Chapter 6 Groups And Representations In Quantum Mechanics

A further introduction to modern developments in the representation theory of finite groups and associative algebras.

This volume is divided into three parts. Part I provides the foundations of the theory of modular representations. Special attention is drawn to the Brauer-Swan theory and the theory of Brauer characters. A detailed investigation of quadratic, symplectic and symmetric modules is also provided. Part II is devoted entirely to the Green theory: vertices and sources, the Green correspondence, the Green ring, etc. In Part III, permutation modules are investigated with an emphasis on the study of p-permutation modules and Burnside rings. The material is developed with sufficient attention to detail so that it can easily be read by the novice, although its chief appeal will be to specialists. A number of the results presented in this volume have almost certainly never been published before.

This book is essentially self-contained and requires only a basic abstract algebra course as background. The book includes and extends much of the classical theory of $SL(2)$ representations of groups. Readers will find $SL(2)$Representations of Finitely Presented Groups relevant to geometric theory of three dimensional manifolds, representations of infinite groups, and invariant theory. It features: a new finitely computable invariant $H[\pi]$ associated to groups and used to study the $SL(2)$ representations of π; and, invariant theory and knot theory related through $SL(2)$ representations of knot groups.

This book is suitable for use in any graduate course on analytical methods and their application to representation theory. Each concept is developed with special emphasis on lucidity and clarity. The book also shows the direct link of Cauchy-Pochhammer theory with the Hadamard-Reisz-Schwartz-Gel'fand et al. regularization. The flaw in earlier works on the Plancheral formula for the universal covering group of SL(2,R) is pointed out and rectified. This topic appears here for the first time in the correct form.Existing treatises are essentially magnum opus of the experts, intended for other experts in the field. This book, on the other hand, is unique insofar as every chapter deals with topics in a way that differs remarkably from traditional treatment. For example, Chapter 3 presents the Cauchy-Pochhammer theory of gamma, beta and zeta function in a form which has not been presented so far in any treatise of classical analysis.

Algebra and Arithmetic

Elements of the Representation Theory of the Jacobi Group

Volume 3: Classical and Quantum Groups and Special Functions

An Introduction to Groups, Groupoids and Their Representations

Representation Theory of Solvable Lie Groups and Related Topics

Groups, Representations and Physics

This book is intended to present group representation theory at a level accessible to mature undergraduate students and beginning graduate students. This is achieved by mainly keeping the required background to the level of undergraduate linear algebra, group theory and very basic ring theory. Module theory and Wedderburn theory, as well as tensor products, are deliberately avoided. Instead, we take an approach based on discrete Fourier Analysis. Applications to the spectral theory of graphs are given to help the student appreciate the usefulness of the subject. A number of exercises are included. This book is intended for a 3rd/4th undergraduate course or an introductory graduate course on group representation theory. However, it can also be used as a reference for workers in all areas of mathematics and statistics.

This book is devoted to the theory of group representations and is intended for a broad audience of researchers and graduate students.

This is an elementary introduction to the representation theory of real and complex matrix groups. The text is written for students in mathematics and physics who have a good knowledge of differential/integral calculus and linear algebra and are familiar with basic facts from algebra, number theory and complex analysis. The goal is to present the fundamental concepts of representation theory, to describe the connection between them, and to explain some of their background. The focus is on groups which are of particular interest for applications in physics and number theory (e.g. Gell-Mann's eightfold way and theta functions, automorphic forms). The reader finds a large variety of examples which are presented in detail and from different points of view.

