Knots Links Braids And 3 Manifolds An Introduction To The New Invariants In Low Dimensional Topology Translations Of Mathematical Monographs Translations Of Mathematical Monographs Reprint

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. Other key books of interest on this topic available from the AMS are ""The Shoelace Book: A Mathematical Guide to the Best (and Worst) Ways to Lace your Shoes"" and ""The Knot Book"".

Since discovery of the Jones polynomial, knot theory has enjoyed a virtual explosion of important results and now plays a significant role in modern mathematics. In a unique presentation with contents not found in any other monograph, Knot Theory describes, with full proofs, the main concepts and the latest investigations in the field. The book is divided into six thematic sections. The first part discusses "pre-Vassiliev" knot theory, from knot arithmetics through the Jones polynomial and the famous Kauffman-Murasugi theorem. The second part explores braid theory, including braids in different spaces and simple word recognition algorithms. A section devoted to the Vassiliev knot invariants follows, wherein the author proves that Vassiliev invariants are stronger than all polynomial invariants and introduces Bar-Natan's theory on Lie algebra respresentations and knots. The fourth part describes a new way, proposed by the author, to encode knots by d-diagrams. This method allows the encoding of topological objects by words in a finite alphabet. Part Five delves into virtual knot theory and virtualizations of knot and link invariants. This section includes the author's own important results regarding new invariants of virtual knots. The book concludes with an introduction to knots in 3-manifolds and Legendrian knots and links, including Chekanov's differential graded algebra (DGA) construction. Knot Theory is notable not only for its expert presentation of knot theory's state of the art but also for its accessibility. It is valuable as a professional reference and will serve equally well as a text for a course on knot theory.

The book is the first systematic research completely devoted to a comprehensive study of virtual knots and classical knots as its integral part. The book is self-contained and contains up-to-date exposition of the key aspects of virtual (and classical) knot theory.Virtual knots were discovered by Louis Kauffman in 1996. When virtual knot theory arose, it became clear that classical knot theory was a small integral part of a larger theory, and studying properties of virtual knots helped one understand better some aspects of classical knot theory and encouraged the study of further problems. Virtual knot theory finds its applications in classical knot theory. Virtual knot theory occupies an intermediate position between the theory of knots in arbitrary three-manifold and classical knot theory.In this book we present the latest achievements in virtual knot theory including Khovanov homology theory and parity theory due to V O Manturov and graph-link theory due to both authors. By means of parity, one can construct functorial mappings from knots to knots, filtrations on the space of knots, refine many invariants and prove minimality of many series of knot diagrams.Graph-links can be treated as OC diagramless knot theoryOCO: such OC linksOCO have crossings, but they do not have arcs connecting these crossings. It turns out, however, that to graph-links one can extend many methods of classical and virtual knot theories, in particular, the Khovanov homology and the parity theory.

This book grew out of a graduate course on 3-manifolds and is intended for a mathematically experienced audience that is new to low-dimensional topology. The exposition begins with the definition of a manifold, explores possible additional structures on manifolds, discusses the classification of surfaces, introduces key foundational results for 3-manifolds, and provides an overview of knot theory. It then continues with more specialized topics by briefly considering triangulations of 3-manifolds, normal surface theory, and Heegaard splittings. The book finishes with a discussion of topics relevant to viewing 3-manifolds via the curve complex. With about 250 figures and more than 200 exercises, this book can serve as an excellent overview and starting point for the study of 3-manifolds.

This book is a survey of current topics in the mathematical theory of knots. For a mathematician, a knot is a closed loop in 3-dimensional space: imagine knotting an extension cord and then closing it up by inserting its plug into its outlet. Knot theory is of central importance in pure and applied mathematics, as it stands at a crossroads of topology, combinatorics, algebra, mathematical physics and biochemistry. * Survey of mathematical knot theory * Articles by leading world authorities * Clear exposition, not over-technical * Accessible to readers with undergraduate background in mathematics

This book, written by a mathematician known for his own work on knot theory, is a clear, concise, and engaging introduction to this complicated subject, and a guide to the basic ideas and applications of knot theory. 63 illustrations.

