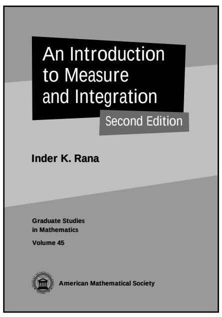
New Publications Offered by the AMS

Analysis

Recommended Text



An Introduction to Measure and Integration
Second Edition

Inder K. Rana, *Indian Institute of Technology, Powai, Mumbai*

From reviews for the First Edition:

Distinctive features include: 1) An unusually extensive treatment of the historical developments leading up to the Lebesgue integral … 2) Presentation of the standard extension of an abstract measure on an algebra to a sigma algebra prior to the final stage of development of Lebesgue measure. 3) Extensive treatment of change of variables theorems for functions of one and several variables … the conversational tone and helpful insights make this a useful introduction to the topic … The material is presented with generous details and helpful examples at a level suitable for an introductory course or for self-study.

—Zentralblatt MATH

A special feature [of the book] is the extensive historical and motivational discussion … At every step, whenever a new concept is introduced, the author takes pains to explain how the concept can be seen to arise naturally … The book attempts to be comprehensive and largely succeeds … The text can be used for either a one-semester or a one-year course at M.Sc. level … The book is clearly a labor of love. The exuberance of detail, the wealth of examples and the evident delight in discussing variations and counter examples, all attest to that … All in all, the book is highly recommended to serious and demanding students.

—Resonance

Integration is one of the two cornerstones of analysis. Since the fundamental work of Lebesgue, integration has been interpreted in terms of measure theory. This introductory text starts with the historical development of the notion of the integral and a review of the Riemann integral. From here, the reader is naturally led to the consideration of the Lebesgue integral, where abstract integration is developed via measure theory. The important basic topics are all covered: the Fundamental Theorem of Calculus, Fubini's Theorem, L_p spaces, the Radon-Nikodym Theorem, change of variables formulas, and so on.

The book is written in an informal style to make the subject matter easily accessible. Concepts are developed with the help of motivating examples, probing questions, and many exercises. It would be suitable as a textbook for an introductory course on the topic or for self-study.

For this edition, more exercises and four appendices have been added.

The AMS maintains exclusive distribution rights for this edition in North America and nonexclusive distribution rights worldwide, excluding India, Pakistan, Bangladesh, Nepal, Bhutan, Sikkim, and Sri Lanka.

Contents: Prologue: The length function; Riemann integration; Recipes for extending the Riemann integral; General extension theory; The Lebesgue measure on $\mathbb{R}$ and its properties; Integration; Fundamental theorem of calculus for the Lebesgue integral; Measure and integration on product spaces; Modes of convergence and L_p-spaces; The Radon-Nikodym theorem and its applications; Signed measures and complex measures; Extended real numbers; Axiom of choice; Continuum hypotheses; Urysohn's lemma; Singular value decomposition of a matrix; Functions of bounded variation; Differentiable transformations; Index of symbols; References; Index.

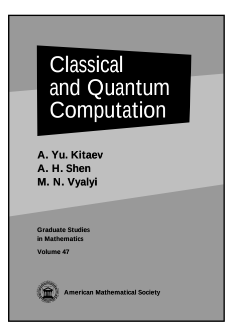
Graduate Studies in Mathematics, Volume 45

July 2002, approximately 456 pages, Hardcover, ISBN 0-8218-2974-2, LC 2002018244, 2000 *Mathematics Subject Classification*: 28–01; 28A05, 28A10, 28A12, 28A15, 28A20, 28A25, 28A33, 28A35, 26A30, 26A42, **All AMS members $47**, List $59, Order code GSM/45N

Applications

Recommended Text

Available in Hardcover and Softcover Editions



Classical and Quantum Computation

A. Yu. Kitaev, *California Institute of Technology, Pasadena,* and **A. H. Shen** and **M. N. Vyalyi**, *Independent University of Moscow, Russia*

This book is an introduction to a new rapidly developing topic: the theory of quantum computing. It begins with the basics of classical theory of computation: Turing machines, Boolean circuits, parallel algorithms, probabilistic computation, NP-complete problems, and the idea of complexity of an algorithm. The second part of the book provides an exposition of quantum computation theory. It starts with the introduction of general quantum formalism (pure states, density matrices, and superoperators), universal gate sets and approximation theorems. Then the authors study various quantum computation algorithms: Grover's algorithm, Shor's factoring algorithm, and the Abelian hidden subgroup problem. In concluding sections, several related topics are discussed (parallel quantum computation, a quantum analog of NP-completeness, and quantum error-correcting codes).

