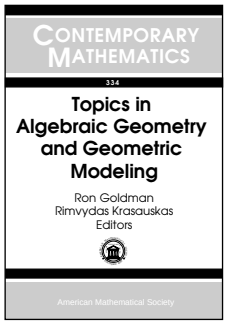
New Publications Offered by the AMS

Algebra and Algebraic Geometry



Topics in Algebraic Geometry and Geometric Modeling

Ron Goldman, *Rice University, Houston, TX*, and **Rimvydas Krasauskas**, *Vilnius University, Lithuania*, Editors

Algebraic geometry and geometric modeling both deal with curves and surfaces generated by polynomial equations. Algebraic geometry investigates the theoretical properties of polynomial curves and surfaces; geometric modeling uses polynomial, piecewise polynomial, and rational curves and surfaces to build computer models of mechanical components and assemblies for industrial design and manufacture.

The NSF sponsored the four-day "Vilnius Workshop on Algebraic Geometry and Geometric Modeling", which brought together some of the top experts in the two research communities to examine a wide range of topics of interest to both fields. This volume is an outgrowth of that workshop. Included are surveys, tutorials, and research papers. In addition, the editors have included a translation of Minding's 1841 paper, "On the determination of the degree of an equation obtained by elimination", which foreshadows the modern application of mixed volumes in algebraic geometry.

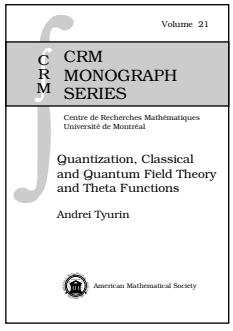
The volume is suitable for mathematicians, computer scientists, and engineers interested in applications of algebraic geometry to geometric modeling.

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

Contents: R. Goldman, Polar forms in geometric modeling and algebraic geometry; **W. Wang** and **R. Krasauskas**, Interference analysis of conics and quadrics; **R. Vidūnas**, Geometrically continuous octahedron; **J. Peters**, Smoothness, fairness and the need for better multi-sided patches; **R. Krasauskas** and **R. Goldman**, Toric Bézier patches with depth; **J. Warren**, On the uniqueness of barycentric coordinates; **K. Karčiauskas**, Rational M-patches and tensor-border patches; **D. Cox**, Curves, surfaces, and syzygies; **J. Zheng**, **T. W. Sederberg**, **E.-W. Chionh**, and **D. A. Cox**, Implicitizing rational surfaces with base points using the method of moving surfaces; **T. Dokken** and **J. B. Thomassen**, Overview of approximate implicitization; **J. Schicho**, Algorithms for rational surfaces; **D. Cox**, What is a toric variety?; **F. Sottile**, Toric ideals, real toric varieties, and the moment map; **D. Cox**, **R. Krasauskas**, and **M. Mustaţă**, Universal rational parametrizations and toric varieties; **C. Delaunay**, Real structures on smooth compact toric surfaces; **J. M. Rojas**, Why polyhedra matter in non-linear equation solving; **L. Busé**, **M. Elkadi**, and **B. Mourrain**, Using projection operators in computer aided geometric design; **I. Soprounov**, On combinatorial coefficients and the Gelfond-Khovanskii residue formula; **F. Minding**, On the determination of the degree of an equation obtained by elimination; Index.

Contemporary Mathematics, Volume 334

December 2003, approximately 360 pages, Softcover, ISBN 0-8218-3420-7, 2000 *Mathematics Subject Classification*: 14M25, 14Qxx, 52B20, 65Dxx, 68U07; 13D02, 13P10, 14E20, 41A25, 58D99, **All AMS members $71**, List $89, Order code CONM/334N



Quantization, Classical and Quantum Field Theory and Theta Functions

Andrei Tyurin, *Steklov Institute of Mathematical Sciences, Moscow*

This book is written by a well-known expert in classical algebraic geometry. Tyurin's research was specifically in explicit computations to vector bundles on algebraic varieties. This is the only available monograph written from his unique viewpoint.

Ordinary (abelian) theta functions describe properties of moduli spaces of one-dimensional vector bundles on algebraic curves. Non-abelian theta functions, which are the main topic of this book, play a similar role in the study of higher-dimensional vector bundles. The book presents various aspects of the theory of non-abelian theta functions and the moduli

spaces of vector bundles, including their applications to problems of quantization and to classical and quantum conformal field theories.