Providing a course of modern topology intended for biologists and physicists, this book presents a class of results in molecular biology for which topological methods and ideas are important. These include: the large-scale conformation

properties of DNA; computational methods; the structure of proteins; and other problems in molecular biology.
This introductory volume provides the basics of surface-knots and related topics, not only for researchers in these areas but also for graduate students and researchers who are not familiar with the field.Knot theory is one of the most active research fields in modern mathematics. Knots and links are closed curves (one-dimensional manifolds) in Euclidean 3-space, and they are related to braids and 3-manifolds. These notions are generalized into higher dimensions. Surface-knots or surface-links are closed surfaces (two-dimensional manifolds) in Euclidean 4-space, which are related to two-dimensional braids and 4-manifolds. Surface-knot theory treats not only closed surfaces but also surfaces with boundaries in 4-manifolds. For example, knot concordance and knot cobordism, which are also important objects in knot theory, are surfaces in the product space of the 3-sphere and the interval.Included in this book are basics of surface-knots and the related topics of classical knots, the motion picture method, surface diagrams, handle surgeries, ribbon surface-knots, spinning construction, knot concordance and 4-genus, quandles and their homology theory, and two-dimensional braids.
Based on a Special Session at the AMS Sectional Meeting in Las Vegas (NV) in April 2001, this volume discusses critical questions and new ideas in the areas of knotting and folding of curves in surfaces in three-dimensional space and applications of these ideas to biology, chemistry, computer science, and engineering. Some of the papers are primarily theoretical; others are experimental. Some are purely mathematical; others deal with applications of mathematics to theoretical computer science, engineering, physics, biology, or chemistry. Connections are made between classical knot theory and the physical world of macromolecules, such as DNA, geometric linkages, rope, and even cooked spaghetti. This book introduces the world of physical knot theory in all its manifestations and points the way for new research. It is suitable for a diverse audience of mathematicians, computer scientists, engineers, biologists, chemists, and physicists.
This is the award-winning monograph of the Sunyer i Balaguer Prize 1999. The book presents recently discovered connections between Artin’s braid groups and left self-distributive systems, which are sets equipped with a binary operation satisfying the identity x(yz) = (xy)(xz). Although not a comprehensive course, the exposition is self-contained, and many basic results are established. In particular, the first chapters include a thorough algebraic study of Artin’s braid groups.
Upon publication, the first edition of the CRC Concise Encyclopedia of Mathematics received overwhelming accolades for its unparalleled scope, readability, and utility. It soon took its place among the top selling books in the history of Chapman & Hall/CRC, and its popularity continues unabated. Yet also unabated has been the d
This book provides an accessible introduction to knot theory, focussing on Vassiliev invariants, quantum knot invariants constructed via representations of quantum groups, and how these two apparently distinct theories come together through the Kontsevich invariant. Consisting of four parts, the book opens with an introduction to the fundamentals of knot theory, and to knot invariants such as the Jones polynomial. The second part introduces quantum invariants of knots, working constructively from first principles towards the construction of Reshetikhin-Turaev invariants and a description of how these arise through Drinfeld and Jimbo's quantum groups. Its third part offers an introduction to Vassiliev invariants, providing a careful account of how chord diagrams and Jacobi diagrams arise in the theory, and the role that Lie algebras play. The final part of the book introduces the Konstevich invariant. This is a universal quantum invariant and a universal Vassiliev invariant, and brings together these two seemingly different families of knot invariants. The book provides a detailed account of the construction of the Jones polynomial via the quantum groups attached to sl(2), the Vassiliev weight system arising from sl(2), and how these invariants come together through the Kontsevich invariant.