This book explains the group representation theory for quantum theory in the language of quantum theory. As is well known, group representation theory is very strong tool for quantum theory, in particular, angular momentum, hydrogen-type Hamiltonian, spin-orbit interaction, quark model, quantum optics, and quantum information processing including quantum error correction. To describe a big picture of application of representation theory to quantum theory, the book needs to contain the following six topics, permutation group, SU(2) and SU(d), Heisenberg representation, squeezing operation, Discrete Heisenberg representation, and the relation with Fourier transform from a unified viewpoint by including projective representation. Unfortunately, although there are so many good mathematical books for a part of six topics, no book contains all of these topics because they are too segmentalized. Further, some of them are written in an abstract way in mathematical style and, often, the materials are too segmented. At least, the notation is not familiar to people working with quantum theory. Others are good elementary books, but do not deal with topics related to quantum theory. In particular, such elementary books do not cover projective representation, which is more important in quantum theory. On the other hand, there are several books for physicists. However, these books are too simple and lack the detailed discussion. Hence, they are not useful for advanced study even in physics. To resolve this issue, this book starts with the basic mathematics for quantum theory. Then, it introduces the basics of group representation and discusses the case of the finite groups, the symmetric group, e.g. Next, this book discusses Lie group and Lie algebra. This part starts with the basics knowledge, and proceeds to the special groups, e.g., SU(2), SU(1,1), and SU(d). After the special groups, it explains concrete applications to physical systems, e.g., angular momentum, hydrogen-type Hamiltonian, spin-orbit interaction, and quark model. Then, it proceeds to the general theory for Lie group and Lie algebra. Using this knowledge, this book explains the Bosonic system, which has the symmetries of Heisenberg group and the squeezing symmetry by SL(2,R) and Sp(2n,R). Finally, as the discrete version, this book treats the discrete Heisenberg representation which is related to quantum error correction. To enhance readers' undersnding, this book contains 54 figures, 23 tables, and 111 exercises with solutions.

Frames, Bases and Group Representations

Topological Methods in Galois Representation Theory

Representations and Cohomology: Volume 2, Cohomology of Groups and Modules

Symmetry Groups and Their Applications

An Invitation to Representation Theory

An Introduction Based on Examples from Physics and Number Theory

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.

Two surveys introducing readers to the subjects of harmonic analysis on semi-simple spaces and group theoretical methods, and preparing them for the study of more specialised literature. This book will be very useful to students and researchers in mathematics, theoretical physics and those chemists dealing with quantum systems.

There has been much important work done in the past two decades in America on issues of under representation based on social differences such as race, ethnicity, class, gender, sexuality, and age. While this scholarship has examined the ways in which women and racial, ethnic, and sexual minorities suffer disproportionately on measures of full citizenship, social class and culture have received relatively little attention. This new study addresses various manifestations of social class and cultural difference as well as their implications for political representation. The analysis demonstrates how three of the most influential feminist theorists who write about political representation conceive of group representation, identify the problems that group representation claims to remedy, and assess the strengths and weaknesses associated with these models. Using theoretical argument, the volume suggests practical electoral reform in order to encourage new and emancipating forms of political engagement. It will be of value to those interested in public policy and governance, political theory, gender studies and law and society in general.

This book offers an introduction to the theory of groupoids and their representations encompassing the standard theory of groups. Using a categorical language, developed from simple examples, the theory of finite groupoids is shown to knit neatly with that of groups and their structure as well as that of their representations is described. The book comprises numerous examples and applications, including well-known games and puzzles, databases and physics applications. Key concepts have been presented using only basic notions so that it can be used both by students and researchers interested in the subject. Category theory is the natural language that is being used to develop the theory of groupoids. However, categorical presentations of mathematical subjects tend to become highly abstract very fast and out of reach of many potential users. To avoid this, foundations of the theory, starting with simple examples, have been developed and used to study the structure of finite groups and groupoids. The appropriate language and notions from category theory have been developed for students of mathematics and theoretical physics. The book presents the theory on the same level as the ordinary and elementary theories of finite groups and their representations, and provides a unified picture of the same. The structure of the algebra of finite groupoids is analysed, along with the classical theory of characters of their representations. Unnecessary complications in the formal presentation of the subject are avoided. The book offers an introduction to the language of category theory in the concrete setting of finite sets. It also shows how this perspective provides a common ground for various problems and applications, ranging from combinatorics, the topology of graphs, structure of databases and quantum physics.

