidean n -spaces and on related n -manifolds. Although the presentation relies on the recent theory of function spaces, basic notation and classical results are repeated in order to make the text independently understandable and usable.

This book is addressed to two types of readers: researchers in the theory of function spaces who are interested in wavelets as new effective building blocks for functions, and scientists who wish to use wavelet bases in classical function spaces for various applications. Adapted to the second type of readers, the preface contains a guide to where one finds basic definitions and key assertions.

Vol. 6
Erich Novak (University of Jena, Germany)
Henryk Wozniakowski (Columbia University, New York, USA, and University of Warsaw, Poland)
Tractability of Multivariate Problems
Volume I: Linear Information

ISBN 978-3-03719-026-5
2008. Approx. 400 pages. Hardcover. 17 x 24 cm
68.00 Euro

Multivariate problems occur in many applications. These problems are defined on spaces of d -variate functions and d can be huge – in the hundreds or even in the thousands. Some high-dimensional problems can be solved efficiently to within ε , i.e., the cost increases polynomially in ε^{-1} and d . However, there are many multivariate problems for which even the minimal cost increases exponentially in d . This exponential dependence on d is called intractability or the curse of dimensionality.

This is the first volume of a two-volume set comprising a comprehensive study of the tractability of multivariate problems. It is devoted to tractability in the case of algorithms using linear information and develops the theory for multivariate problems in various settings: worst case, average case, randomized and probabilistic. A problem is tractable if its minimal cost is not exponential in ε^{-1} and d . There are various notions of tractability, depending on how we measure the lack of exponential dependence. For example, a problem is polynomially tractable if its minimal cost is polynomial in ε^{-1} and d . The study of tractability was initiated about fifteen years ago. This is the first and only research monograph on this subject.

The book is of interest for researchers working in computational mathematics, especially in approximation of high-dimensional problems. It may be also suitable for graduate courses and seminars. The text concludes with a list of thirty open problems that can be good candidates for future tractability research.



EMS Tracts in Mathematics

Vol. 5

Gennadiy Feldman (Institute for Low Temperature Physics and Engineering, Kharkov, Ukraine)

Functional Equations and Characterization Problems on Locally Compact Abelian Groups

ISBN 978-3-03719-045-6

2008. 268 pages. Hardcover. 17 x 24 cm
58.00 Euro

This book deals with the characterization of probability distributions. It is well known that both the sum and the difference of two Gaussian independent random variables with equal variance are independent as well. The converse statement was proved independently by M. Kac and S. N. Bernstein. This result is a famous example of a characterization theorem. In general, characterization problems in mathematical statistics are statements in which the description of possible distributions of random variables follows from properties of some functions in these variables.

In recent years, a great deal of attention has been focused upon generalizing the classical characterization theorems to random variables with values in various algebraic structures such as locally compact Abelian groups, Lie groups, quantum groups, or symmetric spaces. The present book is aimed at the generalization of some well-known characterization theorems to the case of independent random variables taking values in a locally compact Abelian group. The main attention is paid to the characterization of the Gaussian and the idempotent distribution (group analogs of the Kac–Bernstein, Skitovich–Darmois, and Heyde theorems).

The author is an expert in algebraic probability theory. His comprehensive and self-contained monograph is addressed to mathematicians working in probability theory on algebraic structures, abstract harmonic analysis, and functional equations. The book concludes with comments and unsolved problems that provide further stimulation for future research in the theory.

Vol. 4

Gohar Harutyunyan (University of Oldenburg, Germany)
B.-Wolfgang Schulze (University of Potsdam, Germany)

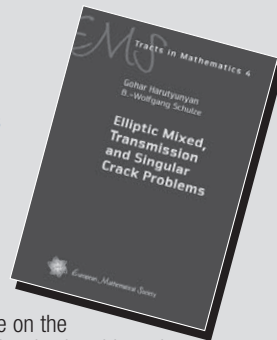
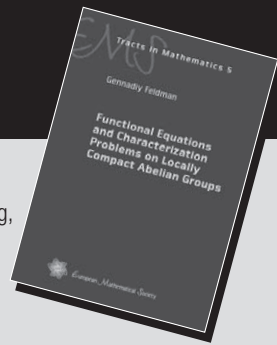
Elliptic Mixed, Transmission and Singular Crack Problems

