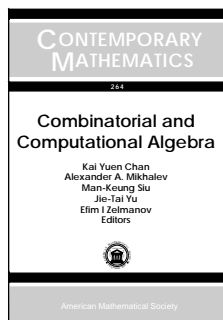


New Publications Offered by the AMS

Algebra and Algebraic Geometry



Combinatorial and Computational Algebra

Kai Yuen Chan, Alexander A. Mikhalev, Man-Keung Siu, and Jie-Tai Yu, University of Hong Kong, China, and Efim I. Zelmanov, Yale University, New Haven, CT, Editors

This volume presents articles based on the talks at the International Conference on Combinatorial and Computational Algebra held at the University of Hong Kong (China). The conference was part of the Algebra Program at the Institute of Mathematical Research and the Mathematics Department at the University of Hong Kong. Topics include recent developments in the following areas: combinatorial and computational aspects of group theory, combinatorial and computational aspects of associative and nonassociative algebras, automorphisms of polynomial algebras and the Jacobian conjecture, and combinatorics and coding theory.

This volume can serve as a solid introductory guide for advanced graduate students, as well as a rich and up-to-date reference source for contemporary researchers in the field.

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

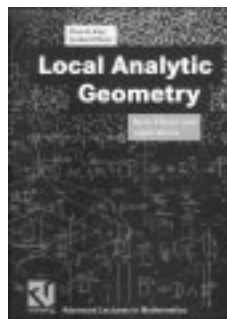
Contents: *Combinatorial and computational aspects of group theory:* E. Aljadeff and A. R. Magid, Deformations and liftings of representations; A. Yu. Ol'shanskii and M. V. Sapir, Embeddings of relatively free groups into finitely presented groups; A. Shalev, Fixed point ratios, character ratios, and Cayley graphs; *Combinatorial and computational aspects of associative and nonassociative algebras:* L. A. Bokut, Y. Fong, and W.-F. Ke, Gröbner-Shirshov bases and composition lemma for associative conformal algebras: An example; Y. Fong, Derivations in nearring theory; A. A. Mikhalev and J.-T. Yu, Automorphic orbits of elements of free algebras with the Nielsen-Schreier property; A. V. Mikhalev and I. A. Pinchuk, Universal central extensions of the matrix Lie superalgebras $sl(m, n, A)$; G. F. Pilz, The useful world of one-sided distributive systems; E. Zelmanov,

On the structure of conformal algebras; *Automorphisms of polynomial algebras and the Jacobian conjecture:* L. A. Campbell, Unipotent Jacobian matrices and univalent maps; V. Drensky and J.-T. Yu, Automorphisms and coordinates of polynomial algebras; A. van den Essen, On Bass' inverse degree approach to the Jacobian conjecture and exponential automorphisms; A. van den Essen and P. van Rossum, A note on possible counterexamples to the Abhyankar-Sathaye conjecture constructed by Shpilrain and Yu; W. D. Neumann and P. G. Wightwick, Algorithms for polynomials in two variables; V. Shpilrain and J.-T. Yu, Peak reduction technique in commutative algebra: A survey; D. Wright, Reversion, trees, and the Jacobian conjecture; *Combinatorics and coding theory:* W.-C. W. Li, Various constructions of good codes; M.-K. Siu, Combinatorics and algebra: A medley of problems? A medley of techniques?

Contemporary Mathematics, Volume 264

November 2000, approximately 304 pages, Softcover, ISBN 0-8218-1984-4, LC 00-059345, 2000 *Mathematics Subject Classification:* 05-06, 08-06, 12-06, 13-06, 14-06, 17-06, 20-06, 26-06, 68-06, 94-06, **Individual member \$45**, List \$75, Institutional member \$60, Order code CONM/264N

Supplementary Reading



Local Analytic Geometry

Basic Theory and Applications

Theo de Jong, Universität des Saarlandes, Saarbrücken, Germany, and Gerhard Pfister, Universität Kaiserslautern, Germany

A publication of the Vieweg Verlag.

This volume presents the basic tools of algebra and analytic geometry, including the Weierstraß Division Theorem, the Nullstellensatz, dimension theory, normalization, and further topics. As applications, fundamental facts of singularity theory are presented.

Chapter 1 discusses the necessary algebra, assuming a basic background in linear algebra and abstract algebra, including some Galois theory. Chapter 2 deals with the basics of affine algebraic geometry up to Hilbert's Nullstellensatz and decomposition into irreducible components. Chapter 3 addresses the corresponding basics for local analytic geometry, assuming

knowledge of the theory of holomorphic functions in one variable. Chapter 4 is written from the point of view of local analytic geometry, yet also can apply to affine algebraic geometry.

As application to the general theory, Chapter 5 studies the simplest germs of local analytic spaces: plane curve singularities. Topics include Puiseux expansion, semigroups of curves, and resolutions of plane curve singularities.

The remaining chapters discuss topics not usually found in books on local analytic geometry. Chapter 6 addresses the behavior of numerical invariants of curves in families; Chapter 7, standard bases. Chapter 8 is devoted to approximation theorems and Chapter 9, the classification of simple hypersurface singularities. The concluding Chapter 10 gives as application of Grauert's Approximation Theorem, a proof of the existence of a semi-universal deformation of an isolated singularity.