Rapid development of quantum computing started in 1994 with a stunning suggestion by Peter Shor to use quantum computation for factoring large numbers—an extremely difficult and time-consuming problem when using a conventional computer. Shor's result spawned a burst of activity in designing new algorithms and in attempting to actually build quantum computers. Currently, the progress is much more significant in the former: A sound theoretical basis of quantum computing is under development and many algorithms have been suggested.

In this concise text, the authors provide solid foundations to the theory—in particular, a careful analysis of the quantum circuit model—and cover selected topics in depth. Some of the results have not appeared elsewhere while others improve on existing works. Included are a complete proof of the Solovay-Kitaev theorem with accurate algorithm complexity bounds, approximation of unitary operators by circuits of doubly logarithmic depth. Among other interesting topics are toric codes and their relation to the anyon approach to quantum computing.

Prerequisites are very modest and include linear algebra, elements of group theory and probability, and the notion of a formal or an intuitive algorithm. This text is suitable for a course in quantum computation for graduate students in mathematics, physics, or computer science. More than 100 problems (most of them with complete solutions) and an appendix summarizing the necessary results are a very useful addition to the book. It is available in both hardcover and softcover editions.

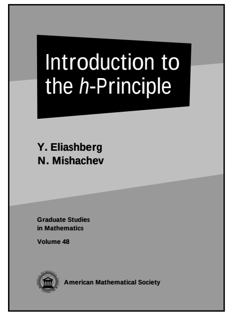
Contents: Introduction; Classical computation; Quantum computation; Solutions; Elementary number theory; Bibliography; Index.

Graduate Studies in Mathematics, Volume 47

July 2002, approximately 272 pages, Hardcover, ISBN 0-8218-2161-X, LC 2002016686, 2000 *Mathematics Subject Classification*: 68–02, 81–02; 68Qxx, 81P68, **All AMS members $47**, List $59, Order code GSM/47N
July 2002, approximately 272 pages, Softcover, ISBN 0-8218-3229-8, LC 2002016686, 2000 *Mathematics Subject Classification*: 68–02, 81–02; 68Qxx, 81P68, **All AMS members $29**, List $36, Order code GSM/47.SN

Geometry and Topology

Recommended Text



Introduction to the h-Principle

Y. Eliashberg, *Stanford University, CA,* and
N. Mishachev, *Lipetsk Technical University, Russia*

One of the most powerful modern methods of solving partial differential equations is Gromov's h-principle. It has also been, traditionally, one of the most difficult to explain. This book is the first broadly accessible exposition of the principle and its applications.

The essence of the h-principle is the reduction of problems involving partial differential relations to problems of a purely homotopy-theoretic nature. Two famous examples of the h-principle are the Nash-Kuiper C^1-isometric embedding theory in Riemannian geometry and the Smale-Hirsch immersion theory in differential topology. Gromov transformed these examples into a powerful general method for proving the h-principle. Both of these examples and their explanations in terms of the h-principle are covered in detail in the book.

The authors cover two main embodiments of the principle: *holonomic approximation* and *convex integration*. The first is a version of the method of continuous sheaves. The reader will find that, with a few notable exceptions, most instances of the h-principle can be treated by the methods considered here. There are, naturally, many connections to symplectic and contact geometry.

The book would be an excellent text for a graduate course on modern methods for solving partial differential equations. Geometers and analysts will also find much value in this very readable exposition of an important and remarkable technique.

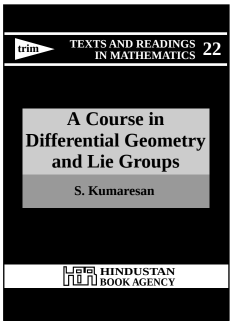
This item will also be of interest to those working in analysis.

Contents: Intrigue; *Holonomic approximation:* Jets and holonomy; Thom transversality theorem; Holonomic approximation; Applications; *Differential relations and Gromov's h-principle:* Differential relations; Homotopy principle; Open Diff V-invariant differential relations; Applications to closed manifolds; *Homotopy principle in symplectic geometry:* Symplectic and contact basics; Symplectic and contact structures on open manifolds; Symplectic and contact structures on closed manifolds; Embeddings into symplectic and contact manifolds; Microflexibility and holonomic $\mathcal{R}$-approximation; First applications of microflexibility; Microflexible $\mathfrak{U}$-invariant differential relations; Further applications to symplectic geometry; *Convex integration:* One-dimensional convex integration; Homotopy principle for ample differential relations; Directed immersions and embeddings; First order linear differential operators; Nash-Kuiper theorem; Bibliography; Index.

