The Classical Groups Their Invariants And Representations Princeton Landmarks In Mathematics And Physics

Asymptotic Differential Algebra and Model Theory of TransseriesSemi-Simple Lie Algebras and Their RepresentationsApplications of Tensor Functions in Solid MechanicsRepresentation Theory, Number Theory, and Invariant TheoryEncyclopaedia of MathematicsBlocks of Finite Groups and Their InvariantsThe Classical Groups and K-TheoryAlgebraic TheoriesOn the Automorphisms of the Classical GroupsThe Classical GroupsThe Mathematical Heritage of Hermann WeylThe Development of MathematicsClifford Algebras and the Classical GroupsThe Classical GroupsPolynomial Invariants of Finite GroupsThe Invariant Theory of MatricesGroup TheoryLie Groups, Lie Algebras, and RepresentationsClassical Invariant TheoryThe Classical GroupsQuantum Invariants of Knots and 3-ManifoldsLie Groups, Lie Algebras, and Some of Their ApplicationsSymmetry, Representations, and InvariantsThe Book of InvolutionsLie GroupsSelected Papers on Harmonic Analysis, Groups, and InvariantsLie Groups, Physics, and GeometrySymmetry, Representations, and InvariantsThe p-adic Simpson Correspondence (AM-193)Algebraic Theory of NumbersEquivalence, Invariants and SymmetryThe Classical GroupsScalar, Vector, and Matrix MathematicsThe Classical GroupsLie GroupsModular Invariant TheoryAn Introduction to Invariants and ModuliOffice Hours with a Geometric Group TheoristClassical Groups for PhysicistsRepresentations and Invariants of the Classical Groups

Asymptotic Differential Algebra and Model Theory of Transseries

Presents an updated version of Weyl's invariant theory of the classical groups, together with many of the important recent developments.

Semi-Simple Lie Algebras and Their Representations

The book is a self-contained introduction to the results and methods in classical invariant theory.

Applications of Tensor Functions in Solid Mechanics

Providing a nearly complete selection of up-to-date methods and results on block invariants with respect to their defect groups, this book covers the classical theory pioneered by Brauer, the modern theory of fusion systems introduced by Puig, the geometry of numbers developed by Minkowski, the classification of finite simple groups, and various computer assisted methods. In a powerful combination, these tools are applied to solve many special cases of famous open conjectures in the representation theory of finite groups. Most of the material is drawn from peer-reviewed journal articles, but there are also new previously unpublished results. In order to make the text self-contained, detailed proofs are given whenever possible. Several tables add to the text's usefulness as a reference. The book is aimed at experts in group theory or representation theory who may wish to make use of the presented ideas in their research.

Representation Theory, Number Theory, and Invariant Theory

Describing many of the most important aspects of Lie group theory, this book presents the subject in a 'hands on' way. Rather than concentrating on theorems and proofs, the book shows the applications of the material to physical sciences and applied mathematics. Many examples of Lie groups and Lie algebras are given throughout the text. The relation between Lie group theory and algorithms for solving ordinary differential equations is presented and shown to be analogous to the relation between Galois groups and algorithms for solving polynomial equations. Other chapters are devoted to differential geometry, relativity, electrodynamics, and the hydrogen atom. Problems are given at the end of each chapter so readers can monitor their understanding of the materials. This is a fascinating introduction to Lie groups for graduate and undergraduate students in physics, mathematics and electrical engineering, as well as researchers in these fields.

Encyclopaedia of Mathematics

Hermann Weyl was one of the most influential mathematicians of the twentieth century. Viewing mathematics as an organic whole rather than a collection of separate subjects, Weyl made profound contributions to a wide range of areas, including analysis, geometry, number theory, Lie groups, and mathematical physics, as well as the philosophy of science and of mathematics. The topics he chose to study, the lines of thought he initiated, and his general perspective on mathematics have proved remarkably fruitful and have formed the basis for some of the best of modern mathematical research. This volume contains the proceedings of the AMS Symposium on the Mathematical Heritage of Hermann Weyl, held in May 1987 at Duke University. In addition to honoring Weyl's great accomplishments in mathematics, the symposium also sought to stimulate the younger generation of mathematicians by highlighting the cohesive nature of modern mathematics as seen from Weyl's ideas. The symposium assembled a brilliant array of speakers and covered a wide range of topics. All of the papers are expository and will appeal to a broad audience of mathematicians, theoretical physicists, and other scientists.