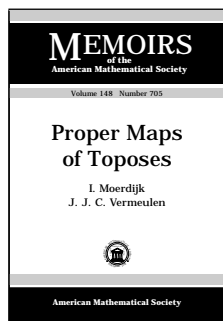
The authors give full proofs of all statements in the book or present them as exercises with sufficient hints. Prerequisites include basic algebra, analysis, and function theory. The volume can be used by advanced undergraduates and graduate students for course study, seminars, or as a reference source for research papers in algebraic and analytic geometry.

The AMS is exclusive distributor in North America, and non-exclusive distributor worldwide except in Germany, Switzerland, Austria, and Japan.

Contents: Algebra; Affine algebraic geometry; Basics of analytic geometry; Further development of analytic geometry; Plane curve singularities; The principle of conservation of number; Standard bases; Approximation theorems; Classification of simple hypersurface singularities; Deformations of singularities; Bibliography; Index.

Vieweg Advanced Lectures in Mathematics

June 2000, 382 pages, Softcover, ISBN 3-528-03137-9, 2000 *Mathematics Subject Classification:* 32Bxx, **All AMS members \$53**, List \$59, Order code VWALM/7N



Proper Maps of Toposes

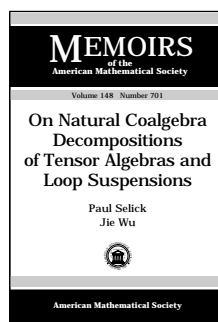
I. Moerdijk, *Utrecht University, Netherlands*, and **J. J. C. Vermeulen**, *University of Cape Town, Rondebosch, South Africa*

Contents: Introduction; Proper maps; Separated maps; Tidy maps; Strongly separated maps; Relatively tidy maps

and lax descent; References.

Memoirs of the American Mathematical Society, Volume 148, Number 705

November 2000, 108 pages, Softcover, ISBN 0-8218-2168-7, 2000 *Mathematics Subject Classification:* 18B25, 18F10, 22A22, **Individual member \$26**, List \$43, Institutional member \$34, Order code MEMO/148/705N



On Natural Coalgebra Decompositions of Tensor Algebras and Loop Suspensions

Paul Selick, *University of Toronto, ON, Canada*, and **Jie Wu**, *National University of Singapore*

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

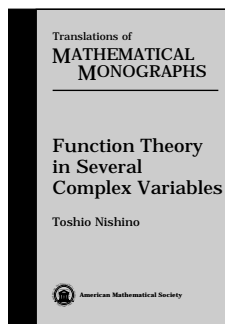
Contents: Introduction; Natural coalgebra transformations of tensor algebras; Geometric realizations and the proof of Theorem 1.3; Existence of minimal natural coalgebra retracts of tensor algebras; Some lemmas on coalgebras; Functorial version of the Poincaré-Birkhoff-Whitt theorem; Projective $\mathbf{k}(S_n)$ -submodules of $\text{Lie}(n)$; The functor A^{\min} over a field of characteristic $p > 0$; Proof of Theorems 1.1 and 1.6; The functor L'_n and the associated $\mathbf{k}(\Sigma_n)$ -module $\text{Lie}'(n)$; Examples; References.

Memoirs of the American Mathematical Society, Volume 148, Number 701

November 2000, 109 pages, Softcover, ISBN 0-8218-2110-5, LC 00-059369, 2000 *Mathematics Subject Classification:* 55P35, 55P45, 20C30, 16W30, 17B01; 17B50, 17B70, **Individual member \$26**, List \$43, Institutional member \$34, Order code MEMO/148/701N

Analysis

Supplementary Reading



Function Theory in Several Complex Variables

Toshio Nishino, *Kyushu University, Fukuoka, Japan*

Kiyoshi Oka, at the beginning of his research, regarded the collection of problems which he encountered in the study of domains of holomorphy as large mountains which separate today

and tomorrow. Thus, he believed that there could be no essential progress in analysis without climbing over these mountains ... this book is a worthwhile initial step for the reader in order to understand the mathematical world which was created by Kiyoshi Oka.

—From the Preface

This book explains results in the theory of functions of several complex variables which were mostly established from the late nineteenth century through the middle of the twentieth century. In the work, the author introduces the mathematical world created by his advisor, Kiyoshi Oka.

In this volume, Oka's work is divided into two parts. The first is the study of analytic functions in univalent domains in C^n . Here Oka proved that three concepts are equivalent: domains of holomorphy, holomorphically convex domains, and pseudoconvex domains; and moreover that the Poincaré problem, the

Cousin problems, and the Runge problem, when stated properly, can be solved in domains of holomorphy satisfying the appropriate conditions. The second part of Oka's work established a method for the study of analytic functions defined in a ramified domain over C^n in which the branch points are considered as interior points of the domain. Here analytic functions in an analytic space are treated, which is a slight generalization of a ramified domain over C^n .

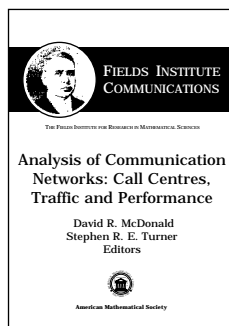
In writing the book, the author's goal was to bring to readers a real understanding of Oka's original papers. This volume is an English translation of the original Japanese edition, published by the University of Tokyo Press (Japan). It would make a suitable course text for advanced graduate level introductions to several complex variables.

Contents: *Fundamental theory:* Holomorphic functions and domains of holomorphy; Implicit functions and analytic sets; The Poincaré, Cousin, and Runge problems; Pseudoconvex domains and pseudoconcave sets; Holomorphic mappings; *Theory of analytic spaces:* Ramified domains; Analytic sets and holomorphic functions; Analytic spaces; Normal pseudoconvex spaces; Bibliography; Index.