ISBN 978-3-03719-040-1

2007. 777 pages. Hardcover. 17 x 24 cm
112.00 Euro

Mixed, transmission, or crack problems belong to the analysis of boundary value problems on manifolds with singularities. The Zaremba problem with a jump between Dirichlet and Neumann conditions along an interface on the boundary is a classical example. The central theme of this book is to study mixed problems in standard Sobolev spaces as well as in weighted edge spaces where the interfaces are interpreted as edges. Parametrices and regularity of solutions are obtained within a systematic calculus of boundary value problems on manifolds with conical or edge singularities. This calculus allows singularities on the interface, and homotopies between mixed and crack problems. Additional edge conditions are computed in terms of relative index results. In a detailed final chapter, the intuitive ideas of the approach are illustrated, and there is a discussion of future challenges. A special feature of the text is the inclusion of many worked out examples which help the reader to appreciate the scope of the theory and to treat new cases of practical interest.

This book is addressed to mathematicians and physicists interested in models with singularities, associated boundary value problems, and their solvability strategies based on pseudo-differential operators. The material is also useful for students in higher semesters and young researchers, as well as for experienced specialists working in analysis on manifolds with geometric singularities, the applications of index theory and spectral theory, operator algebras with symbolic structures, quantisation, and asymptotic analysis.



EMS Tracts in Mathematics

Vol. 3

Ralf Meyer (University of Göttingen, Germany)
Local and Analytic Cyclic Homology

ISBN 978-3-03719-039-5

2007. 368 pages. Hardcover. 17 x 24 cm
58.00 Euro

Periodic cyclic homology is a homology theory for non-commutative algebras that plays a similar role in non-commutative geometry as de Rham cohomology for smooth manifolds. While it produces good results for algebras of smooth or polynomial functions, it fails for bigger algebras such as most Banach algebras or C^* -algebras. Analytic and local cyclic homology are variants of periodic cyclic homology that work better for such algebras. In this book the author develops and compares these theories, emphasising their homological properties.

The cyclic homology theories studied in this text require a good deal of functional analysis in bornological vector spaces, which is supplied in the first chapters. The focal points here are the relationship with inductive systems and the functional calculus in non-commutative bornological algebras.

The book is mainly intended for researchers and advanced graduate students interested in non-commutative geometry. Some chapters are more elementary and independent of the rest of the book, and will be of interest to researchers and students working in functional analysis and its applications.

... The present monograph is based on the author's thesis but rewritten almost entirely. The main change is the inclusion of bivariant local cyclic homology, which is quite close to the analytic theory, but has much better formal properties, with the main difference being that complete bornological vector spaces are replaced by inductive systems of Banach spaces. The detailed exposition of the analytic and local cyclic homology is concluded by the description of the bivariant Chern-Connes character as a map from Kasparov's KK-theory to HL^ . (Zentralblatt für Mathematik)*

Vol. 1

Panagiota Daskalopoulos (University of California, Irvine, USA)
Carlos E. Kenig (University of Chicago, USA)

Degenerate diffusions

Initial value problems and local regularity theory

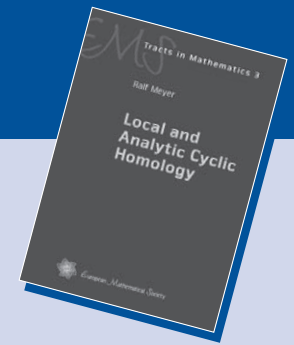
ISBN 978-3-03719-033-3

2007. 207 pages. Hardcover. 17 cm x 24 cm
48.00 Euro

The book deals with existence, uniqueness, regularity and asymptotic behavior of solutions to the initial value problem (Cauchy problem) and the initial-Dirichlet problem for a class of degenerate diffusions modeled on the porous medium type equation $u_t = \Delta u^m$, $m \geq 0$, $u \geq 0$. Such models arise in plasma physics, diffusions through porous media, thin liquid film dynamics as well as in geometric flows such as the Ricci flow on surfaces and the Yamabe flow. The approach presented to these problems is through the use of local regularity estimates and Harnack type inequalities, which yield compactness for families of solutions. The theory is quite complete in the slow diffusion case ($m > 1$) and in the supercritical fast diffusion case ($m_c < m < 1$, $m_c = (n-2)_+/n$) while many problems remain in the range $m \leq m_c$. All of these aspects of the theory are discussed in the book.

The book is addressed to both researchers and to graduate students with a good background in analysis and some previous exposure to partial differential equations.