Blocks of Finite Groups and Their Invariants

The p-adic Simpson correspondence, recently initiated by Gerd Faltings, aims at describing all p-adic representations of the fundamental group of a proper smooth variety over a p-adic field in terms of linear algebra—namely Higgs bundles. This book undertakes a systematic development of the theory following two new approaches, one by Ahmed Abbes and Michel Gros, the other by Takeshi Tsuji. The authors mainly focus on generalized representations of the fundamental group that are p-adically close to the trivial representation. The first approach relies on a new family of period rings built from the torsor of deformations of the variety over a universal p-adic thickening defined by J. M. Fontaine. The second approach introduces a crystalline-type topos and replaces the notion of Higgs bundles with that of Higgs isocrystals. The authors show the compatibility of the two constructions and the compatibility of the correspondence with the natural cohomologies. The last part of the volume contains results of wider interest in p-adic Hodge theory. The reader will find a concise introduction to Faltings' theory of almost étale extensions and a chapter devoted to the Faltings topos. Though this topos is the general framework for Faltings' approach in p-adic Hodge theory, it remains relatively unexplored. The authors present a new approach based on a generalization of P. Deligne's covanishing topos.

The Classical Groups and K-Theory

Algebraic Theories

This book contains selected papers based on talks given at the "Representation Theory, Number Theory, and Invariant Theory" conference held at Yale University from June 1 to June 5, 2015. The meeting and this resulting volume are in honor of Professor Roger Howe, on the occasion of his 70th birthday, whose work and insights have been deeply influential in the development of these fields. The speakers who contributed to this work include Roger Howe's doctoral students, Roger Howe himself, and other world renowned mathematicians. Topics covered include automorphic forms, invariant theory, representation theory of reductive groups over local fields, and related subjects.

On the Automorphisms of the Classical Groups

Heavy use is made of techniques from commutative algebra in this account of invariant theory for the action of a finite group on the ring of polynomial functions on a linear representation, both in characteristic zero and characteristic p, a topic of great interest in abstract algebra.

The Classical Groups

Symmetry is a key ingredient in many mathematical, physical, and biological theories. Using representation theory and invariant theory to analyze the symmetries that arise from group actions, and with strong emphasis on the geometry and basic theory of Lie groups and Lie algebras, Symmetry, Representations, and Invariants is a significant reworking of an earlier highly-acclaimed work by the authors. The result is a comprehensive introduction to Lie theory, representation theory, invariant theory, and algebraic groups, in a new presentation that is more accessible to students and includes a broader range of applications. The philosophy of the earlier book is retained, i.e., presenting the principal theorems of representation theory for the classical matrix groups as motivation for the general theory of reductive groups. The wealth of examples and discussion prepares the reader for the complete arguments now given in the general case. Key Features of Symmetry, Representations, and Invariants: (1) Early chapters suitable for honors undergraduate or beginning graduate courses, requiring only linear algebra, basic abstract algebra, and advanced calculus; (2)

Applications to geometry (curvature tensors), topology (Jones polynomial via symmetry), and combinatorics (symmetric group and Young tableaux); (3) Self-contained chapters, appendices, comprehensive bibliography; (4) More than 350 exercises (most with detailed hints for solutions) further explore main concepts; (5) Serves as an excellent main text for a one-year course in Lie group theory; (6) Benefits physicists as well as mathematicians as a reference work.

The Mathematical Heritage of Hermann Weyl

Time-honored study by a prominent scholar of mathematics traces decisive epochs from the evolution of mathematical ideas in ancient Egypt and Babylonia to major breakthroughs in the 19th and 20th centuries. 1945 edition.