Translations of Mathematical Monographs

December 2000, approximately 450 pages, Hardcover, ISBN 0-8218-0816-8, LC 00-058292, 2000 *Mathematics Subject Classification:* 32A05, 32A10, 32B15, 32C20, 32C22, 32C55, 32D05, 32E10, 32E40, 32U05, **Individual member \$77**, List \$129, Institutional member \$103, Order code MMONO-NISHINON

Applications



Analysis of Communication Networks: Call Centres, Traffic and Performance

David R. McDonald, *University of Ottawa, ON, Canada*, and Stephen R. E. Turner, *University of Cambridge, England*, Editors

This volume consists of the proceedings of the Workshop on Analysis and Simulation of Communication Networks held at The Fields Institute (Toronto). The workshop was divided into two main themes, entitled "Stability and Load Balancing of a Network of Call Centres" and "Traffic and Performance".

The call center industry is large and fast-growing. In order to provide top-notch customer service, it needs good mathematical models. The first part of the volume focuses on probabilistic issues involved in optimizing the performance of a call center. While this was the motivating application, many of the papers are also applicable to more general distributed queueing networks.

The second part of the volume discusses the characterization of traffic streams and how to estimate their impact on the performance of a queueing system. The performance of queues under worst-case traffic flows or flows with long bursts is

treated. These studies are motivated by questions about buffer dimensioning and call admission control in ATM or IP networks.

This volume will serve researchers as a comprehensive, state-of-the-art reference source on developments in this rapidly expanding field.

Contents: A. R. Ward and W. Whitt, Predicting response times in processor-sharing queues; D. A. Stanford and W. K. Grassmann, Bilingual server call centres; R. J. Williams, On dynamic scheduling of a parallel server system with complete resource pooling; Y. C. Teh, Dynamic scheduling for queueing networks derived from discrete-review policies; S. R. E. Turner, Large deviations for join the shorter queue; D. R. McDonald and S. R. E. Turner, Comparing load balancing algorithms for distributed queueing networks; P. W. Glynn and A. J. Zeevi, Estimating tail probabilities in queues via extremal statistics; G. Kesidis and T. Konstantopoulos, Extremal traffic and worst-case performance for queues with shaped arrivals; D. J. Daley and R. A. Vesilo, Long range dependence of inputs and outputs of some classical queues; S. Grishechkin, M. Devetsikiotis, I. Lambadaris, and C. Hobbs, On 'catastrophic' behavior of queueing networks.

Fields Institute Communications, Volume 28

October 2000, 200 pages, Hardcover, ISBN 0-8218-1991-7, LC 00-059371, 2000 *Mathematics Subject Classification:* 60-06, 90Bxx, **Individual member \$45**, List \$75, Institutional member \$60, Order code FIC/28N

General and Interdisciplinary

A Classic

Lectures on Mathematics

Felix Klein

It is a noble example that Professor Klein has set all ages of mathematicians that, beginning his activity at a time when the contributions of the immediate past were so rich and so unrelated, he was able to uncover the essential bonds that connect them and to discern the fields to whose development the new methods were best adapted ... His instinct for that which is vital in mathematics is sure, and the light with which his treatment illumines the problems here considered may well serve as a guide for the youth who is approaching the study of the problems of a later day.

—William F. Osgood, *President of the AMS, 1905-1906*

In the late summer of 1893, following the Congress of Mathematicians held in Chicago, Felix Klein gave two weeks of lectures on the current state of mathematics. Rather than offering a universal perspective, Klein presented his personal view of the most important topics of the time. It is remarkable how most of the topics continue to be important today. Originally published in 1893 and republished by the AMS in 1911, we are pleased to bring this work into print once more with this new edition.

Klein begins by highlighting the works of Clebsch and of Lie. In particular, he discusses Clebsch's work on Abelian functions and compares his approach to the theory with Riemann's more geometrical point of view. Klein devotes two lectures to Sophus Lie, focussing on his contributions to geometry, including sphere geometry and contact geometry.

Klein's ability to connect different mathematical disciplines clearly comes through in his lectures on mathematical developments. For instance, he discusses recent progress in non-Euclidean geometry by emphasizing the connections to projective geometry and the role of transformation groups. In his descriptions of analytic function theory and of recent work in hyperelliptic and Abelian functions, Klein is guided by Riemann's geometric point of view. He discusses Galois theory and solutions of algebraic equations of degree five or higher by reducing them to normal forms that might be solved by non-algebraic means. Thus, as discovered by Hermite and Kronecker, the quintic can be solved "by elliptic functions". This also leads to Klein's well-known work connecting the quintic to the group of the icosahedron.

Klein expounds on the roles of intuition and logical thinking in mathematics. He reflects on the influence of physics and the physical world on mathematics and, conversely, on the influence of mathematics on physics and the other natural sciences. The discussion is strikingly similar to today's discussions about "physical mathematics".

There are a few other topics covered in the lectures which are somewhat removed from Klein's own work. For example, he discusses Hilbert's proof of the transcendence of certain types of numbers (including π and e), which Klein finds much simpler than the methods used by Lindemann to show the transcendence of π . Also, Klein uses the example of quadratic forms (and forms of higher degree) to explain the need for a theory of ideals as developed by Kummer.