The book is an important source of information for specialists in algebraic geometry and its applications to mathematical aspects of quantum field theory.

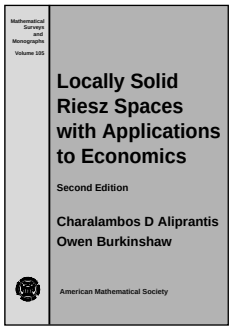
This item will also be of interest to those working in mathematical physics.

Contents: Quantization procedure; Algebraic curves = Riemann surfaces; Non-abelian theta functions; Symplectic geometry of moduli spaces of vector bundles; Two versions of CQFT; Three-valent graphs; Analytical aspects of the theory of non-abelian theta functions; BPU-map; The main weapon; Bibliography.

CRM Monograph Series, Volume 21

November 2003, 136 pages, Hardcover, ISBN 0-8218-3240-9, LC 2003061207, 2000 *Mathematics Subject Classification*: 53D50; 14D21, 14K25, 53D12, 53D30, 57M27, 57R56, 81T40, **All AMS members $34**, List $43, Order code CRMM/21N

Analysis



Locally Solid Riesz Spaces with Applications to Economics

Second Edition

Charalambos D. Aliprantis, *Purdue University, West Lafayette, IN*, and **Owen Burkinshaw**, *Indiana University-Purdue University, Indianapolis*

From reviews of the First Edition:

Self-contained … should be accessible to any student with a standard course in functional analysis.

—Mathematical Reviews

Tightly written book … supplemented by numerous examples … special notes trace the history of the subject.

—Zentralblatt MATH

Riesz space (or a vector lattice) is an ordered vector space that is simultaneously a lattice. A topological Riesz space (also called a locally solid Riesz space) is a Riesz space equipped with a linear topology that has a base consisting of solid sets. Riesz spaces and ordered vector spaces play an important role in analysis and optimization. They also provide the natural framework for any modern theory of integration.

This monograph is the revised edition of the authors' book *Locally Solid Riesz Spaces* (1978, Academic Press). It presents an extensive and detailed study (with complete proofs) of topological Riesz spaces. The book starts with a comprehensive exposition of the algebraic and lattice properties of Riesz spaces and the basic properties of order bounded operators between Riesz spaces. Subsequently, it introduces and studies locally solid topologies on Riesz spaces— the main link between order and topology used in this monograph. Special attention is paid to several continuity properties relating the order and topological structures of Riesz spaces, the most important of which are the Lebesgue and Fatou properties. A new chapter presents some surprising applications of topological Riesz spaces to economics. In particular, it demonstrates that the existence of economic equilibria and the supportability of optimal allocations by prices in the classical economic models can be proven easily using techniques from the theory of topological Riesz spaces.

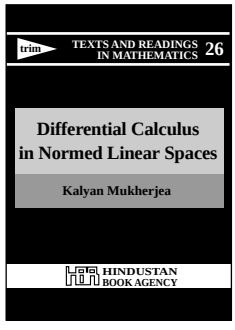
At the end of each chapter there are exercises that complement and supplement the material in the chapter. The last chapter of the book presents complete solutions to all exercises. Prerequisites are the fundamentals of real analysis, measure theory, and functional analysis. This monograph will be useful to researchers and graduate students in mathematics. It will also be an important reference tool to mathematical economists and to all scientists and engineers who use order structures in their research.

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

Contents: The lattice structure of Riesz spaces; Locally solid topologies; Lebesgue topologies; Fatou topologies; Metrizability; Weak compactness in Riesz spaces; Lateral completeness; Market economies; Solutions to the exercises; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 105

December 2003, approximately 360 pages, Hardcover, ISBN 0-8218-3408-8, LC 2003057948, 2000 *Mathematics Subject Classification*: 46A40, 46B40, 47B60, 47B65, 91B50; 28A33, **All AMS members $67**, List $84, Order code SURV/105N



Differential Calculus in Normed Linear Spaces

Kalyan Mukherjea, *Indian Statistical Institute, Kolkata*

This book presents advanced calculus from a geometric point of view: Instead of dealing with partial derivatives of functions of several variables, the derivative of the function is treated as a linear transformation between normed linear spaces. Not only does this lead to a simplified and transparent exposition of "difficult" results like the inverse and implicit function theorems but also permits, without any extra effort, a discussion of the differential calculus of functions defined on infinite dimensional Hilbert or Banach spaces.