... This book is addressed to graduate students and does an excellent job. Actually, it is a good compromise between the necessity to show the critical points of the theory and the need (in order to be readable for a student) to avoid the deep technicalities that naturally arise when one faces these questions... (Zentralblatt für Mathematik)



EMS Tracts in Mathematics

Vol. 2

Karl H. Hofmann (Technische Hochschule Darmstadt, Germany)
Sidney A. Morris (University of Ballarat, Australia)

The Lie Theory of Connected Pro-Lie Groups

A Structure Theory for Pro-Lie Algebras, Pro-Lie Groups, and Connected Locally Compact Groups

ISBN 978-3-03719-032-6

2007. 693 pages. Hardcover. 17 cm x 24 cm

88.00 Euro

Lie groups were introduced in 1870 by the Norwegian mathematician Sophus Lie. A century later Jean Dieudonné quipped that Lie groups had moved to the center of mathematics and that one cannot undertake anything without them.

If a complete topological group G can be approximated by Lie groups in the sense that every identity neighborhood U of G contains a normal subgroup N such that G/N is a Lie group, then it is called a pro-Lie group. Every locally compact connected topological group and every compact group is a pro-Lie group. While the class of locally compact groups is not closed under the formation of arbitrary products, the class of pro-Lie groups is.

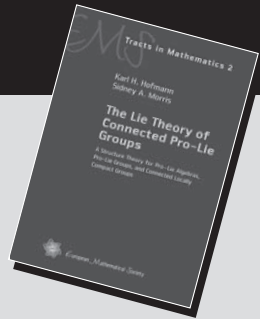
For half a century, locally compact pro-Lie groups have drifted through the literature, yet this is the first book which systematically treats their Lie and structure theory, irrespective of local compactness. This study fits very well into that current trend which addresses infinite dimensional Lie groups. The results of this text are based on a theory of pro-Lie algebras which parallels the structure theory of finite dimensional real Lie algebras to an astonishing degree even though it has to overcome greater technical obstacles.

This book exposes a Lie theory of connected locally compact groups and illuminates the manifold ways in which their structure theory reduces to that of compact groups on the one hand and of finite dimensional Lie groups on the other. It is a continuation of the authors' fundamental monograph on the structure of compact groups (1998, 2006), and is an invaluable tool for researchers in topological groups, Lie theory, harmonic analysis and representation theory. It is written to be accessible to advanced graduate students wishing to study this fascinating and important area of current research, which has so many fruitful interactions with other fields of mathematics.

... The present book contains valuable tools for researchers in topological groups, Lie theory, harmonic analysis and representation theory. It should be accessible to advanced graduate students provided that they have the energy to work their way through the abstract theory, and through the sheer mass of material assembled in more than 660 pages.

A special feature is the large collection of examples that fills a whole chapter. This collection is well organized and contains many useful comments. Several of these examples actually belong to the realm of Lie groups of finite dimension and show that many of the problems encountered in the theory of pro-Lie groups arise inside the theory of (nonlinear) Lie groups of finite dimension.

At the beginning of each chapter, the prerequisites needed for that chapter are stated clearly. The postscript at the end of each chapter usually puts the contents of that chapter into perspective, be it in the context of the book or in the larger context of (the history of) mathematics. Many readers (including the reviewer) will find these parts of the book very helpful on the way through a very beautiful but deep and interwoven theory. (Mathematical Reviews)



Heritage of European Mathematics

Janet Beery (University of Redlands, USA)

Jacqueline Stedall (The Queen's College, Oxford, UK)

The "Magisteria magna" of Thomas Harriot

ISBN 978-3-03719-059-3

2008. Approx. 150 pages. Hardcover. 17 x 24 cm

64.00 Euro

Thomas Harriot (1560–1621) was a mathematician and astronomer who founded the English school of algebra. He is not only known for his work in algebra and geometry, but also as a prolific writer with wide-ranging interests in ballistics, navigation, and optics (he discovered the sine law of refraction now known as Snell's law).

By about 1614, Harriot had developed finite difference interpolation methods for navigational tables. In 1618 (or slightly later) he composed a treatise entitled "De numeris triangularibus et inde de progressionibus arithmeti- cis, Magisteria magna", in which he derived symbolic interpolation formulae and showed how to use them. This treatise was never published and is here reproduced for the first time. Commentary has been added to help the reader to follow Harriot's beautiful but almost completely nonverbal presentation. The introductory essay preceding the treatise gives an overview of the contents of the "Magisteria" and describes its influence on Harriot's contemporaries and successors over the next sixty years. Harriot's method was not superseded until Newton, apparently independently, made a similar discovery in the 1660s. The ideas in the "Magisteria" were spread primarily through personal communication and unpublished manuscripts, and so, quite apart from their intrinsic mathematical interest, their survival in England during the seventeenth century provides an important case study in the dissemination of mathematics through informal networks of friends and acquaintances.