Klein's look at mathematics at the end of the 19th Century remains compelling today, both as history and as mathematics. It is delightful and fascinating to observe from a one-hundred year retrospect, the musings of one of the masters of an earlier era.

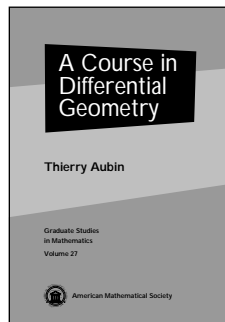
Contents: Lecture I.: Clebsch; Lecture II.: Sophus Lie; Lecture III.: Sophus Lie; Lecture IV.: On the real shape of algebraic curves and surfaces; Lecture V.: Theory of functions and geometry; Lecture VI.: On the mathematical character of space-intuition and the relation of pure mathematics to the applied sciences; Lecture VII.: The transcendency of the numbers e and π ; Lecture VIII.: Ideal numbers; Lecture IX.: The solution of higher algebraic equations; Lecture X.: On some recent advances in hyperelliptic and Abelian functions; Lecture XI.: The most recent researches in non-Euclidean geometry; Lecture XII.: The study of mathematics at Göttingen; The development of mathematics at the German Universities.

AMS Chelsea Publishing

October 2000, 109 pages, Hardcover, ISBN 0-8218-2733-2, LC 00-058295, 2000 *Mathematics Subject Classification*: 01A55, 01A73, 11-XX, 13-XX, 14-XX, 22Exx, 33-XX, 34-XX, 34Mxx, 35-XX, 51M10, 53Axx, 53Dxx, **All AMS members \$17**, List \$19, Order code CHEL/339.HN

Geometry and Topology

Recommended Text



A Course in Differential Geometry

Thierry Aubin, *University of Paris, France*

This textbook for second-year graduate students is intended as an introduction to differential geometry with principal emphasis on Riemannian geometry. Chapter I

explains basic definitions and gives the proofs of the important theorems of Whitney and Sard. Chapter II deals with vector fields and differential forms. Chapter III addresses integration of vector fields and p -plane fields. Chapter IV develops the notion of connection on a Riemannian manifold considered as a means to define parallel transport on the manifold. The author also discusses related notions of torsion and curvature, and gives a working knowledge of the covariant derivative. Chapter V specializes on Riemannian manifolds by deducing global properties from local properties of curvature, the final goal being to determine the manifold completely. Chapter VI explores some problems in PDEs suggested by the geometry of manifolds.

The author is well-known for his significant contributions to the field of geometry and PDEs—particularly for his work on the Yamabe problem—and for his expository accounts on the subject.

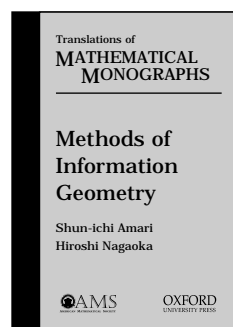
The text contains many problems and solutions, permitting the reader to apply the theorems and to see concrete developments of the abstract theory.

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

Contents: Background material; Differentiable manifolds; Tangent space; Integration of vector fields and differential forms; Linear connections; Riemannian manifolds; The Yamabe problem—An introduction to research; Bibliography; Subject index; Notation.

Graduate Studies in Mathematics, Volume 27

December 2000, approximately 208 pages, Hardcover, ISBN 0-8218-2709-X, LC 00-058275, 2000 *Mathematics Subject Classification*: 53B05, 53C05, 53C22, 53C40, 58A17, 58C05, 58C25, 58C35, 58J05, **All AMS members \$28**, List \$35, Order code GSM/27N



Methods of Information Geometry

Shun-ichi Amari, *RIKEN Brain Science Institute, Saitama, Japan*, and Hiroshi Nagaoka, *University of Electro-Communications, Tokyo, Japan*

Information geometry provides the mathematical sciences with a new framework of analysis. It has emerged from the investigation of the natural differential geometric structure on manifolds of probability distributions, which consists of a Riemannian metric defined by the Fisher information and a one-parameter family of affine connections called the α -connections. The duality between the α -connection and the $(-\alpha)$ -connection together with the metric play an essential role in this geometry. This kind of duality, having emerged from manifolds of probability distributions, is ubiquitous, appearing in a variety of problems which might have no explicit relation to probability theory. Through the duality, it is possible to analyze various fundamental problems in a unified perspective.

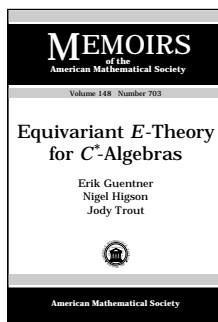
The first half of this book is devoted to a comprehensive introduction to the mathematical foundation of information geometry, including preliminaries from differential geometry, the geometry of manifolds or probability distributions, and the general theory of dual affine connections. The second half of the text provides an overview of wide areas of applications, such as statistics, linear systems, information theory, quantum mechanics, convex analysis, neural networks, and affine differential geometry. The book will serve as a suitable text for a topics course for advanced undergraduates and graduate students.

This volume is copublished by the AMS and Oxford University Press. The AMS has exclusive distribution rights in North America. AMS members in Europe may purchase the book from the AMS. Both the AMS and OUP have worldwide distribution rights.

Contents: Elementary differential geometry; The geometric structure of statistical models; Dual connections; Statistical inference and differential geometry; The geometry of time series and linear systems; Multiterminal information theory and statistical inference; Information geometry for quantum systems; Miscellaneous topics; Guide to the bibliography; Bibliography; Index.