The Development of Mathematics

This book gives a unified, complete, and self-contained exposition of the main algebraic theorems of invariant theory for matrices in a characteristic free approach. More precisely, it contains the description of polynomial functions in several variables on the set of matrices with coefficients in an infinite field or even the ring of integers, invariant under simultaneous conjugation. Following Hermann Weyl's classical approach, the ring of invariants is described by formulating and proving (1) the first fundamental theorem that describes a set of generators in the ring of invariants, and (2) the second fundamental theorem that describes relations between these generators. The authors study both the case of matrices over a field of characteristic 0 and the case of matrices over a field of positive characteristic. While the case of characteristic 0 can be treated following a classical approach, the case of positive characteristic (developed by Donkin and Zubkov) is much harder. A presentation of this case requires the development of a collection of tools. These tools and their application to the study of invariants are exlained in an elementary, self-contained way in the book.

Clifford Algebras and the Classical Groups

This monograph is an exposition of the theory of central simple algebras with involution, in relation to linear algebraic groups. It provides the algebra-theoretic foundations for much of the recent work on linear algebraic groups over arbitrary fields. Involutions are viewed as twisted forms of (hermitian) quadrics, leading to new developments on the model of the algebraic theory of quadratic forms. In addition to classical groups, phenomena related to triality are also discussed, as well as groups of type F_4 or G_2 arising from exceptional Jordan or composition algebras. Several results and notions appear here for the first time, notably the discriminant algebra of an algebra with unitary involution and the algebra-theoretic counterpart to linear groups of type D_4. This volume also contains a Bibliography and Index. Features: original material not in print elsewhere a comprehensive discussion of algebra-theoretic and group-theoretic aspects extensive notes that give historical perspective and a survey on the literature rational methods that allow possible generalization to more general base rings

The Classical Groups

Sample Text

Polynomial Invariants of Finite Groups

The Invariant Theory of Matrices

Group Theory

DIVThis in-depth introduction to classical topics in higher algebra provides rigorous, detailed proofs for its explorations of some of mathematics' most significant concepts, including matrices, invariants, and groups. 1926 edition. /div

Lie Groups, Lie Algebras, and Representations

Designed to acquaint students of particle physics already familiar with SU(2) and SU(3) with techniques applicable to all simple Lie algebras, this text is especially suited to the study of grand unification theories. 1984 edition.

Classical Invariant Theory

The Classical Groups

Due to the strong appeal and wide use of this monograph, it is now available in its third revised edition. The monograph gives a systematic treatment of 3-dimensional topological quantum field theories (TQFTs) based on the work of the author with N. Reshetikhin and O. Viro. This subject was inspired by the discovery of the Jones polynomial of knots and the Witten-Chern-Simons field theory. On the algebraic side, the study of 3-dimensional TQFTs has been influenced by the theory of braided categories and the theory of quantum groups. The book is divided into three parts. Part I presents a construction of 3-dimensional TQFTs and 2-dimensional modular functors from so-called modular categories. This gives a vast class of knot invariants and 3-manifold invariants as well as a class of linear representations of the mapping class groups of surfaces. In Part II the technique of 6j-symbols is used to define state sum invariants of 3-manifolds. Their relation to the TQFTs constructed in Part I is established via the theory of shadows. Part III provides constructions of modular categories, based on quantum groups and skein modules of tangles in the 3-space. This fundamental contribution to topological quantum field theory is accessible to graduate students in mathematics and physics with knowledge of basic algebra and topology. It is an indispensable source for everyone who wishes to enter the forefront of this fascinating area at the borderline of mathematics and physics. Contents: Invariants of graphs in Euclidean 3-space and of closed 3-manifolds Foundations of topological quantum field theory Three-dimensional topological quantum field theory Two-dimensional modular functors 6j-symbols Simplicial state sums on 3-manifolds Shadows of manifolds and state sums on shadows Constructions of modular categories

Quantum Invariants of Knots and 3-Manifolds

Lie Groups, Lie Algebras, and Some of Their Applications

This book presents an innovative synthesis of methods used to study the problems of equivalence and symmetry that arise in a variety of mathematical fields and physical applications. It draws on a wide range of disciplines, including geometry, analysis, applied mathematics, and algebra. Dr. Olver develops systematic and constructive methods for solving equivalence problems and calculating symmetries, and applies them to a variety of mathematical systems, including differential equations, variational problems, manifolds, Riemannian metrics, polynomials, and differential operators. He emphasizes the construction and classification of invariants and reductions of complicated objects to simple canonical forms. This book will be a valuable resource for students and researchers in geometry, analysis, algebra, mathematical physics and related fields.