Dieser Band beinhaltet eine Sammlung wissenschaftlicher Forschungsbeiträge zu unendlich-dimensionalen Gruppen und Mannigfaltigkeiten in der Mathematik und Quantenphysik.
Contents:Notes on Subfactors and Statistical Mechanics (V F R Jones)Polynomial Invariants in Knot Theory (L H Kauffman)Algebras of Loops on Surfaces, Algebras of Knots, and Quantization (V G Turaev)Quantum Groups (L Faddeev et al.)Introduction to the Yang-Baxter Equation (M Jimbo)Integrable Systems Related to Braid Groups and Yang-Baxter Equation (T Kohno)The Yang-Baxter Relation: A New Tool for Knot Theory (Y Akutsu et al.)Akutsu-Wadati Link Polynomials from Feynman-Kauffman Diagrams (M-L Ge et al.)Quantum Field Theory and the Jones Polynomial (E Witten) Readership: Mathematical physicists.
The present volume is an updated version of the book edited by C N Yang and M L Ge on the topics of braid groups and knot theory, which are related to statistical mechanics. This book is based on the 1989 volume but has new material included and new contributors. Contents:On the Combinatorics of Vassiliev Invariants (J S Birman)Solvable Methods, Link Invariants and Their Applications to Physics (T Deguchi & M Wadati)Quantum Symmetry in Conformal Field Theory by Hamiltonian Methods (L D Faddeev)Yang-Baxterization & Algebraic Structures (M L Ge, K Xue, Y S Wu)Spin Networks, Topology and Discrete Physics (L H Kauffman)Tunnel Numbers of Knots and Jones-Witten Invariants (T Kohno)Knot Invariants and Statistical Mechanics: A Physicist's Perspective (F Y Wu)and other papers Readership: Mathematical physicists. keywords:Braid Group;Knot Theory;Statistical Mechanics “It has been four years since the publication in 1989 of the previous volume bearing the same title as the present one. Enormous amounts of work have been done in the meantime. We hope the present volume will provide a summary of some of these works which are still progressing in several directions.” from the foreword by C N Yang
LinKnot - Knot Theory by Computer provides a unique view of selected topics in knot theory suitable for students, research mathematicians, and readers with backgrounds in other exact sciences, including chemistry, molecular biology and physics. The book covers basic notions in knot theory, as well as new methods for handling open problems such as unknotting number, braid family representatives, invertibility, amphicheirality, undetectability, non-algebraic tangles, polyhedral links, and (2,2)-moves. Conjectures discussed in the book are explained at length. The beauty, universality and diversity of knot theory is illuminated through various non-standard applications: mirror curves, fullerens, self-referential systems, and KL automata.
Topological surgery is a mathematical technique used for creating new manifolds out of known ones. In this book the authors observe that it also occurs in natural phenomena of all scales: 1-dimensional surgery happens during DNA recombination and when cosmic magnetic lines reconnect; 2-dimensional surgery happens during tornado formation and cell mitosis; and they conjecture that 3-dimensional surgery happens during the formation of black holes from cosmic strings, offering an explanation for the existence of a black hole’s singularity. Inspired by such phenomena, the authors present a new topological model that extends the formal definition to a continuous process caused by local forces. Lastly, they describe an intrinsic connection between topological surgery and a chaotic dynamical system exhibiting a “hole drilling” behavior. The authors’ model indicates where to look for the forces causing surgery and what deformations should be observed in the local submanifolds involved. These predictions are significant for the study of phenomena exhibiting surgery and they also open new research directions. This novel study enables readers to gain a better understanding of the topology and dynamics of various natural phenomena, as well as topological surgery itself and serves as a basis for many more insightful observations and new physical implications.
This book provides an extensive and self-contained presentation of quantum and related invariants of knots and 3-manifolds.