Translations of Mathematical Monographs

November 2000, approximately 208 pages, Hardcover, ISBN 0-8218-0531-2, LC 00-059362, 2000 *Mathematics Subject Classification:* 00A69, 53-02, 53B05, 53A15, 62-02, 62F05, 62F12, 93C05, 81Q70, 94A15, **Individual member \$33**, List \$55, Institutional member \$44, Order code MMONO-AMARIN



Equivariant E -Theory for C^* -Algebras

Erik Guentner, *Indiana University-Purdue University Indianapolis, Indianapolis*, Nigel Higson, *Pennsylvania State University, University Park*, and Jody Trout, *Dartmouth College, Hanover, NH*

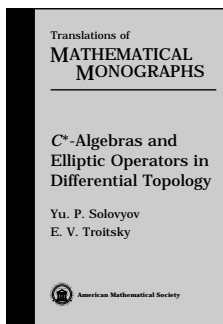
This item will also be of interest to those working in algebra and algebraic geometry.

Contents: Introduction; Asymptotic morphisms; The homotopy category of asymptotic morphisms; Functors on the homotopy category; Tensor products and descent; C^* -algebra extensions; E -theory; Cohomological properties; Proper algebras; Stabilization; Assembly; The Green-Julg theorem; Induction and compression; A generalized Green-Julg theorem; Application to the Baum-Connes conjecture; Concluding remarks on assembly for proper algebras; References.

Memoirs of the American Mathematical Society, Volume 148, Number 703

November 2000, 86 pages, Softcover, ISBN 0-8218-2116-4, LC 00-059366, 2000 *Mathematics Subject Classification:* 19K35, 46L80; 22D25, **Individual member \$25**, List \$42, Institutional member \$34, Order code MEMO/148/703N

Recommended Text



C^* -Algebras and Elliptic Operators in Differential Topology

Yu. P. Solov'yov and E. V. Troitsky, *Moscow State University, Russia*

The aim of this book is to present some applications of functional analysis and the theory of differential operators to the investigation of topological invariants of manifolds.

The main topological application discussed in the book concerns the problem of the description of homotopy-invariant rational Pontryagin numbers of non-simply connected manifolds and the Novikov conjecture of homotopy invariance of higher signatures. The definition of higher signatures and the formulation of the Novikov conjecture are given in Chapter 3. In this chapter, the authors also give an overview of different approaches to the proof of the Novikov conjecture. First, there is the Mishchenko symmetric signature and the generalized Hirzebruch formulae and the Mishchenko theorem of homotopy invariance of higher signatures for manifolds whose fundamental groups have a classifying space, being a complete Riemannian non-positive curvature manifold. Then the authors present Solov'yov's proof of the Novikov conjecture for manifolds with fundamental group isomorphic to a discrete subgroup of a linear algebraic group over a local field, based on the notion of the Bruhat-Tits building. Finally, the authors discuss the approach due to Kasparov based on the operator KK -theory and another proof of the Mishchenko theorem. In Chapter 4, they outline the approach to the Novikov conjecture

due to Connes and Moscovici involving cyclic homology. That allows one to prove the conjecture in the case when the fundamental group is a (Gromov) hyperbolic group.

The text provides a concise exposition of some topics from functional analysis (for instance, C^* -Hilbert modules, K -theory or C^* -bundles, Hermitian K -theory, Fredholm representations, KK -theory, and functional integration) from the theory of differential operators (pseudodifferential calculus and Sobolev chains over C^* -algebras), and from differential topology (characteristic classes).

The book explains basic ideas of the subject and can serve as a course text for an introduction to the study of original works and special monographs.

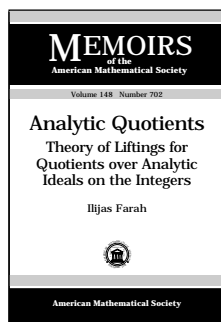
This item will also be of interest to those working in analysis.

Contents: C^* -algebras and K -theory; Index theorems; The higher signatures; Noncommutative differential geometry; Bibliography; Index.

Translations of Mathematical Monographs

November 2000, approximately 232 pages, Hardcover, ISBN 0-8218-1399-4, 2000 *Mathematics Subject Classification*: 46Lxx; 19K56, 35S05, 47G30, 57R99, **Individual member \$51**, List \$85, Institutional member \$68, Order code MMONO-SOLOVIEVN

Logic and Foundations



Analytic Quotients Theory of Liftings for Quotients over Analytic Ideals on the Integers

Ilijas Farah, *York University,
Toronto, ON, Canada*

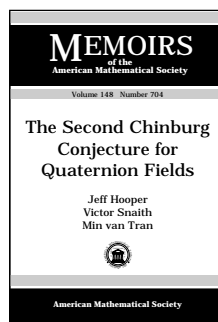
Contents: Introduction; Baire-measurable homomorphisms of analytic quotients; Open coloring axiom and uniformization; Homomorphisms of

analytic quotients under OCA; Weak extension principle; Gaps and limits in analytic quotients; Bibliography; Index; Index of special symbols.