Andrzej Schinzel

Selecta

Henryk Iwaniec (Rutgers University, USA)

Władysław Narkiewicz (Uniwersytet Wrocławski, Poland)

Jerzy Urbanowicz (Polish Academy of Sciences, Warsaw, Poland)

Editors

Volume I: Diophantine Problems and Polynomials

Volume II: Elementary, Analytic and Geometric Number Theory

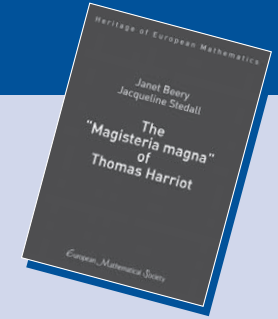
ISBN 978-3-03719-038-8

2007. 1417 pages. Hardcover. 17 cm x 24 cm

168.00 Euro

Andrzej Schinzel, born in 1937, is a leading number theorist whose work has a lasting impact on modern mathematics. He is the author of over 200 research articles in various branches of arithmetics, including elementary, analytic and algebraic number theory. He is also, for nearly 40 years, the editor of *Acta Arithmetica*, the first international journal devoted exclusively to number theory.

These Selecta contain Schinzel's most important articles published between 1955 and 2006. The arrangement is by topic, with each major category introduced by an expert's comment. Many of the hundred selected papers deal with arithmetical and algebraic properties of polynomials in one or several variables, but there are also articles on Euler's totient function, the favorite subject of Schinzel's early research, on prime numbers (including the famous paper with Sierpiński on the Hypothesis "H"), algebraic number theory, diophantine equations, analytical number theory and geometry of numbers. Volume II concludes with some papers from outside number theory, as well as a list of unsolved problems and unproved conjectures, taken from the work of Schinzel.



EMS Series of Congress Reports

EMS Series of Congress Reports publishes volumes originating from conferences or seminars focusing on any field of pure or applied mathematics. The individual volumes include an introduction into their subject and review of the contributions in this context. Articles are required to undergo a refereeing process and are accepted only if they contain a survey or significant results not published elsewhere in the literature.

K-theory and Noncommutative Geometry

Valladolid, August 31–September 6, 2006

Guillermo Cortiñas (Universidad de Buenos Aires, Argentina), Joachim Cuntz (University of Münster, Germany), Max Karoubi (University of Paris 7, France), Ryszard Nest (University of Copenhagen, Denmark) and Charles A. Weibel (Rutgers University, New Brunswick, USA), Editors

ISBN 978-3-03719-060-9

2008. Approx. 400 pages. Hardcover. 17 cm x 24 cm
88.00 Euro

Since its inception fifty years ago, K-theory has been a tool for understanding a wide-ranging family of mathematical structures and their invariants: topological spaces, rings, algebraic varieties and operator algebras are the dominant examples. The invariants range from characteristic classes in cohomology, determinants of matrices, Chow groups of varieties, as well as traces and indices of elliptic operators. Thus K-theory is notable for its connections with other branches of mathematics.

To study noncommutative geometric problems one considers invariants of the relevant noncommutative algebras. These invariants include algebraic and topological K-theory, and also cyclic homology, discovered independently by Alain Connes and Boris Tsygan, which can be regarded both as a noncommutative version of de Rham cohomology, and as an additive version of K-theory. There are primary and secondary Chern characters which pass from K-theory to cyclic homology. These characters are relevant both to noncommutative and commutative problems, and have applications ranging from index theorems to the detection of singularities of commutative algebraic varieties.

The contributions to this volume represent this range of connections between K-theory, noncommutative geometry, and other branches of mathematics.

Trends in Representation Theory of Algebras and Related Topics

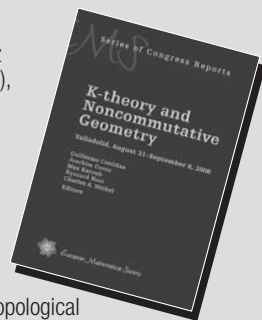
Andrzej Skowroński (University of Torun, Poland), Editor

ISBN 978-3-03719-062-3

2008. Approx. 700 pages. Hardcover. 17 x 24 cm
98.00 Euro

This book is concerned with recent trends in the representation theory of algebras and its exciting interaction with geometry, topology, commutative algebra, Lie algebras, quantum groups, homological algebra, invariant theory, combinatorics, model theory and theoretical physics. The collection of articles, written by leading researchers from the field, is conceived as a sort of handbook which provides an easy access to present state of knowledge and its aim is to stimulate further development.