Graduate Studies in Mathematics, Volume 48

June 2002, approximately 198 pages, Hardcover, ISBN 0-8218-3227-1, 2000 *Mathematics Subject Classification*: 58Axx, **All AMS members $24**, List $30, Order code GSM/48N

Recommended Text



A Course in Differential Geometry and Lie Groups

S. Kumaresan, *University of Mumbai, India*

A publication of the Hindustan Book Agency.

This book arose out of courses taught by the author. It covers the traditional topics of differential manifolds, tensor fields, Lie groups, integration on manifolds and basic differential and Riemannian geometry. The author emphasizes geometric concepts, giving the reader a working knowledge of the topic. Motivations are given, exercises are included, and illuminating nontrivial examples are discussed.

Important features include the following:

- Geometric and conceptual treatment of differential calculus with a wealth of nontrivial examples.
- A thorough discussion of the much-used result on the existence, uniqueness, and smooth dependence of solutions of ODEs.
- Careful introduction of the concept of tangent spaces to a manifold.
- Early and simultaneous treatment of Lie groups and related concepts.
- A motivated and highly geometric proof of the Frobenius theorem.
- A constant reconciliation with the classical treatment and the modern approach.
- Simple proofs of the hairy-ball theorem and Brouwer's fixed point theorem.
- Construction of manifolds of constant curvature à la Chern.

This text would be suitable for use as a graduate-level introduction to basic differential and Riemannian geometry.

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

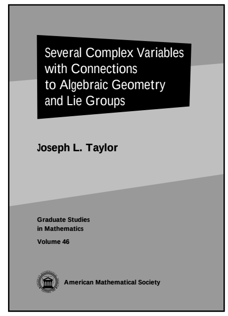
Distributed worldwide except in India by the American Mathematical Society.

Contents: Differential calculus; Manifolds and Lie groups; Tensor analysis; Integration; Riemannian geometry; Tangent bundles and vector bundles; Partitions of unity; Bibliography; List of symbols; Index.

Number 9

January 2002, 295 pages, Hardcover, ISBN 81-85931-29-1, 2000 *Mathematics Subject Classification*: 22–01, 53–01, **All AMS members $30**, List $38, Order code HIN/9N

Recommended Text



Several Complex Variables with Connections to Algebraic Geometry and Lie Groups

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

This text presents an integrated development of core material from several complex variables and complex algebraic geometry, leading to proofs of Serre's celebrated GAGA theorems relating the two subjects, and including applications to the representation theory of complex semisimple Lie groups. It includes a thorough treatment of the local theory using the tools of commutative algebra, an extensive development of sheaf theory and the theory of coherent analytic and algebraic sheaves, proofs of the main vanishing theorems for these categories of sheaves, and a complete proof of the finite dimensionality of the cohomology of coherent sheaves on compact varieties. The vanishing theorems have a wide variety of applications and these are covered in detail.

Of particular interest are the last three chapters, which are devoted to applications of the preceding material to the study of the structure theory and representation theory of complex semisimple Lie groups. Included are introductions to harmonic analysis, the Peter-Weyl theorem, Lie theory and the structure of Lie algebras, semisimple Lie algebras and their representations, algebraic groups and the structure of complex semisimple Lie groups. All of this culminates in Miličić's proof of the Borel-Weil-Bott theorem, which makes extensive use of the material developed earlier in the text.

There are numerous examples and exercises in each chapter. This modern treatment of a classic point of view would be an excellent text for a graduate course on several complex variables, as well as a useful reference for the expert.

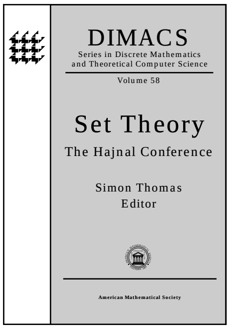
This item will also be of interest to those working in analysis.

Contents: Selected problems in one complex variable; Holomorphic functions of several variables; Local rings and varieties; The Nullstellensatz; Dimension; Homological algebra; Sheaves and sheaf cohomology; Coherent algebraic sheaves; Coherent analytic sheaves; Stein spaces; Fréchet sheaves—Cartan's theorems; Projective varieties; Algebraic vs. analytic—Serre's theorems; Lie groups and their representations; Algebraic groups; The Borel-Weil-Bott theorem; Bibliography; Index.