Memoirs of the American Mathematical Society, Volume 148, Number 702

November 2000, 177 pages, Softcover, ISBN 0-8218-2117-2, LC 00-059368, 2000 *Mathematics Subject Classification*: 03E50, 03E65, 03G05, 03E15, 06E05, 28A05, 54D40, 54C05, **Individual member \$31**, List \$51, Institutional member \$41, Order code MEMO/148/702N

Number Theory



The Second Chinburg Conjecture for Quaternion Fields

Jeff Hooper, *University of
Durham, UK*, Victor Snaith,
University of Southampton, UK,
and Min van Tran, *A C Nielsen
Vietnam—Tecasin Business
Centre, Ho Chi Minh City*

Contents: Introduction; Class-groups of group-rings; The evaluation of $[X]$; Quaternion fields over \mathbb{Q}_2 ; The invariant in Cases A, B and C; The evaluation of $[M]$; The conjecture in Cases A, B and C; Epilogue; Bibliography; Index.

Memoirs of the American Mathematical Society, Volume 148, Number 704

November 2000, 144 pages, Softcover, ISBN 0-8218-2164-4, 2000 *Mathematics Subject Classification*: 11R33; 11M06, 11R23, 11R34, 11R65, 11R70, 11S25, 11S31, 11S40, 12G05, 16G99, 16H05, 19A31, 19D99, 19F27, 20J06, **Individual member \$26**, List \$44, Institutional member \$35, Order code MEMO/148/704N

Previously Announced Publications

New Series from the AMS!

The AMS is pleased to present this important series, the Courant Lecture Notes, copublished by the AMS and the Courant Institute of Mathematical Sciences at New York University (New York City). Books in this series offer cutting-edge research in mathematics and theoretical computer science. Most of the volumes are written by the faculty and visitors and originate from graduate courses and minicourses offered at the institute.

Independent Study

Elliptic Partial Differential Equations

Qing Han, *University of Notre Dame, IN*, and
Fanghua Lin, *New York University, Courant Institute, NY*

This volume is based on PDE courses given by the authors at the Courant Institute and at the University of Notre Dame (IN). Presented are basic methods for obtaining various a priori estimates for second-order equations of elliptic type with particular emphasis on maximal principles, Harnack inequalities, and their applications. The equations considered in the book are linear, however, the presented methods also apply to nonlinear problems.

Titles in this series are copublished with the Courant Institute of Mathematical Sciences at New York University.

Courant Lecture Notes, Volume 1

August 2000, 123 pages, Softcover, ISBN 0-8218-2691-3, LC 00-044151, 2000 *Mathematics Subject Classification*: 35-XX, **All AMS members \$16**, List \$20, Order code CLN/1RT010

Recommended Text

An Introduction to Symplectic Geometry

Rolf Berndt, *University of Hamburg, Germany*

Symplectic geometry is a central topic of current research in mathematics. Indeed, symplectic methods are key ingredients in the study of dynamical systems, differential equations, algebraic geometry, topology, mathematical physics and representations of Lie groups.

This book is a true introduction to symplectic geometry, assuming only a general background in analysis and familiarity with linear algebra. It starts with the basics of the geometry of symplectic vector spaces. Then, symplectic manifolds are defined and explored. In addition to the essential classic results, such as Darboux's theorem, more recent results and ideas are also included here, such as symplectic capacity and pseudoholomorphic curves. These ideas have revolutionized the subject. The main examples of symplectic manifolds are given, including the cotangent bundle, Kähler manifolds, and coadjoint orbits. Further principal ideas are carefully examined, such as Hamiltonian vector fields, the Poisson bracket, and connections with contact manifolds.

Berndt describes some of the close connections between symplectic geometry and mathematical physics in the last two chapters of the book. In particular, the moment map is defined and explored, both mathematically and in its relation to physics. He also introduces symplectic reduction, which is an important tool for reducing the number of variables in a physical system and for constructing new symplectic manifolds from old. The final chapter is on quantization, which uses symplectic methods to take classical mechanics to quantum mechanics. This section includes a discussion of the Heisenberg group and the Weil (or metaplectic) representation of the symplectic group.

Several appendices provide background material on vector bundles, on cohomology, and on Lie groups and Lie algebras and their representations.

Berndt's presentation offers a clear and concise introduction to the major methods and applications of the subject, and requires only a minimum of prerequisites. This book would be an excellent text for a graduate course or as a source for anyone who wishes to learn about symplectic geometry.

Graduate Studies in Mathematics, Volume 26

October 2000, approximately 224 pages, Hardcover, ISBN 0-8218-2056-7, LC 00-033139, 2000 *Mathematics Subject Classification*: 53C15, 53Dxx, 20G20, 81S10, **All AMS members \$29**, List \$36, Order code GSM/26RT010

Recommended Text

Groups and Geometric Analysis Integral Geometry, Invariant Differential Operators, and Spherical Functions

Sigurdur Helgason, *Massachusetts Institute of Technology, Cambridge*

From reviews of the original edition ...

The book is excellent both as a text and as a reference work; it will clearly become another instant classic.

—*American Scientist*

This volume makes an excellent companion to the author's Differential Geometry, Lie Groups, and Symmetric Spaces, putting to work many of the abstract concepts developed in the earlier volume. The introductory material and large number of exercises (with answers!) will make the book quite appropriate for students. Researchers will find numerous useful references on geometric analysis, along with proofs, connections with other parts of mathematics, and valuable historical remarks.

This book, like the author's previous work on differential geometry, will no doubt inspire considerable further research and become the standard text on the subjects it covers.

—*Mathematical Reviews*

Few treatises today can lay claim to being "aere perennius", but all of Helgason's books certainly do with a vengeance ... [He] sets a model of style and clarity that has not been matched since Enriques's Geometria proiettiva. This is the kind of mathematics that will live forever.