Representation Theory and Noncommutative Harmonic Analysis II

An Approach through Invariants and Representations

SL(2) Representations of Finitely Presented Groups

An Introduction to Symmetry Principles, Group Representations, and Special Functions in Classical and Quantum Physics

Group Representation, Feminist Theory, and the Promise of Justice

Polynomial Representations of the Symmetric Group

This book is based on a one-semester course for advanced undergraduates specializing in physical chemistry. I am aware that the mathematical training of most science majors is more heavily weighted towards analysis – typ- ally calculus and differential equations – than towards algebra. But it remains my conviction that the basic ideas and applications of group theory are not only vital, but not dif?cult to learn, even though a formal mathematical setting with emphasis on rigor and completeness is not the place where most chemists would feel most comfortable in learning them. The presentation here is short, and limited to those aspects of symmetry and group theory that are directly useful in interpreting molecular structure and spectroscopy. Nevertheless I hope that the reader will begin to sense some of the beauty of the subject. Symmetry is at the heart of our understanding of the physical laws of nature. If a reader is happy with what appears in this book, I must count this a success. But if the book motivates a reader to move deeper into the subject, I shall be grati?ed.

One of the best-written, most skillful expositions of group theory and its physical applications, directed primarily to advanced undergraduate and graduate students in physics, especially quantum physics. With problems.

Combining algebraic groups and number theory, this volume gathers material from the representation theory of this group for the first time, doing so for both local (Archimedean and non-Archimedean) cases as well as for the global number field case.

Table of Contents Preface 1 Foundations 1 2 Why Geometry, so Physics, Require Complex Numbers 25 3 Properties of Statefunctions 38 4 The Foundations of Coherent Superposition 58 5 Geometry, Transformations, Groups and Observers 85 6 The Poincare Group and Its Implications 108 7 The Dimension of Space 122 8 Bosons, Fermions, Spinors and Orthogonal Groups 146 9 The Complete Reasonableness of Quantum Mechanics 159 A: Terminology and Conventions 177 The Einstein Podolsky Rosen Paradox 185 Experimental Meaning of the Concept of Identical Particles 191 Nonexistence of Superselection Rules; Definition of Term "Frame of Reference" 203 Complex Groups, Quantum Mechanics, and the Dimension and Reality of Space 221 The Reality and Dimension of Space and the Complexity of Quantum Mechanics 235 References 255 Index 259.

An Introduction

Group Theory in Physics: Basic Group Theory; Chapter 3 Group Representations; Chapter 4 General Properties of Irreducible Vectors and Operators; Chapter 5 Representations of the Symmetric Groups; Chapter 6 One-Dimensional Continuous Groups; Chapter 7 Rotations in 3-Dimensional Space -The Group SO(3); Chapter 8 The Group SU(2) and More About SO(3); Chapter 9 Euclidean Groups in Two- and Three-Dimensional Space; Chapter 10 The Lorentz and Poincaré Groups, and Space-Time Symmetries; Chapter 11 Space Inversion Invariance; Chapter 12 Time Reversal Invariance

Introduction to Symmetry and Group Theory for Chemists

Elements of Group Theory for Physicists

Introduction to Representation Theory

An Introductory Approach

This monograph gives access to the theory of continuous linear representations of general real Lie groups to readers who are already familiar with the rudiments of functional analysis and Lie groups. The first half of the book is centered around the relation between a continuous linear representation (of a Lie group over a Banach space or even a more general space) and its tangent; the latter is a Lie algebra representation in a sense. Starting with the Hille-Yosida theory, quite recent results are reached. The second half is more standard unitary theory with applications concerning the Galilean and Poincaré groups. Appendices help readers with diverse backgrounds to find the precise descriptions of the concepts needed from earlier literature. Each chapter includes exercises.