Graduate Studies in Mathematics, Volume 46

July 2002, approximately 528 pages, Hardcover, ISBN 0-8218-3178-X, LC 2002018346, 2000 *Mathematics Subject Classification*: 34–01, 14–01, 22–01, 43–01, **All AMS members $59**, List $74, Order code GSM/46N

Logic and Foundations



Set Theory
The Hajnal Conference

Simon Thomas, *Rutgers University, New Brunswick, NJ*, Editor

This volume presents the proceedings from the Mid-Atlantic Mathematical Logic Seminar (MAMLS) conference held in honor of András Hajnal at the DIMACS Center, Rutgers University (New Brunswick, NJ). Articles include both surveys and high-level research papers written by internationally recognized experts in the field of set theory.

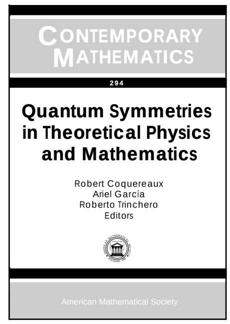
Many of the current active areas of set theory are represented in this volume. It includes research papers on combinatorial set theory, set theoretic topology, descriptive set theory, and set theoretic algebra. There are valuable surveys on combinatorial set theory, fragments of the proper forcing axiom, and the reflection properties of stationary sets. The book also includes an exposition of the ergodic theory of lattices in higher rank semisimple Lie groups—essential reading for anyone who wishes to understand much of the recent work on countable Borel equivalence relations.

Contents: S. Adams, Containment does not imply Borel reducibility; **J. E. Baumgartner**, Hajnal's contributions to combinatorial set theory and the partition calculus; **C. Darby** and **J. A. Larson**, Multicolored graphs on countable ordinals of finite exponent; **M. Džamonja**, On D-spaces and discrete families of sets; **I. Farah**, Analytic Hausdorff gaps; **M. D. Foreman**, Stationary sets, Chang's conjecture and partition theory; **I. Juhász**, **L. Soukup**, and **Z. Szentmiklóssy**, A consistent example of a hereditarily $\mathfrak{c}$-Lindelöf first countable space of size $> \mathfrak{c}$; **P. Komjáth**, Subgraph chromatic number; **S. Shelah**, Superatomic Boolean algebras: Maximal rigidity; **S. Thomas**, Some applications of superrigidity to Borel equivalence relations; **S. Todorčević**, Localized reflection and fragments of PFA; **B. Velickovic**, The basis problem for CCC posets.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 58

June 2002, 162 pages, Hardcover, ISBN 0-8218-2786-3, 2000 *Mathematics Subject Classification*: 03E02, 03E15, 03E35, 03E55; 03G05, 37A20, 54A35, **Individual member $35**, List $59, Institutional member $47, Order code DIMACS/58N

Mathematical Physics



Quantum Symmetries in Theoretical Physics and Mathematics

Robert Coquereaux, *Centre de Physique Théorique, Marseille, France, and Centre de International de Rencontres Mathématiques, Marseille, France*, **Ariel García**, *Max-Planck-Institut für Physik, München, Germany*, and **Roberto Trinchero**, *Centro Atómico Bariloche and Instituto Balseiro, Argentina*, Editors

This volume presents articles from several lectures presented at the school on "Quantum Symmetries in Theoretical Physics and Mathematics" held in Bariloche, Argentina. The various lecturers provided significantly different points of view on several aspects of Hopf algebras, quantum group theory, and noncommutative differential geometry, ranging from analysis, geometry, and algebra to physical models, especially in connection with integrable systems and conformal field theories.

Primary topics discussed in the text include subgroups of quantum $SU(N)$, quantum ADE classifications and generalized Coxeter systems, modular invariance, defects and boundaries in conformal field theory, finite dimensional Hopf algebras, Lie bialgebras and Belavin-Drinfeld triples, real forms of quantum spaces, perturbative and non-perturbative Yang-Baxter operators, braided subfactors in operator algebras and conformal field theory, and generalized (d^N) cohomologies.

Contents: N. Andruskiewitsch, About finite dimensional Hopf algebras; **M. Dubois-Violette**, Lectures on differentials, generalized differentials and on some examples related to theoretical physics; **J. Böckenhauer** and **D. E. Evans**, Modular invariants from subfactors; **A. Ocneanu**, The classification of subgroups of quantum $SU(N)$; **O. Ogievetsky**, Uses of quantum spaces; **J.-B. Zuber**, CFT, BCFT, ADE and all that.

Contemporary Mathematics, Volume 294

June 2002, 230 pages, Softcover, ISBN 0-8218-2655-7, 2000 *Mathematics Subject Classification*: 16W30, 17B37, 20G42, 81R50, 46L87, 46L37, 81T40, 82B20, 81Txx, 18G60, **Individual member $41**, List $69, Institutional member $55, Order code CONM/294N