The prerequisites demanded of the reader are modest: a sound understanding of convergence of sequences and series of real numbers, the continuity and differentiability properties of functions of a real variable, and a little linear algebra should provide adequate background for understanding the book. The first two chapters cover much of the more advanced background material on linear algebra (such as dual spaces, multilinear functions and tensor products). Chapter 3 gives an *ab initio* exposition of the basic results concerning the topology of metric spaces, particularly of normed linear spaces.

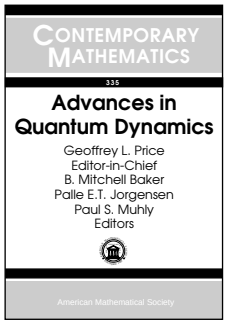
The last chapter deals with miscellaneous applications of the differential calculus including an introduction to the calculus of variations. As a corollary to this, there is a brief discussion of geodesics in Euclidean and hyperbolic planes and non-Euclidean geometry.

A publication of the Hindustan Book Agency. Distributed exclusively by the American Mathematical Society in North America and worldwide on the AMS Bookstore.

Contents: Preliminaries; Linear spaces: New spaces for old; Normed linear spaces, metric spaces; Calculus; Existence theorems; Applications: Stationary values; Appendix: Green's theorem; References; Index.

Hindustan Book Agency

July 2003, 285 pages, Hardcover, ISBN 81-85931-43-7, 2000 *Mathematics Subject Classification*: 26–01; 26Bxx, 26Exx, **All AMS members $30**, List $38, Order code HIN/17N



Advances in Quantum Dynamics

Geoffrey L. Price, Editor-in-Chief, and **B. Mitchell Baker**, *U.S. Naval Academy, Annapolis, MD*, and **Palle E.T. Jorgensen** and **Paul S. Muhly**, *University of Iowa, Iowa City*, Editors

This volume contains the proceedings of the conference on Advances in Quantum Dynamics. The purpose of the conference was to assess the current state of knowledge and to outline future research directions of quantum dynamical semigroups on von Neumann algebras.

Since the appearance of the landmark papers by F. Murray and J. von Neumann, *On the Rings of Operators*, von Neumann algebras have been used as a mathematical model in the study of time evolution of quantum mechanical systems. Following the work of M. H. Stone, von Neumann, and others on the structure of one-parameter groups of unitary transformations, many researchers have made fundamental contributions to the understanding of time-reversible dynamical systems. This book deals with the mathematics of time-irreversible systems, also called dissipative systems. The time parameter is the half-line, and the transformations are now endomorphisms as opposed to automorphisms.

For over a decade, W. B. Arveson and R. T. Powers have pioneered the effort to understand the structure of irreversible quantum dynamical systems on von Neumann algebras. Their papers in this volume serve as an excellent introduction to the theory. Also included are contributions in other areas which have had an impact on the theory, such as Brownian motion, dilation theory, quantum probability, and free probability.

The volume is suitable for graduate students and research mathematicians interested in the dynamics of quantum systems and corresponding topics in the theory of operator algebras.

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

Contents: W. Arveson, Four lectures on noncommutative dynamics; **R. T. Powers**, Construction of E_0-semigroups of $\mathfrak{B}(\mathfrak{h})$ from CP-flows; **B. V. R. Bhat**, Atomic dilations; **F. Cipriani** and **J.-L. Sauvageot**, Strong solutions to the Dirichlet problem for differential forms: A quantum dynamical semigroup approach; **D. E. Evans** and **P. R. Pinto**, Modular invariants and their fusion rules; **R. Floricel**, A decomposition of E_0-semigroups; **R. Gohm**, A duality between extension and dilation; **I. Hirshberg** and **J. Zacharias**, On the structure of spectral algebras and their generalizations; **Y. Katayama** and **M. Takesaki**, Outer actions of a countable discrete amenable group on an AFD factor; **T. Katsura**, A construction of C^*-algebras from C^*-correspondences; **Y. Kawahigashi**, Classification of operator algebraic conformal field theories; **A. Kishimoto**, Rohlin property for flows; **C. Köstler**, Survey on a quantum stochastic extension of Stone's theorem; **D. Markiewicz**, Quantized convolution semigroups; **P. S. Muhly** and **B. Solel**, A model for quantum Markov semigroups; **T. Oikhberg**, **H. P. Rosenthal**, and **E. Størmer**, A predual characterization of semi-finite von Neumann algebras; **S. Sakai**, Pure states on C^*-algebras; **M. Skeide**, Commutants of von Neumann modules, representations of $\mathcal{B}^a(E)$ and other topics related to product systems of Hilbert modules; **R. Speicher**, Non-commutative Brownian motions; **B. Tsirelson**, Non-isomorphic product systems.