This book introduces systematically the eigenfunction method, a new approach to the group representation theory which was developed by the authors in the 1970's and 1980's in accordance with the concept and method used in quantum mechanics. It covers the applications of the group theory in various branches of physics and quantum chemistry, especially nuclear and molecular physics. Extensive tables and computational methods are presented. Group Representation Theory for Physicists may serve as a handbook for researchers doing group theory calculations. It is also a good reference book and textbook for undergraduate and graduate students who intend to use group theory in their future research careers.

"An advanced monograph on Galois representation theory by one of the world's leading algebraists, this volume is directed at mathematics students who have completed a graduate course in introductory algebraic topology. Topics include Abelian and nonabelian cohomology of groups, characteristic classes of forms and algebras, explicit Brauer induction theory, and much more. 1989 edition"--

Very roughly speaking, representation theory studies symmetry in linear spaces. It is a beautiful mathematical subject which has many applications, ranging from number theory and combinatorics to geometry, probability theory, quantum mechanics, and quantum field theory. The goal of this book is to give a ``holistic'' introduction to representation theory, presenting it as a unified subject which studies representations of associative algebras and treating the representation theories of groups, Lie algebras, and quivers as special cases. Using this approach, the book covers a number of standard topics in the representation theories of these structures. Theoretical material in the book is supplemented by many problems and exercises which touch upon a lot of additional topics; the more difficult exercises are provided with hints. The book is designed as a textbook for advanced undergraduate and beginning graduate students. It should be accessible to students with a strong background in linear algebra and a basic knowledge of abstract algebra.

Group Matrices, Group Determinants and Representation Theory

Lie Groups

Homogeneous Spaces, Representations and Special Functions

An Introduction to Matrices, Sets and Groups for Science Students

Introduction To Classical And Modern Analysis And Their Application To Group Representation Theory

Group Representation Theory for Physicists

Symmetry Groups and Their Applications

This is the last of three major volumes which present a comprehensive treatment of the theory of the main classes of special functions from the point of view of the theory of group representations. This volume deals with q-analogs of special functions, quantum groups and algebras (including Hopf algebras), and (representations of) semi-simple Lie groups. Also treated are special functions of a matrix argument, representations in the Gel'fand-Tsetlin basis, and, finally, modular forms, theta-functions and affine Lie algebras. The volume builds upon results of the previous two volumes, and presents many new results. Subscribers to the complete set of three volumes will be entitled to a discount of 15%.

- Combines material from many areas of mathematics, including algebra, geometry, and analysis, so students see connections between these areas - Applies material to physics so students appreciate the applications of abstract mathematics - Assumes only linear algebra and calculus, making an advanced subject accessible to undergraduates - Includes 142 exercises, many with hints or complete solutions, so text may be used in the classroom or for self study

The material collected in this book originated from lectures given by authors over many years in Warsaw, Trieste, Schladming, Istanbul, Goteborg and Boulder. There is no other comparable book on group representations, neither in mathematical nor in physical literature and it is hoped that this book will prove to be useful in many areas of research. It is highly recommended as a textbook for an advanced course in mathematical physics on Lie algebras, Lie groups and their representations. Request Inspection Copy

Quantum Theory, Groups and Representations

Representations and Invariants of the Classical Groups

Between promise and practice

From Finite Groups to Lie Groups

Group Representation for Quantum Theory

An introductory text book for graduates and advanced undergraduates on group representation theory. It emphasizes group theory's role as the mathematical framework for describing symmetry properties of classical and quantum mechanical systems. Familiarity with basic group concepts and techniques is invaluable in the education of a modern-day physicist. This book emphasizes general features and methods which demonstrate the power of the group-theoretical approach in exposing the systematics of physical systems with associated symmetry. Particular attention is given to pedagogy. In developing the theory, clarity in presenting the main ideas and consequences is given the same priority as comprehensiveness and strict rigor. To preserve the integrity of the mathematics, enough technical information is included in the appendices to make the book almost self-contained. A set of problems and solutions has been published in a separate booklet. Request Inspection Copy