The book consists of fifteen self-contained expository survey articles and is addressed to researchers and graduate students in algebra as well as a broader mathematical community. The contributions reflect the topics of lectures given during the Twelfth International Conference on Representations of Algebras and Workshop (ICRA XII) held in Torun in August 2007. They contain a large number of open problems and give new perspectives for research in the field.



6th International Congress on Industrial and Applied Mathematics

Zürich, Switzerland, 16–20 July 2007

Invited Lectures

Rolf Jeltsch (ETH Zürich, Switzerland)

Gerhard Wanner (University of Geneva, Switzerland)

Editors

ISBN 978-3-03719-056-2

2008. Approx. 600 pages. Hardcover. 16.5 x 23.5 cm
108.00 Euro

Included in this volume are the invited lectures given at the 6th International Congress of Industrial and Applied Mathematics, the Euler Lecture which was held by W. Gautschi on the occasion of the 300th anniversary of Euler and the public lecture by Ivar Ekeland. The authors of these papers are leading researchers of their fields, having been chosen through a rigorous selection process by a distinguished International Program Committee. The book presents an overview of contemporary applications of mathematics, new perspectives and open problems. It includes analysis and numerical methods for nonlinear partial differential equations, elliptic, parabolic and hyperbolic; multiscale modeling (Weinan E), nonlinear problems involving integral operators (Luis A. Caffarelli), controllability and observability (Tatsien Li), asymptotic solutions of Hamilton-Jacobi equations (Hitoshi Ishii), contact problems in solid mechanics (Michel Fortin), topology optimization of structures (Grégoire Allaire), dissipation inequalities in systems theory (Frank Allgöwer), greedy algorithms (Albert Cohen), sampling in function space (Andrew Stuart), order-value optimization (José Mario Martínez), parabolic partial differential equations and deterministic games (Robert V. Kohn). Particular applications include risk in financial markets (Nicole El Karoui), radar imaging (Margaret Cheney), brain dynamics (Ichiro Tsuda), complex geometric optics applied to acoustics and electromagnetics (Gunther Uhlmann). Also included are the appreciations of the ICIAM Prize winners' achievements.



**Proceedings of the
International Congress of
Mathematicians
Madrid, 22–30 August 2006**

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Spain)
Juan Luis Varona (University of La Rioja, Logroño, Spain)
Joan Verdera (University Autònoma, Barcelona, Spain)

ISBN 978-3-03719-022-7
2007. 4392 pages in three volumes. Hardcover. 17 cm x 24 cm
348.00 Euro

The International Congress of Mathematicians (ICM) is held every four years. It is a major scientific event, bringing together mathematicians from all over the world, and demonstrating the vital role that mathematics play in our society. In particular, the Fields Medals are awarded to recognize outstanding mathematical achievement. At the same time, the International Mathematical Union awards the Nevanlinna Prize for work in the field of theoretical computer science.

The proceedings of ICM 2006, published as a three-volume set, present an overview of current research in all areas of mathematics and provide a permanent record of the congress. The first volume features the works of Fields Medallists and the Nevanlinna Prize winner, the plenary lectures, and the speeches and pictures of the opening and closing ceremonies and award sessions. The other two volumes present the invited lectures, arranged according to their mathematical subject.



**Proceedings of the Fourth
European Congress of Mathematics
Stockholm, June 27–July 2, 2004**

Ari Laptev (Royal Institute of Technology, Stockholm, Sweden), Editor

ISBN 978-3-03719-009-8
2005. 900 pages. Hardcover. 16.5 cm x 23.5 cm.
118.00 Euro

The European Congress of Mathematics, held every four years, has established itself as a major international mathematical event. Following those in Paris, 1992, Budapest, 1996 and Barcelona, 2000, the Fourth European Congress of Mathematics took place in Stockholm, Sweden, June 27 to July 2, 2004 with 913 participants from 65 countries. Apart from seven plenary and thirty three invited lectures, there were six “Science Lectures” covering the most relevant aspects of mathematics in science and technology. Moreover, twelve projects of the EU Research Training Networks in Mathematics and Information Sciences, as well as Programmes from the European Science Foundation in Physical and Engineering Sciences were presented. Ten EMS Prizes were awarded to young European mathematicians who have made a particular contribution to the progress of mathematics. Five of the prize winners were independently chosen by the 4ECM Scientific Committee as plenary or invited speakers. The other five prize winners gave their lectures in parallel sessions. Most of these contributions are now collected in this volume, providing a permanent record of so much that is best in mathematics today.