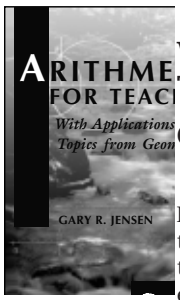
Contemporary Mathematics, Volume 335

December 2003, approximately 336 pages, Softcover, ISBN 0-8218-3215-8, LC 2003059154, 2000 *Mathematics Subject Classification*: 46L55, 46L57, 47D03, 47N50, 46L53, 47A20, 60G20, 60A10, 46L60, 46L35, **All AMS members $63**, List $79, Order code CONM/335N

General and Interdisciplinary

Arithmetic for Teachers

With Applications and Topics from Geometry



Gary R. Jensen, *Washington University, St. Louis, MO*

Excellent teaching of mathematics at the elementary school level requires teachers to be experts in school mathematics. This textbook helps prospective teachers achieve this expertise by presenting topics from the K–6 mathematics curriculum at a greater depth than is found in most classrooms. The knowledge that comes from this approach gives prospective teachers essential insight into how topics interrelate and where the difficulties may lie.

Information is presented at a pace that makes it interesting, rewarding, and enjoyable. With the deeper mathematical preparation inherent in this book, prospective teachers will come away knowing how to explain concepts, demonstrate computational procedures, and lead students through problem-solving techniques. Both students and teachers will

find this book key to learning the necessary material and knowing how to express it at the right level.

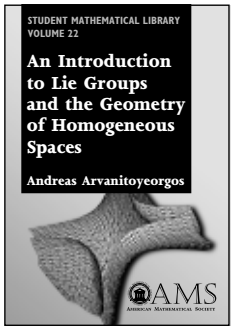
The primary focus is on the foundations of arithmetic, along with a selection of topics from geometry, and a wide range of applications. The number line is used throughout to visualize concepts and to tie them to solutions. The book emphasizes explanations: of concepts, of how to solve problems, and of how the concepts relate to the solutions of the problems.

This is a textbook for a college course in mathematics for prospective elementary school teachers. It will also be an excellent reference source for the instructors of such courses.

Contents: Counting; Whole number arithmetic; Whole number computation; Number theory; Rational numbers; Decimals; Integers; Clock arithmetic; RSA encryption; Bibliography; Index.

December 2003, approximately 392 pages, Hardcover, ISBN 0-8218-3418-5, 2000 *Mathematics Subject Classification*: 97–01, 97B50, 97D50, 00A06, **Individual member $35**, List $59, Institutional member $47, Order code FOAN

Geometry and Topology



An Introduction to Lie Groups and the Geometry of Homogeneous Spaces

Andreas Arvanitoyeorgos, *The American College of Greece, Deree Campus, Athens*

It is remarkable that so much about Lie groups could be packed into this small book. But after reading it, students will be well-prepared to continue with more advanced, graduate-level topics in differential geometry or the theory of Lie groups.

The theory of Lie groups involves many areas of mathematics: algebra, differential geometry, algebraic geometry, analysis, and differential equations. In this book, Arvanitoyeorgos outlines enough of the prerequisites to get the reader started. He then chooses a path through this rich and diverse theory that aims for an understanding of the geometry of Lie groups and homogeneous spaces. In this way, he avoids the extra detail needed for a thorough discussion of representation theory.

Lie groups and homogeneous spaces are especially useful to study in geometry, as they provide excellent examples where quantities (such as curvature) are easier to compute. A good understanding of them provides lasting intuition, especially in differential geometry.

The author provides several examples and computations. Topics discussed include the classification of compact and connected Lie groups, Lie algebras, geometrical aspects of compact Lie groups and reductive homogeneous spaces, and important classes of homogeneous spaces, such as symmetric spaces and flag manifolds. Applications to more advanced topics are also included, such as homogeneous Einstein metrics, Hamiltonian systems, and homogeneous geodesics in homogeneous spaces.