Symmetry, Representations, and Invariants

This book addresses Lie groups, Lie algebras, and representation theory. The author restricts attention to matrix Lie groups and Lie algebras. This approach keeps the discussion concrete, allows the reader to get to the heart of the subject quickly, and covers all of the most interesting examples.From the reviews:"Sure to become a standard textbook for graduate students in mathematics and physics with little or no prior exposure to Lie theory." --L'Enseignement Mathematique

The Book of Involutions

Symmetry is a key ingredient in many mathematical, physical, and biological theories. Using representation theory and invariant theory to analyze the symmetries that arise from group actions, and with strong emphasis on the geometry and basic theory of Lie groups and Lie algebras, Symmetry, Representations, and Invariants is a significant reworking of an earlier highly-acclaimed work by the authors. The result is a comprehensive introduction to Lie theory, representation theory, invariant theory, and algebraic groups, in a new presentation that is more accessible to students and includes a broader range of applications. The philosophy of the earlier book is retained, i.e., presenting the principal theorems of representation theory for the classical matrix groups as motivation for the general theory of reductive groups. The wealth of examples and discussion prepares the reader for the complete arguments now given in the general case. Key Features of Symmetry, Representations, and Invariants: (1) Early chapters suitable for honors undergraduate or beginning graduate courses, requiring only linear algebra, basic abstract algebra, and advanced calculus; (2) Applications to geometry (curvature tensors), topology (Jones polynomial via symmetry), and combinatorics (symmetric group and Young tableaux); (3) Self-contained chapters, appendices, comprehensive bibliography; (4) More than 350 exercises (most with detailed hints for solutions) further explore main concepts; (5)

Serves as an excellent main text for a one-year course in Lie group theory; (6) Benefits physicists as well as mathematicians as a reference work.

Lie Groups

Selected Papers on Harmonic Analysis, Groups, and Invariants

Asymptotic differential algebra seeks to understand the solutions of differential equations and their asymptotics from an algebraic point of view. The differential field of transseries plays a central role in the subject. Besides powers of the variable, these series may contain exponential and logarithmic terms. Over the last thirty years, transseries emerged variously as super-exact asymptotic expansions of return maps of analytic vector fields, in connection with Tarski's problem on the field of reals with exponentiation, and in mathematical physics. Their formal nature also makes them suitable for machine computations in computer algebra systems. This self-contained book validates the intuition that the differential field of transseries is a universal domain for asymptotic differential algebra. It does so by establishing in the realm of transseries a complete elimination theory for systems of algebraic differential equations with asymptotic side conditions. Beginning with background chapters on valuations and differential algebra, the book goes on to develop the basic theory of valued differential fields, including a notion of differential-henselianity. Next, H-fields are singled out among ordered valued differential fields to provide an algebraic setting for the common properties of Hardy fields and the differential field of transseries. The study of their extensions culminates in an analogue of the algebraic closure of a field: the Newton-Liouville closure of an H-field. This paves the way to a quantifier elimination with interesting consequences.

Lie Groups, Physics, and Geometry

This volume contains papers that originally appeared in Japanese in the journal ""Sugaku"". Ordinarily the papers would appear in the AMS translation of that journal, but to expedite publication the Society has chosen to publish them as a volume of selected papers. The papers range over a variety of topics, including representation theory, differential geometry, invariant theory, and complex analysis.

Symmetry, Representations, and Invariants

This book covers the modular invariant theory of finite groups, the case when the characteristic of the field divides the order of the group, a theory that is more complicated than the study of the classical non-modular case. Largely self-contained, the book develops the theory from its origins up to modern results. It explores many examples, illustrating the theory and its contrast with the better understood non-modular setting. It details techniques for the computation of invariants for many modular representations of finite groups, especially the case of the cyclic group of prime order. It includes detailed examples of many topics as well as a quick survey of the elements of algebraic geometry and commutative algebra as they apply to invariant theory. The book is aimed at both graduate students and researchers—an introduction to many important topics in modern algebra within a concrete setting for the former, an exploration of a fascinating subfield of algebraic geometry for the latter.