Dynamics on the Riemann Sphere

A Bodil Branner Festschrift
Poul G. Hjorth (University of Southern Denmark, Odense, Denmark)
Carsten Lunde Petersen (University of Roskilde, Denmark), Editors

ISBN 978-3-03719-011-1
2006. 226 pages. Hardcover. 16.5 cm x 23.5 cm
68.00 Euro

Dynamics on the Riemann Sphere presents a collection of original research articles by leading experts in the area of holomorphic dynamics. These papers arose from the symposium *Dynamics in the Complex Plane*, Holbæk 2003, held on the occasion of the 60th birthday of Bodil Branner. Topics covered range from Lattès maps to cubic polynomials over rational maps with Sierpinsky Carpets and Gaskets as Julia sets, as well as rational and entire transcendental maps with Herman rings.

Contributors include Artur Avila (Paris VI, France), Arnault Cheritat (Toulouse, France), Bob Devaney (Boston, USA), Adrien Douady (Orsay, France), Nuria Fagella (Barcelona, Spain), Christian Henriksen (Lyngby, Denmark), Wolf Jung (Aachen, Germany), Tomoki Kawahira (Kyoto, Japan), Tan Lei (Cergy Pontoise, France), Michael Lyubich (Stony Brook, USA), Carsten Lunde Petersen (Roskilde, Denmark), John Milnor (Stony Brook, USA), Pascale Roesch (Lille, France).



Jerzy Trzeciak
Writing Mathematical Papers in English
a practical guide

ISBN 978-3-03719-014-2
2005. 48 pages. Softcover. 14.8 cm x 21 cm
8.00 Euro

This booklet is intended to provide practical help for authors of mathematical papers. It is written mainly for writers with English as a foreign language but should prove useful even to native speakers of English who are beginning their mathematical writing and may not yet have developed a command of the structure of mathematical discourse.

The first part provides a collection of ready-made sentences and expressions occurring in mathematical papers. The examples are divided into sections according to their use (in introductions, definitions, theorems, proofs, comments, references to the literature, acknowledgements, editorial correspondence and referee’s reports). Typical errors are also pointed out.

The second part concerns selected problems of English grammar and usage, most often encountered by mathematical writers. Just as in the first part, an abundance of examples are presented, all of them taken from actual mathematical texts.

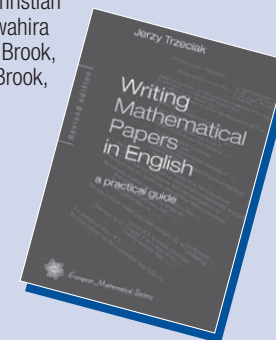
“The author has packed an awful lot in a few pages and has obviously been collecting his best (or worst) examples for a long time.”
Edwin F. Beschler

“The reviewer highly recommends this guide to authors as well as to editors in mathematics.”

O. Ninnemann, Zentralblatt MATH

About the author:

Jerzy Trzeciak, formerly of Polish Scientific Publishers, is now the senior copy editor at the Institute of Mathematics, Polish Academy of Sciences. He is responsible for journals including *Studia Mathematica*, *Fundamenta Mathematicae*, *Acta Arithmetica* and others. He is also the author of “Mathematical English Usage – a Glossary”, available at www.impan.gov.pl/Glossary.



Portugaliae Mathematica

A journal of the Portuguese Mathematical Society

Published by the European Mathematical Society with the support of the Portuguese Science Foundation.

ISSN: 0032-5155
2009. Vol. 66. 4 issues.
Approx. 500 pages. 17 cm x 24 cm
Price of subscription, including electronic edition:
196 Euro plus shipping (add 20 Euro for normal delivery).
Other subscriptions on request.

Aims and Scope

Since its foundation in 1937, *Portugaliae Mathematica* has aimed at publishing high-level research articles in all branches of mathematics. With great efforts by its founders, the journal was able to publish articles by some of the best mathematicians of the time. In 2001 a New Series of *Portugaliae Mathematica* was started, reaffirming the purpose of maintaining a high-level research journal in mathematics with a wide range scope.