Polynomial invariants of knots, such as the Jones and Alexander polynomials, are constructed as quantum invariants, i.e. invariants derived from representations of quantum groups and from the monodromy of solutions to the Knizhnik-Zamolodchikov equation. With the introduction of the Kontsevich invariant and the theory of Vassiliev invariants, the quantum invariants become well-organized. Quantum and perturbative invariants, the LMO invariant, and finite type invariants of 3-manifolds are discussed. The Chern-Simons field theory and the Wess-Zumino-Witten model are described as the physical background of the invariants.
This book studies diverse aspects of braid representations via knots and links. Complete classification results are illustrated for several properties through Xu's normal 3-braid form and the Hecke algebra representation theory of link polynomials developed by Jones. Topological link types are identified within closures of 3-braids which have a given Alexander or Jones polynomial. Further classifications of knots and links arising by the closure of 3-braids are given, and new results about 4-braids are part of the work. Written with knot theorists, topologists,and graduate students in mind, this book features the identification and analysis of effective techniques for diagrammatic examples with unexpected properties.
Vladimir Abramovich Rokhlin (8/23/1919–12/03/1984) was one of the leading Russian mathematicians of the second part of the twentieth century. His main achievements were in algebraic topology, real algebraic geometry, and ergodic theory. The volume contains the proceedings of the Conference on Topology, Geometry, and Dynamics: V. A. Rokhlin-100, held from August 19–23, 2019, at The Euler International Mathematics Institute and the Steklov Institute of Mathematics, St. Petersburg, Russia. The articles deal with topology of manifolds, theory of cobordisms, knot theory, geometry of real algebraic manifolds and dynamical systems and related topics. The book also contains Rokhlin's biography supplemented with copies of actual very interesting documents.
In the fifteen years since the discovery that Artin's braid groups enjoy a left-invariant linear ordering, several quite different approaches have been used to understand this phenomenon. This book is an account of those approaches, which involve such varied objects and domains as combinatorial group theory, self-distributive algebra, finite combinatorics, automata, low-dimensional topology, mapping class groups, and hyperbolic geometry. The remarkable point is that all these approaches lead to the same ordering, making the latter rather canonical. We have attempted to make the ideas in this volume accessible and interesting to students and seasoned professionals alike. Although the text touches upon many different areas, we only assume that the reader has some basic background in group theory and topology, and we include detailed introductions wherever they may be needed, so as to make the book as self-contained as possible. The present volume follows the book, Why are braids orderable?, written by the same authors and published in 2002 by the Societe Mathematique de France. The current text contains a considerable amount of new material, including ideas that were unknown in 2002.In addition, much of the original text has been completely rewritten, with a view to making it more readable and up-to-date.
With hundreds of worked examples, exercises and illustrations, this detailed exposition of the theory of Vassiliev knot invariants opens the field to students with little or no knowledge in this area. It also serves as a guide to more advanced material. The book begins with a basic and informal introduction to knot theory, giving many examples of knot invariants before the class of Vassiliev invariants is introduced. This is followed by a detailed study of the algebras of Jacobi diagrams and 3-graphs, and the construction of functions on these algebras via Lie algebras. The authors then describe two constructions of a universal invariant with values in the algebra of Jacobi diagrams: via iterated integrals and via the Drinfeld associator, and extend the theory to framed knots. Various other topics are then discussed, such as Gauss diagram formulae, before the book ends with Vassiliev's original construction.
This book introduces the study of knots, providing insights into recent applications in DNA research and graph theory. It sets forth fundamental facts such as knot diagrams, braid representations, Seifert surfaces, tangles, and Alexander polynomials. It also covers more recent developments and special topics, such as chord diagrams and covering spaces. The author avoids advanced mathematical terminology and intricate techniques in algebraic topology and group theory. Numerous diagrams and exercises help readers understand and apply the theory. Each chapter includes a supplement with interesting historical and mathematical comments.
Starting in the middle of the 80s, there has been a growing and fruitful interaction between algebraic geometry and certain areas of theoretical high-energy physics, especially the various versions of string theory. Physical heuristics have provided inspiration for new mathematical definitions (such as that of Gromov-Witten invariants) leading in turn to the solution of problems in enumerative geometry. Conversely, the availability of mathematically rigorous definitions and theorems has benefited the physics research by providing the required evidence in fields where experimental testing seems problematic. The aim of this volume, a result of the CIME Summer School held in Cetraro, Italy, in 2005, is to cover part of the most recent and interesting findings in this subject.
There have been exciting developments in the area of knot theory in recent years. They include Thurston's work on geometric structures on 3-manifolds (e.g. knot complements), Gordon?Luecke work on surgeries on knots, Jones' work on invariants of links in S3, and advances in the theory of invariants of 3-manifolds based on Jones- and Vassiliev-type invariants of links. Jones ideas and Thurston's idea are connected by the following path: hyperbolic structures, PSL(2, C) representations, character varieties, quantization of the coordinate ring of the variety to skein modules (i.e. Kauffman, bracket skein module), and finally quantum invariants of 3-manifolds. This proceedings volume covers all those exciting topics.
Algebra, as we know it today, consists of many different ideas, concepts and results. A reasonable estimate of the number of these different items would be somewhere between 50,000 and 200,000. Many of these have been named and many more could (and perhaps should) have a name or a convenient designation. Even the nonspecialist is likely to encounter most of these, either somewhere in the literature, disguised as a definition or a theorem or to hear about them and feel the need for more information. If this happens, one should be able to find enough information in this Handbook to judge if it is worthwhile to pursue the quest. In addition to the primary information given in the Handbook, there are references to relevant articles, books or lecture notes to help the reader. An excellent index has been included which is extensive and not limited to definitions, theorems etc. The Handbook of Algebra will publish articles as they are received and thus the reader will find in this third volume articles from twelve different sections. The advantages of this scheme are two-fold: accepted articles will be published quickly and the outline of the Handbook can be allowed to evolve as the various volumes are published. A particularly important function of the Handbook is to provide professional mathematicians working in an area other than their own with sufficient information on the topic in question if and when it is needed. - Thorough and practical source for information - Provides in-depth coverage of new topics in algebra - Includes references to relevant articles, books and lecture notes