—*Bulletin of Mathematical Books*

A most valuable contribution to Lie theory and to the interplay between geometry and analysis. It is remarkable that the beautiful theory in Chapter IV can be presented in a textbook form with complete proofs.

—*Bulletin of the London Mathematical Society*

The diversity of subjects treated is great. Nevertheless the author has managed to achieve coherence of presentation by clearly putting forward a few main themes and basic problems. The first third of the book is suitable as a text for beginning graduate students; the book is also an excellent source of reference for experts. No doubt it will become a new standard in the field.

—*CWI Quarterly*

This volume, the second of Helgason's impressive three books on Lie groups and the geometry and analysis of symmetric spaces, is an introduction to group-theoretic methods in analysis on spaces with a group action.

The first chapter deals with the three two-dimensional spaces of constant curvature, requiring only elementary methods and no Lie theory. It is remarkably accessible and would be suitable for a first-year graduate course. The remainder of the book covers more advanced topics, including the work of Harish-Chandra and others, but especially that of Helgason himself. Indeed, the exposition can be seen as an account of the author's tremendous contributions to the subject.

Chapter I deals with modern integral geometry and Radon transforms. The second chapter examines the interconnection between Lie groups and differential operators. Chapter IV develops the theory of spherical functions on semisimple Lie groups with a certain degree of completeness, including a study of Harish-Chandra's c -function. The treatment of analysis on compact symmetric spaces (Chapter V) includes some finite-dimensional representation theory for compact Lie groups and Fourier analysis on compact groups. Each chapter ends with exercises (with solutions given at the end of the book!) and historical notes.

This book, which is new to the AMS publishing program, is an excellent example of the author's well-known clear and careful writing style. It has become the standard text for the study of spherical functions and invariant differential operators on symmetric spaces.

Sigurdur Helgason was awarded the Steele Prize for *Groups and Geometric Analysis* and the companion volume, *Differential Geometry, Lie Groups and Symmetric Spaces*.

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

Mathematical Surveys and Monographs

October 2000, 667 pages, Hardcover, ISBN 0-8218-2673-5, LC 00-034997, 2000 *Mathematics Subject Classification*: 22E30, 22-02, 43A85, 53-02, 53C65, 22E46, 53C35, 58C35, 43A77, 43A90, 35C15, 44A12, 51M10, 58J70, **All AMS members \$45**, List \$56, Order code SURV-HELGASON2RT010

Advance Notice
Recommended Text

Noncommutative Noetherian Rings

J. C. McConnell and J. C. Robson, *University of Leeds, England*

From reviews of the first edition ...

A model of mathematical writing, as perfectly written a mathematics book as I have seen ... It can be profitably read by non-experts ... an almost perfectly conceived account of major developments and general methods ... will remain a basic reference for many years ...

—*Bulletin of the AMS*

Very thorough and illuminating ... A veritable tour de force, encompassing a wide range of topics in some depth ... very easy to find information in this book ... full of illuminating examples which throw a light on [the theory].

—*Proceedings of the Edinburgh Mathematical Society*

Self-contained, comprehensive ... The creation of this valuable resource is a service to mathematics ...

—*Mathematical Reviews*

An intrinsically interesting branch of algebra ... Until ... this book there has been no attempt to provide an overview of, and a general reference for, the most important developments in the theory. The ... authors set out to fill this gap and have succeeded admirably ... easy to read and use ... well written ... An essential possession for any serious worker in the area.

—*Zentralblatt für Mathematik*

An account of noncommutative Noetherian rings, giving the theory as far as it exists but with constant emphasis on constructions and examples. [This is] a daunting task but the authors have succeeded well ... highly readable ... well indexed ... will rapidly become the standard text in the field and will stimulate further progress.

—*Bulletin of the LMS*

An abundance of well-organized material ... a must for those in the area.

—*International Mathematical News*

This is a reprinted edition of a work that was considered the definitive account in the subject area upon its initial publication by J. Wiley & Sons in 1987. It presents, within a wider context, a comprehensive account of noncommutative Noetherian rings. The author covers the major developments from the 1950s, stemming from Goldie's theorem and onward, including applications to group rings, enveloping algebras of Lie algebras, PI rings, differential operators, and localization theory. The book is not restricted to Noetherian rings, but discusses wider classes of rings where the methods apply more generally. In the current edition, some errors were corrected, a number of arguments have been expanded, and the references were brought up to date. This reprinted edition will continue to be a valuable and stimulating work for readers

interested in ring theory and its applications to other areas of mathematics.

Graduate Studies in Mathematics

January 2001, approximately 616 pages, Hardcover, ISBN 0-8218-2169-5, LC 00-034990, 2000 *Mathematics Subject Classification*: 16-XX, **All AMS members \$58**, List \$72, Order code GSM-MCCONNELLRT010

**Quantum Field Theory
A Twentieth Century Profile**

Asoke N. Mitra, Editor

A publication of the Hindustan Book Agency.

After serving his apprenticeship as a field theorist at Cornell University ... Dr. Mitra sacrificed his chance of a brilliant research career in America in order to serve his country and his people. I deeply respect that choice, and I rejoice that his sacrifice was not made in vain. After a fruitful career as a pioneer and teacher of modern science in India, he now stands at the center of the vibrant scientific community that he helped to create. This volume is, among other things, a monument to his vision.