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Groups, Geometry, and Dynamics

ISSN: 1661-7207
2009. Vol. 3, 4 issues.
Approx. 600 pages, 17 cm x 24 cm
Price of subscription, including electronic edition:
212 Euro plus shipping (add 20 Euro for normal delivery).
Other subscriptions on request.

Aims and Scope

Groups, Geometry, and Dynamics is devoted to publication of research articles that focus on groups or group actions as well as articles in other areas of mathematics in which groups or group actions are used as a main tool. The journal covers all topics of modern group theory with preference given to geometric, asymptotic and combinatorial group theory, dynamics of group actions, probabilistic and analytical methods, interaction with ergodic theory and operator algebras, and other related fields.

Topics covered include: geometric group theory; asymptotic group theory; combinatorial group theory; probabilities on groups; computational aspects and complexity; harmonic and functional analysis on groups, free probability; ergodic theory of group actions; cohomology of groups and exotic cohomologies; groups and low-dimensional topology; group actions on trees, buildings, rooted trees.

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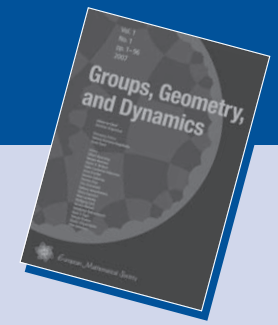
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Journal of Noncommutative Geometry

ISSN: 1661-6952
2009. Vol. 3, 4 issues.
Approx. 500 pages, 17 cm x 24 cm
Price of subscription, including electronic edition:
198 Euro plus shipping (add 20 Euro for normal delivery).
Other subscriptions on request.



Aims and Scope

The *Journal of Noncommutative Geometry* covers the noncommutative world in all its aspects. It is devoted to publication of research articles which represent major advances in the area of noncommutative geometry and its applications to other fields of mathematics and theoretical physics.

Topics covered include in particular: Hochschild and cyclic cohomology; K-theory and index theory; measure theory and topology of noncommutative spaces, operator algebras; spectral geometry of noncommutative spaces; noncommutative algebraic geometry; Hopf algebras and quantum groups; foliations, groupoids, stacks, gerbes; deformations and quantization; noncommutative spaces in number theory and arithmetic geometry; noncommutative geometry in physics: QFT, renormalization, gauge theory, string theory, gravity, mirror symmetry, solid state physics, statistical mechanics

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Published by the EMS Publishing House since 2005 (formerly Birkhäuser)

Commentarii Mathematici Helvetici

A journal of the Swiss Mathematical Society

ISSN 0010-2571
2009. Vol. 84. 4 issues.
Approx. 900 pages. 17 cm x 24 cm
Price of subscription, including electronic edition,
288.00 Euro plus shipping (30 Euro for normal delivery).
Other subscriptions on request.



ISI ranking 2006
Mathematics: 42 out of 181

Aims and Scope

Commentarii Mathematici Helvetici (CMH) was established on the occasion of a meeting of the Swiss Mathematical Society in May 1928. The first volume was published in 1929. The journal soon gained international reputation and is one of the world's leading mathematical periodicals. The first Managing Editor was R. Fueter, followed in 1950 by J. J. Burckhardt, 1982 by P. Gabriel, 1990 by H. Kraft, and 2006 by Eva Bayer-Fluckiger.

The journal is intended for the publication of original research articles on all aspects in mathematics.

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Elemente der Mathematik

A journal of the Swiss Mathematical Society

ISSN 0013-6018
2009. Vol. 64. 4 issues.
Approx. 180 pages. 17 cm x 24 cm

Institutional subscribers
The annual subscription rate, print and online, is
62 Euro plus shipping (add 12 Euro for normal delivery).

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The annual subscription rate, print and online, is
32 Euro (48 CHF in Switzerland) plus shipping (add 12 Euro/18 CHF for normal delivery).

Aims and Scope

Elemente der Mathematik publishes survey articles about important developments in the field of mathematics; stimulating shorter communications that tackle more specialized questions; and papers that report on the latest advances in mathematics and applications in other disciplines. The journal does not focus on basic research. Rather, its articles seek to convey to a wide circle of readers (teachers, students, engineers, professionals in industry and administration) the relevance, intellectual challenge and vitality of mathematics today. The Problems Section, covering a diverse range of exercises of varying degrees of difficulty, encourages an active grappling with mathematical problems. The journal's books and software reviews are additional features that serve to keep readers attuned to what is new and exciting on all mathematical fronts.