The p-adic Simpson Correspondence (AM-193)

Algebraic Theory of Numbers

This new in paperback edition provides a clear introduction to the theory of Lie groups and their representations for advanced undergraduates and graduate students in mathematics. Starting from basic undergraduate level mathematics, the text proceeds through the fundamentals of Lie theory up to topics in representation theory.

Equivalence, Invariants and Symmetry

It is a great satisfaction for a mathematician to witness the growth and expansion of a theory in which he has taken some part during its early years. When H. Weyl coined the words "classical groups", foremost in his mind were their connections with invariant theory, which his famous book helped to revive. Although his approach in that book was deliberately algebraic, his interest in these groups directly derived from his pioneering study of the special case in which the scalars are real or complex numbers, where for the first time he injected Topology into Lie theory. But ever since the definition of Lie groups, the analogy between simple classical groups over finite fields and simple classical groups over IR or C had been observed, even if the concept of "simplicity" was not quite the same in both cases. With the discovery of the exceptional simple complex Lie algebras by Killing and E. Cartan, it was natural to look for corresponding groups over finite fields, and already around 1900 this was done by Dickson for the exceptional Lie algebras G and E • However, a deep reason for this 2 6 parallelism was missing, and it is only Chevalley who, in 1955 and 1961, discovered that to each complex simple Lie algebra corresponds, by a uniform process, a group scheme (fj over the ring Z of integers, from which, for any field K, could be derived a group (fj(K).

The Classical Groups

Central to the work is the classification of the conjugation and reversion anti-involutions that arise naturally in the theory. It is of interest that all the classical groups play essential roles in this classification. Other features include detailed sections on conformal groups, the eight-dimensional non-associative Cayley algebra, its automorphism group, the exceptional Lie group G[subscript 2], and the triality automorphism of Spin 8.

Scalar, Vector, and Matrix Mathematics

This work explores the fundamental concepts in arithmetic. It begins with the definitions and properties of algebraic fields. The theory of divisibility is then discussed. There follows an introduction to p-adic numbers and then culminates with an extensive examination of algebraic number fields.

The Classical Groups

In this renowned volume, Hermann Weyl discusses the symmetric, full linear, orthogonal, and symplectic groups and determines their different invariants and representations. Using basic concepts from algebra, he examines the various properties of the groups. Analysis and topology are used wherever appropriate. The book also covers topics such as matrix algebras, semigroups, commutators, and spinors, which are of great importance in understanding the group-theoretic structure of quantum mechanics. Hermann Weyl was among the greatest mathematicians of the twentieth century. He made fundamental contributions to most branches of mathematics, but he is best remembered as one of the major developers of group theory, a powerful formal method for analyzing abstract and physical systems in which symmetry is present. In The Classical Groups, his most important book, Weyl provided a detailed introduction to the development of group theory, and he did it in a way that motivated and entertained his readers. Departing from most theoretical mathematics books of the time, he introduced historical events and people as well as theorems and proofs. One learned not only about the theory of invariants but also when and where they were originated, and by whom. He once said of his writing, "My work always tried to unite the truth with the beautiful, but when I had to choose one or the other, I usually chose the beautiful." Weyl believed in the overall unity of mathematics and that it should be integrated into other fields. He had serious interest in modern physics, especially quantum mechanics, a field to which The Classical Groups has proved important, as it has to quantum chemistry and other fields. Among the five books Weyl published with Princeton, Algebraic Theory of Numbers inaugurated the Annals of Mathematics Studies book series, a crucial and enduring foundation of Princeton's mathematics list and the most distinguished book series in mathematics.

Lie Groups

Lie groups has been an increasing area of focus and rich research since the middle of the 20th century. In Lie Groups: An Approach through Invariants and Representations, the author's masterful approach gives the reader a comprehensive treatment of the classical Lie groups along with an extensive introduction to a wide range of topics associated with Lie groups: symmetric functions, theory of algebraic forms, Lie algebras, tensor algebra and symmetry, semisimple Lie algebras, algebraic groups, group representations, invariants, Hilbert theory, and binary forms with fields ranging from pure algebra to functional analysis. By covering sufficient background material, the book is made accessible to a reader with a relatively modest mathematical background. Historical information, examples, exercises are all woven into the text. This unique exposition is suitable for a broad audience, including advanced undergraduates, graduates, mathematicians in a variety of areas from pure algebra to functional analysis and mathematical physics.