'We explore widely in the valley of ordinary representations, and we take the reader over the mountain pass leading to the valley of modular representations, to a point from which (s)he can survey this valley, but we do not attempt to widely explore it. We hope the reader will be sufficiently fascinated by the scenery to further explore both valleys on his/her own' - from the Preface. Representation theory plays important roles in geometry, algebra, analysis, and mathematical physics. In particular, it has been one of the great tools in the study and classification of finite groups. The theory contains some particularly beautiful results: Frobenius' theorem, Burnside's theorem, Artin's theorem, Brauer's theorem - all of which are covered in this textbook. Some seem uninspiring at first but prove to be quite useful. Others are clearly deep from the outset.And when a group (finite or otherwise) acts on something else (as a set of symmetries, for example), one ends up with a natural representation of the group. This book is an introduction to the representation theory of finite groups from an algebraic point of view, regarding representations as modules over the group algebra. The approach is to develop the requisite algebra in reasonable generality and then to specialize it to the case of group representations. Methods and results particular to group representations, such as characters and induced representations, are developed in depth. Arithmetic comes into play when considering the field of definition of a representation, especially for subfields of the complex numbers.The book has an extensive development of the semisimple case, where the characteristic of the field is zero or is prime to the order of the group, and builds the foundations of the modular case, where the characteristic of the field divides the order of the group. The book assumes only the material of a standard graduate course in algebra. It is suitable as a text for a year-long graduate course. The subject is of interest to students of algebra, number theory and algebraic geometry. The systematic treatment presented here makes the book also valuable as a reference.

An Invitation to Representation Theory offers an introduction to groups and their representations, suitable for undergraduates. In this book, the ubiquitous symmetric group and its natural action on polynomials are used as a gateway to representation theory. The subject of representation theory is one of the most connected in mathematics, with applications to group theory, geometry, number theory and combinatorics, as well as physics and chemistry. It can however be daunting for beginners and inaccessible to undergraduates. The symmetric group and its natural action on polynomial spaces provide a rich yet accessible model to study, serving as a prototype for other groups and their representations. This book uses this key example to motivate the subject, developing the notions of groups and group representations concurrently. With prerequisites limited to a solid grounding in linear algebra, this book can serve as a first introduction to representation theory at the undergraduate level, for instance in a topics class or a reading course. A substantial amount of content is presented in over 250 exercises with complete solutions, making it well-suited for guided study.

This work develops an operator-theoretic approach to discrete frame theory on a separable Hilbert space. It is then applied to an investigation of the structural properties of systems of unitary operators on Hilbert space which are related to orthonormal wavelet theory. Also obtained are applications of frame theory to group representations, and of the theory of abstract unitary systems to frames generated by Gabor type systems.

Representation of Lie Groups and Special Functions

Group Theory and Its Application to Physical Problems

Groups, representation and democracy

Group Theory in Physics

Continuous Linear Representations

A Course in Finite Group Representation Theory

Group Representation for Quantum TheorySpringer

More than half a century has passed since Weyl's 'The Classical Groups' gave a unified picture of invariant theory. This book presents an updated version of this theory together with many of the important recent developments. As a text for those new to the area, this book provides an introduction to the structure and finite-dimensional representation theory of the complex classical groups that requires only an abstract algebra course as a prerequisite. The more advanced reader will find an introduction to the structure and representations of complex reductive algebraic groups and their compact real forms. This book will also serve as a reference for the main results on tensor and polynomial invariants and the finite-dimensional representation theory of the classical groups. It will appeal to researchers in mathematics, statistics, physics and chemistry whose work involves symmetry groups, representation theory, invariant theory and algebraic group theory.