The publication language is primarily German, but many articles are in English, French or Italian.

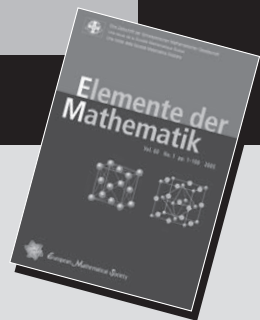
Die *Elemente der Mathematik* richten sich an interessierte Mathematikerinnen und Mathematiker, insbesondere an Lehrende an Gymnasien und Ingenieurschulen sowie an Studierende, Assistentinnen und Assistenten der Mathematik und verwandter Fachgebiete. Ihr Ziel ist es, den Leserinnen und Lesern aktuelle und klassische Gebiete der Mathematik nahe zu bringen, und sie zu einer aktiven Auseinandersetzung mit der Mathematik anzuregen.

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Journal of the European Mathematical Society

ISSN 1435-9855
2009. Vol. 11. 6 issues. Approx. 1200 pages. 17 cm x 24 cm
Price of subscription, including electronic edition, 398.00 Euro
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Aims and Scope

Journal of the European Mathematical Society (JEMS) is the official journal of the EMS. The Society, founded in 1990, works at promoting joint scientific efforts between the many different structures that characterize European mathematics.

JEMS publishes research articles in all active areas of pure and applied mathematics. These are selected by a distinguished, international board of editors for their outstanding quality and interest, according to the highest international standards. Occasionally, substantial survey papers on topics of exceptional interest will also be published.

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ISI ranking 2006
Mathematics: 6 out of 181



Interfaces and Free Boundaries

Mathematical modelling, analysis and computation

ISSN 1463-9963

2009. Vol. 11. 4 issues.

Approx. 500 pages. 17 cm x 24 cm

Price of subscription, including electronic edition,
390.00 Euro plus shipping (20 Euro for normal delivery).

Other subscriptions on request.



ISI ranking 2006
Mathematics: 21 out of 181

Aims and Scope

Interfaces and Free Boundaries is dedicated to the mathematical modelling, analysis and computation of interfaces and free boundary problems in all areas where such phenomena are pertinent. The journal aims to be a forum where mathematical analysis, partial differential equations, modelling, scientific computing and the various applications which involve mathematical modelling meet. Submissions should, ideally, emphasize the combination of theory and application.

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Atti della Accademia Nazionale dei Lincei Rendiconti Lincei – Matematica e Applicazioni

ISSN: 1120-6330

2009. Series 9. Vol. 20. 4 issues.

Approx. 400 pages. 17 cm x 24 cm

Price of subscription, including electronic edition, 200 Euro plus shipping
(add 20 Euro for normal delivery).

Special rate for Italian institutions: 100 Euro plus shipping.

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Zeitschrift für Analysis und ihre Anwendungen Journal for Analysis and its Applications

A periodical edited by the University of Leipzig

ISSN 0232-2064

2009. Vol. 28. 4 issues.

Approx. 500 pages. 17 cm x 24 cm

Price of subscription, including electronic edition, 190 Euro plus shipping (add 20 Euro for normal delivery). Other subscriptions on request.

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OWR – Oberwolfach Reports

ISSN 1660-8933

2009. Vol. 6. 4 issues per volume.

Approx. 3200 pages. 16.5 cm x 23.5 cm. Hardcover

Price of subscription, including electronic edition, 190.00 Euro plus shipping (add 40 Euro for normal delivery).

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Naturally, coincidence also plays a big role. Improving the chances for progress by coincidence is one of the main purposes of the research at the Oberwolfach Institute. When getting to know the background of an important result during a talk, one can suddenly have a bright idea, perhaps leading to a considerable progress in one's own research activity. Within discussions in small groups, when presenting fresh thoughts, one sometimes can find the right direction for further work with the help of the comments of colleagues. Often it also happens that two or three colleagues, during discussions, become aware that they, though coming from different backgrounds and with different motivations, are interested in similar problems and decide to unify their potential in order to establish a common research project.

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ISSN: 1027-488X

Approx. 200 pages. A4 format.

The annual subscription rate is 60 Euro plus 20 Euro for shipping.

The online version of the *EMS Newsletter* is free of charge.

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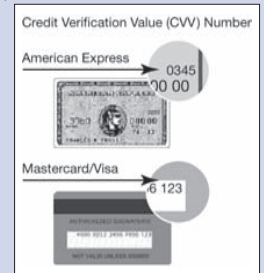
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