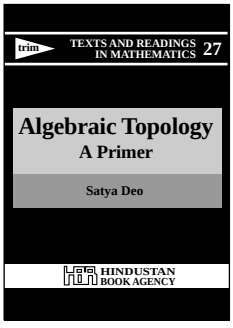
The book is suitable for advanced undergraduates, graduate students, and research mathematicians interested in differential geometry and neighboring fields, such as topology, harmonic analysis, and mathematical physics.

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

Contents: Lie groups; Maximal tori and the classification theorem; The geometry of a compact Lie group; Homogeneous spaces; The geometry of a reductive homogeneous space; Symmetric spaces; Generalized flag manifolds; Advanced topics; Bibliography; Index.

Student Mathematical Library, Volume 22

November 2003, 141 pages, Softcover, ISBN 0-8218-2778-2, 2000 *Mathematics Subject Classification*: 53C30, 53C35, 53C20, 22E15, 17B05, 17B20, 53C25, 53D50, 22E60, **All AMS members $23**, List $29, Order code STML/22N



Algebraic Topology
A Primer

Satya Deo, *Rani Durgawati University, Jabalpur, India*

This is a basic text on algebraic topology designed for a one-year course at the master's or beginning Ph.D. level. Basic concepts are discussed in detail, such as the fundamental group, covering projections, simplicial complexes, and simplicial homology. Singular homology is introduced to give a glimpse of an abstract homology theory in the sense of Elienberg and Steenrod.

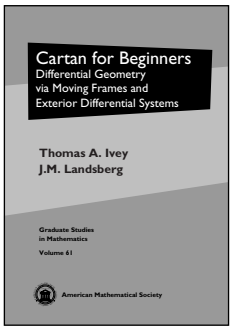
Interesting applications, examples, and exercises are included. An introductory chapter and an appendix covering basic topology and algebra make the book self-contained.

A publication of the Hindustan Book Agency. Distributed exclusively by the American Mathematical Society in North America and worldwide on the AMS Bookstore.

Contents: Basic topology: a review; The fundamental group; Finite simplicial complexes; Simplicial homology; Covering projections; Singular homology; Appendix.

Hindustan Book Agency

July 2003, 373 pages, Hardcover, ISBN 81-85931-44-5, 2000 *Mathematics Subject Classification*: 55–XX; 55Nxx, 55Pxx, 55Qxx, **All AMS members $32**, List $40, Order code HIN/18N



Cartan for Beginners

Differential Geometry via Moving Frames and Exterior Differential Systems

Thomas A. Ivey, *College of Charleston, SC*, and **J.M. Landsberg**, *Georgia Institute of Technology, Atlanta*

This book is an introduction to Cartan's approach to differential geometry. Two central methods in Cartan's geometry are the theory of exterior differential systems and the method of moving frames. This book presents thorough and modern treatments of both subjects, including their applications to both classic and contemporary problems.

It begins with the classical geometry of surfaces and basic Riemannian geometry in the language of moving frames, along with an elementary introduction to exterior differential systems. Key concepts are developed incrementally with motivating examples leading to definitions, theorems, and proofs.

Once the basics of the methods are established, the authors develop applications and advanced topics. One notable application is to complex algebraic geometry, where they expand and update important results from projective differential geometry.

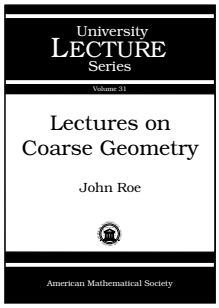
The book features an introduction to G-structures and a treatment of the theory of connections. The Cartan machinery is also applied to obtain explicit solutions of PDEs via Darboux's method, the method of characteristics, and Cartan's method of equivalence.

This text is suitable for a one-year graduate course in differential geometry, and parts of it can be used for a one-semester course. It has numerous exercises and examples throughout. It will also be useful to experts in areas such as PDEs and algebraic geometry who want to learn how moving frames and exterior differential systems apply to their fields.

Contents: Moving frames and exterior differential systems; Euclidean geometry and Riemannian geometry; Projective geometry; Cartan-Kähler I: Linear algebra and constant-coefficient homogeneous systems; Cartan-Kähler II: The Cartan algorithm for linear Pfaffian systems; Applications to PDE; Cartan-Kähler III: The general case; Geometric structures and connections; Linear algebra and representation theory; Differential forms; Complex structures and complex manifolds; Initial value problems; Hints and answers to selected exercises; Bibliography; Index.