—*From the Foreword by Freeman Dyson*

Quantum Field Theory (QFT) may be the single most important concept in physics to be discovered in the twentieth century. This volume reflects the multidimensional impact of QFT on the evolution of physics in the last century. Dr. Asoke Mitra, editor for the volume and former student and colleague of Freeman Dyson, gathers here a selection of articles in the areas where the impact of QFT has been especially pronounced: from particle physics to string theory and extending to facets of astrophysics and the physics of condensed matter.

The wide range of topics covered makes this volume more than just an introductory text on QFT. Contributors include V. Gribov, M. Moshinsky, K. Nishijima, J. Schwarz, D. Shirkov, E. Witten and many more renowned experts in their respective fields. This book makes an excellent reference work for a broad spectrum of readers, from postdocs in key areas of QFT to specialists in currently evolving areas.

Distributed worldwide except in India by the American Mathematical Society.

Published jointly by the Hindustan Book Agency (India) and the Indian National Science Academy.

Contributors include: A. N. Mitra, D. V. Shirkov, S. Szpigel, R. J. Perry, V. Novikov, P. K. Kabir, D. Boyanovsky, H. J. de Vega, V. N. Gribov, K. Nishijima, M. Chaichian, R. Kaul, E. Witten, H. Banerjee, W.-M. Zhang, N. Mukunda, J. Schechter, H. Weigel, R. Ramanathan, A. Das, B. M. Sodermark, P. P. Srivastava, D. S. Kulshreshtha, L. Lusanna, R. N. Mohapatra, N. Sakai, W. Nahm, J. H. Schwarz, J. Maharana, L. Bonora, A. Khare, R. Rajaraman, O. Pene, L. S. Kisslinger, V. A. Karmanov, M. Moshinsky, and D. Home.

Hindustan Book Agency

March 2000, 900 pages, Hardcover, ISBN 81-85931-25-9, 2000 *Mathematics Subject Classification*: 81-XX, **All AMS members \$71**, List \$89, Order code HIN/4RT010

Recommended Text

The Mathematics of Soap Films: Explorations with Maple®

John Oprea, *Cleveland State University, OH*

Nature tries to minimize the surface area of a soap film through the action of surface tension. The process can be understood mathematically by using differential geometry, complex analysis, and the calculus of variations. This book employs ingredients from each of these subjects to tell the mathematical story of soap films.

The text is fully self-contained, bringing together a mixture of types of mathematics along with a bit of the physics that underlies the subject. The development is primarily from first principles, requiring no advanced background material from either mathematics or physics.

Through the Maple® applications, the reader is given tools for creating the shapes that are being studied. Thus, you can “see” a fluid rising up an inclined plane, create minimal surfaces from complex variables data, and investigate the “true” shape of a balloon. Oprea also includes descriptions of experiments and photographs that let you see real soap films on wire frames.

The theory of minimal surfaces is a beautiful subject, which naturally introduces the reader to fascinating, yet accessible, topics in mathematics. Oprea’s presentation is rich with examples, explanations, and applications. It would make an excellent text for a senior seminar or for independent study by upper-division mathematics or science majors.

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

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Student Mathematical Library, Volume 10

September 2000, approximately 277 pages, Softcover, ISBN 0-8218-2118-0, LC 00-041614, 2000 *Mathematics Subject Classification*: 49-01, 49-04, 49Q05, 53-01, 53-04, 53A10, **All AMS members \$23**, List \$29, Order code STML/10RT010

Back in Print from the AMS

A Classic

Lectures on the Calculus of Variations and Optimal Control Theory

L. C. Young

A considerable number of heretofore unpublished results developed by the author are found ... The book is an important contribution to the calculus of variations and optimal control theory. It is most appropriate that the theory of generalized curves should be presented ... by its founder. The book is well written with an unusual and lively style. It is filled with historical remarks and with comments which enlarge one’s outlook on the role of mathematics and mathematicians in our society ... This book should be mastered by anyone who wishes to become an expert in this field.

—*Mathematical Reviews*

This book is divided into two parts. The first addresses the simpler variational problems in parametric and nonparametric form. The second covers extensions to optimal control theory.

The author opens with the study of three classical problems whose solutions led to the theory of calculus of variations. They are the problem of geodesics, the brachistochrone, and the minimal surface of revolution. He gives a detailed discus-

sion of the Hamilton-Jacobi theory, both in the parametric and nonparametric forms. This leads to the development of sufficiency theories describing properties of minimizing extremal arcs.

Next, the author addresses existence theorems. He first develops Hilbert’s basic existence theorem for parametric problems and studies some of its consequences. Finally, he develops the theory of generalized curves and “automatic” existence theorems.

In the second part of the book, the author discusses optimal control problems. He notes that originally these problems were formulated as problems of Lagrange and Mayer in terms of differential constraints. In the control formulation, these constraints are expressed in a more convenient form in terms of control functions. After pointing out the new phenomenon that may arise, namely, the lack of controllability, the author develops the maximum principle and illustrates this principle by standard examples that show the switching phenomena that may occur. He extends the theory of geodesic coverings to optimal control problems. Finally, he extends the problem to generalized optimal control problems and obtains the corresponding existence theorems.

AMS Chelsea Publishing

August 2000, 337 pages, Hardcover, ISBN 0-8218-2690-5, LC 79-57387, 2000 *Mathematics Subject Classification*: 49-02, **All AMS members \$31**, List \$34, Order code CHEL/304.HRT010