Modular Invariant Theory

This text introduces upper-level undergraduates to Lie group theory and physical applications. It further illustrates Lie group theory's role in several fields of physics. 1974 edition. Includes 75 figures and 17 tables, exercises and problems.

An Introduction to Invariants and Moduli

The essential reference book on matrices—now fully updated and expanded, with new material on scalar and vector mathematics Since its initial publication, this book has become the essential reference for users of matrices in all branches of engineering, science, and applied mathematics. In this revised and expanded edition, Dennis Bernstein combines extensive material on scalar and vector mathematics with the latest results in matrix theory to make this the most comprehensive, current, and easy-to-use book on the subject. Each chapter describes relevant theoretical background followed by specialized results. Hundreds of identities, inequalities, and facts are stated clearly and rigorously, with cross-references, citations to the literature, and helpful comments. Beginning with preliminaries on sets, logic, relations, and functions, this unique compendium covers all the major topics in matrix theory, such as transformations and decompositions, polynomial matrices, generalized inverses, and norms. Additional topics include graphs, groups, convex functions, polynomials, and linear systems. The book also features a wealth of new material on scalar inequalities, geometry, combinatorics, series, integrals, and more. Now more comprehensive than ever, Scalar, Vector, and Matrix Mathematics includes a detailed list of symbols, a summary of notation and conventions, an extensive bibliography and author index with page references, and an exhaustive subject index. Fully updated and expanded with new material on scalar and vector mathematics Covers the latest results in matrix theory Provides a list of symbols and a summary of conventions for easy and precise use Includes an extensive bibliography with back-referencing plus an author index

Office Hours with a Geometric Group Theorist

If classical Lie groups preserve bilinear vector norms, what Lie groups preserve trilinear, quadrilinear, and higher order invariants? Answering this question from a fresh and original perspective, Predrag Cvitanovic takes the reader on the amazing, four-thousand-diagram journey through the theory of Lie groups. This book is the first to systematically develop, explain, and apply diagrammatic projection operators to construct all semi-simple Lie algebras, both classical and exceptional. The invariant tensors are presented in a somewhat unconventional, but in recent years widely used, "birdtracks" notation inspired by the Feynman diagrams of quantum field theory. Notably, invariant tensor diagrams replace algebraic reasoning in carrying out all group-theoretic computations. The diagrammatic approach is particularly effective in evaluating complicated coefficients and group weights, and revealing symmetries hidden by conventional algebraic or index notations. The book covers most topics needed in applications from this new perspective: permutations, Young projection operators, spinorial representations, Casimir operators, and Dynkin indices. Beyond this well-traveled territory, more exotic vistas open up, such as "negative dimensional" relations between various groups and their representations. The most intriguing result of classifying primitive invariants is the emergence of all exceptional Lie groups in a single family, and the attendant pattern of exceptional and classical Lie groups, the so-called Magic Triangle. Written in a lively and personable style, the book is aimed at researchers and graduate students in theoretical physics and mathematics.

Classical Groups for Physicists

Representations and Invariants of the Classical Groups

Geometric group theory is the study of the interplay between groups and the spaces they act on, and has its roots in the works of Henri Poincaré, Felix Klein, J.H.C. Whitehead, and Max Dehn. Office Hours with a Geometric Group Theorist brings together leading experts who provide one-on-one instruction on key topics in this exciting and relatively new field of mathematics. It's like having office hours with your most trusted math professors. An essential primer for undergraduates making the leap to graduate work, the book begins with free groups—actions of free groups on trees, algorithmic questions about free groups, the ping-pong lemma, and automorphisms of free groups. It goes on to cover several large-scale geometric invariants of groups, including quasi-isometry groups, Dehn functions, Gromov hyperbolicity, and asymptotic dimension. It also delves into important examples of groups, such as Coxeter groups, Thompson's groups, right-angled Artin groups, lamplighter groups, mapping class groups, and braid groups. The tone is conversational throughout, and the instruction is driven by examples. Accessible to students who have taken a first course in abstract algebra, Office Hours with a Geometric Group Theorist also features numerous exercises and in-depth projects designed to engage readers and provide jumping-off points for research projects.