Quantum computing: an overview / M. Nakahara -- Braid group and topological quantum computing / T. Ootsuka, K. Sakuma -- An introduction to entanglement theory / D.J.H. Markham -- Holonomic quantum computing and its optimization / S. Tanimura -- Playing games in quantum mechanical settings: features of quantum games / S?. K. Özdemir, J. Shimamura, N. Imoto -- Quantum error-correcting codes / M. Hagiwara -- Poster summaries. Controled teleportation of an arbitrary unknown two-qubit entangled state / V. Ebrahimi, R. Rahimi, M. Nakahara. Notes on the Dür-Cirac classification / Y. Ota, M. Yoshida, I. Ohba. Bang-bang control of entanglement in Spin-Bus-Boson model / R. Rahimi, A. SaiToh, M. Nakahara. Numerical computation of time-dependent multipartite nonclassical correlation / A. SaiToh [und weitere]. On classical no-cloning theorem under Liouville dynamics and distances / T. Yamano, O. Iguchi

This proceedings volume presents a diverse collection of high-quality, state-of-the-art research and survey articles written by top experts in low-dimensional topology and its applications. The focal topics include the wide range of historical and contemporary invariants of knots and links and related topics such as three- and four-dimensional manifolds, braids, virtual knot theory, quantum invariants, braids, skein modules and knot algebras, link homology, quandles and their homology; hyperbolic knots and geometric structures of three-dimensional manifolds; the mechanism of topological surgery in physical processes, knots in Nature in the sense of physical knots with applications to polymers, DNA enzyme mechanisms, and protein structure and function. The contents is based on contributions presented at the International Conference on Knots, Low-Dimensional Topology and Applications – Knots in Hellas 2016, which was held at the International Olympic Academy in Greece in July 2016. The goal of the international conference was to promote the exchange of methods and ideas across disciplines and generations, from graduate students to senior researchers, and to explore fundamental research problems in the broad fields of knot theory and low-dimensional topology. This book will benefit all researchers who wish to take their research in new directions, to learn about new tools and methods, and to discover relevant and recent literature for future study.

There have been exciting developments in the area of knot theory in recent years. They include Thurston's work on geometric structures on 3-manifolds (e.g. knot complements), Gordon–Luecke work on surgeries on knots, Jones' work on invariants of links in S3, and advances in the theory of invariants of 3-manifolds based on Jones- and Vassiliev-type invariants of links. Jones ideas and Thurston's idea are connected by the following path: hyperbolic structures, PSL(2, C) representations, character varieties, quantization of the coordinate ring of the variety to skein modules (i.e. Kauffman, bracket skein module), and finally quantum invariants of 3-manifolds. This proceedings volume covers all those exciting topics.

Mathematics has been behind many of humanity's most significant advances in fields as varied as genome sequencing, medical science, space exploration, and computer technology. But those breakthroughs were yesterday. Where will mathematicians lead us tomorrow and can we help shape that destiny? This book assembles carefully selected articles highlighting and explaining cutting-edge research and scholarship in mathematics with an emphasis on three manifolds.

A richly illustrated 2004 textbook on knot theory; minimal prerequisites but modern in style and content.

After an introduction to matrix models and Cherns-Simons gauge theory, this book describes in detail the topological string theories that correspond to these gauge theories and develops the mathematical implication of this duality for the enumerative geometry of Calabi-Yau manifolds and knot theory.

Knots are familiar objects. We use them to moor our boats, to wrap our packages, to tie our shoes. Yet the mathematical theory of knots quickly leads to deep results in topology and geometry. The Knot Book is an introduction to this rich theory, starting from our familiar understanding of knots and a bit of college algebra and finishing with exciting topics of current research. The Knot Book is also about the excitement of doing mathematics. Colin Adams engages the reader with fascinating examples, superb figures, and thought-provoking ideas. He also presents the remarkable applications of knot theory to modern chemistry, biology, and physics. This is a compelling book that will comfortably escort you into the marvelous world of knot theory. Whether you are a mathematics student, someone working in a related field, or an amateur mathematician, you will find much of interest in The Knot Book.