Graduate Studies in Mathematics, Volume 61

October 2003, 378 pages, Hardcover, ISBN 0-8218-3375-8, LC 2003059541, 2000 *Mathematics Subject Classification*: 53–01; 58–01, 58A15, 53C10, 35A30, 58J72, 53C29, 58A17, 14M07, 14M10, **All AMS members $47**, List $59, Order code GSM/61N



Lectures on Coarse Geometry

John Roe, *Pennsylvania State University, University Park*

Coarse geometry is the study of spaces (particularly metric spaces) from a "large scale" point of view, so that two spaces that look the same from a great distance are actually equivalent. This point of view is effective because it is often true that the relevant geometric properties of metric spaces are determined by their coarse geometry. Two examples of important uses of coarse geometry are Gromov's beautiful notion of a hyperbolic group and Mostow's proof of his famous rigidity theorem.

The first few chapters of the book provide a general perspective on coarse structures. Even when only metric coarse structures are in view, the abstract framework brings the same simplification as does the passage from epsilons and deltas to open sets when speaking of continuity. The middle section of the book reviews notions of negative curvature and rigidity. Modern interest in large scale geometry derives in large part from Mostow's rigidity theorem and from Gromov's subsequent "large scale" rendition of the crucial properties of negatively curved spaces.

The final chapters discuss recent results on asymptotic dimension and uniform embeddings into Hilbert space.

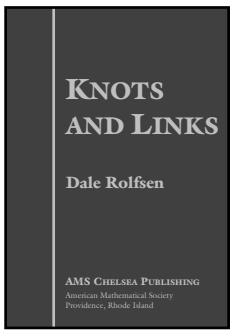
John Roe is known for his work on index theory, coarse geometry, and topology. His exposition is clear and direct, bringing insight to this modern field of mathematics. Students and researchers who wish to learn about contemporary methods of understanding the geometry and topology of manifolds will be well served by reading this book.

Also available from the AMS by John Roe is *Index Theory, Coarse Geometry, and Topology of Manifolds*.

Contents: Metric spaces; Coarse spaces; Growth and amenability; Translation algebras; Coarse algebraic topology; Coarse negative curvature; Limits of metric spaces; Rigidity; Asymptotic dimension; Groupoids and coarse geometry; Coarse embeddability; Bibliography.

University Lecture Series, Volume 31

November 2003, 175 pages, Softcover, ISBN 0-8218-3332-4, LC 2003052385, 2000 *Mathematics Subject Classification*: 20F65, 51K05, 53C24, 46L85, 54E15, **All AMS members $31**, List $39, Order code ULECT/31N



Knots and Links

Dale Rolfsen, *University of British Columbia, Vancouver, Canada*

Rolfsen's beautiful book on knots and links can be read by anyone, from beginner to expert, who wants to learn about knot theory. Beginners find an inviting introduction to the elements of topology, emphasizing the tools needed for understanding knots, the fundamental group and van Kampen's theorem, for example, which are then applied to concrete problems, such as computing knot groups. For experts, Rolfsen explains advanced topics, such as the connections between knot theory and surgery and how they are useful to understanding three-manifolds.

Besides providing a guide to understanding knot theory, the book offers "practical" training. After reading it, you will be able to do many things: compute presentations of knot groups, Alexander polynomials, and other invariants; perform surgery on three-manifolds; and visualize knots and their complements. It is characterized by its hands-on approach and emphasis on a visual, geometric understanding.

Rolfsen offers invaluable insight and strikes a perfect balance between giving technical details and offering informal explanations. The illustrations are superb, and a wealth of examples are included.

Now back in print by the AMS, the book is still a standard reference in knot theory. It is written in a remarkable style that makes it useful for both beginners and researchers. Particularly noteworthy is the table of knots and links at the end. This volume is an excellent introduction to the topic and is suitable as a textbook for a course in knot theory or 3-manifolds.

AMS Chelsea Publishing

November 2003, 439 pages, Hardcover, ISBN 0-8218-3436-3, LC 2003061249, 2000 *Mathematics Subject Classification*: 57–01, 57M25, **All AMS members $50**, List $55, Order code CHEL/346.HN