Braid theory and knot theory are related via two famous results due to Alexander and Markov. Alexander's theorem states that any knot or link can be put into braid form. Markov's theorem gives necessary and sufficient conditions to conclude that two braids represent the same knot or link. Thus, one can use braid theory to study knot theory and vice versa. In this book, the author generalizes braid theory to dimension four. He develops the theory of surface braids and applies it to study surface links. In particular, the generalized Alexander and Markov theorems in dimension four are given. This book is the first to contain a complete proof of the generalized Markov theorem. Surface links are studied via the motion picture method, and some important techniques of this method are studied.For surface braids, various methods to describe them are introduced and developed: the motion picture method, the chart description, the braid monodromy, and the braid system. These tools are fundamental to understanding and computing invariants of surface braids and surface links. Included is a table of knotted surfaces with a computation of Alexander polynomials. Braid techniques are extended to represent link homotopy classes. The book is geared toward a wide audience, from graduate students to specialists. It would make a suitable text for a graduate course and a valuable resource for researchers.

This book gives an exposition of the relations among the following three topics: monoidal tensor categories (such as a category of representations of a quantum group), 3-dimensional topological quantum field theory, and 2-dimensional modular functors (which naturally arise in 2-dimensional conformal field theory). The following examples are discussed in detail: the category of representations of a quantum group at a root of unity and the Wess-Zumino-Witten modular functor. The idea that these topics are related first appeared in the physics literature in the study of quantum field theory. Pioneering works of Witten and Moore-Seiberg triggered an avalanche of papers, both physical and mathematical, exploring various aspects of these relations. Upon preparing to lecture on the topic at MIT, however, the authors discovered that the existing literature was difficult and that there were gaps to fill. The text is wholly expository and finely succinct. It gathers results, fills existing gaps, and simplifies some proofs. The book makes an important addition to the existing literature on the topic. It would be suitable as a course text at the advanced-graduate level.

This book is an introduction to the remarkable work of Vaughan Jones and Victor Vassiliev on knot and link invariants and its recent modifications and generalizations, including a mathematical treatment of Jones-Witten invariants. It emphasizes the geometric aspects of the theory and treats topics such as braids, homeomorphisms of surfaces, surgery of 3-manifolds (Kirby calculus), and branched coverings. This attractive geometric material, interesting in itself yet not previously gathered in book form, constitutes the basis of the last two chapters, where the Jones-Witten invariants are constructed via the rigorous skein algebra approach (mainly due to the Saint Petersburg school). Unlike several recent monographs, where all of these invariants are introduced by using the sophisticated abstract algebra of quantum groups and representation theory, the mathematical prerequisites are minimal in this book. Numerous figures and problems make it suitable as a course text and for self-study.

Knot theory is a rapidly developing field of research with many applications, not only for mathematics. The present volume, written by a well-known specialist, gives a complete survey of this theory from its very beginnings to today's most recent research results. An indispensable book for everyone concerned with knot theory.

Gauss diagram invariants are isotopy invariants of oriented knots in- manifolds which are the product of a (not necessarily orientable) surface with an oriented line. The invariants are defined in a combinatorial way using knot diagrams, and they take values in free abelian groups generated by the first homology group of the surface or by the set of free homotopy classes of loops in the surface. There are three main results: 1. The construction of invariants of finite type for arbitrary knots in non orientable 3-manifolds. These invariants can distinguish homotopic knots with homeomorphic complements. 2. Specific invariants of degree 3 for knots in the solid torus. These invariants cannot be generalized for knots in handlebodies of higher genus, in contrast to invariants coming from the theory of skein modules. 2 3. We introduce a special class of knots called global knots, in F x lR and we construct new isotopy invariants, called T-invariants, for global knots. Some T-invariants (but not all !) are of finite type but they cannot be extracted from the generalized Kontsevich integral, which is consequently not the universal invariant of finite type for the restricted class of global knots. We prove that T-invariants separate all global knots of a certain type. 3 As a corollary we prove that certain links in 5 are not invertible without making any use of the link group! Introduction and announcement This work is an introduction into the world of Gauss diagram invariants.