The Mathematical Study Of Group Theory Was Initiated In The Early Nineteenth Century By Such Mathematicians As Gauss, Cauchy, Abel, Hamilton, Galois, Cayley, And Many Others. However, The Advantages Of Group Theory In Physics Were Not Recognized Till 1925 When It Was Applied For Formal Study Of Theoretical Foundations Of Quantum Mechanics, Atomic Structures And Spectra By, To Name A Few, H A Bethe, E P Wigner, Etc. It Has Now Become Indispensable In Several Branches Of Physics And Physical Chemistry.Dr. Joshi Develops The Mathematics Of Group Theory And Then Goes On To Present Its Applications To Quantum Mechanics, Crystallography, And Solid State Physics. For Proper Comprehension Of Representation Theory, He Has Covered Thoroughly Such Diverse But Relevant Topics As Hilbert Spaces, Function Spaces, Operators, And Direct Sum And Product Of Matrices. He Often Proceeds From The Particular To The General So That The Beginning Student Does Not Have An Impression That Group Theory Is Merely A Branch Of Abstract Mathematics. Various Concepts Have Been Explained Consistently By The Use Of The C4V. Besides, It Contains An Improved And More General Proof Of The Schurs First Lemma And An Interpretation Of The Orthogonality Theorem In The Language Of Vector Spaces (Chapter 3).Throughout The Text The Author Gives Attention To Details And Avoids Complicated Notation. This Is A Valuable Book For Senior Students And Researchers In Physics And Physical Chemistry. A Thorough Understanding Of The Methodology And Results Contained In This Book Will Provide The Reader Sound Theoretical Foundations For Advanced Study Of Quantum Mechanics, Solid State Physics And Atomic And Particle Physics To Help Students A Flow-Chart Explaining Step By Step The Method Of Determining A Parallel-Running Example Illustrating The Procedure In Full Details Have Been Included. An Appendix On Mappings And Functions Has Also Been Added.

This graduate-level text provides a thorough grounding in the representation theory of finite groups over fields and rings. The book provides a balanced and comprehensive account of the subject, detailing the methods needed to analyze representations that arise in many areas of mathematics. Key topics include the construction and use of character tables, the role of induction and restriction, projective and simple modules for group algebras, indecomposable representations, Brauer characters, and block theory. This classroom-tested text provides motivation through a large number of worked examples, with exercises at the end of each chapter that test the reader's knowledge, provide further examples and practice, and include results not proven in the text. Prerequisites include a graduate course in abstract algebra, and familiarity with the properties of groups, rings, field extensions, and linear algebra.

Representations of Linear Groups

Group Representations

Second Edition

The Endoscopic Classification of Representations Orthogonal and Symplectic Groups

Group Theoretical Foundations of Quantum Mechanics

Representation Theory of Finite Groups

Concise, readable text introduces sets, groups, and, most importantly, matrices to undergraduate students of physics, chemistry, and engineering. Each chapter contains worked examples and many problems with answers. 1974 edition.

This third volume can be roughly divided into two parts. The first part is devoted to the investigation of various properties of projective characters. Special attention is drawn to spin representations and their character tables and to various correspondences for projective characters. Among other topics, projective Schur index and projective representations of abelian groups are covered. The last topic is investigated by introducing a symplectic geometry on finite abelian groups. The second part is devoted to Clifford theory for graded algebras and its application to the corresponding theory for group algebras. The volume ends with a detailed investigation of the Schur index for ordinary representations. A prominant role is played in the discussion by Brauer groups together with cyclotomic algebras and cyclic algebras.

Illustrating the fascinating interplay between physics and mathematics, Groups, Representations and Physics, Second Edition provides a solid foundation in the theory of groups, particularly group representations. For this new, fully revised edition, the author has enhanced the book's usefulness and widened its appeal by adding a chapter on the Cartan-Dynkin treatment of Lie algebras. This treatment, a generalization of the method of raising and lowering operators used for the rotation group, leads to a systematic classification of Lie algebras and enables one to enumerate and construct their irreducible representations. Taking an approach that allows physics students to recognize the power and elegance of the abstract, axiomatic method, the book focuses on chapters that develop the formalism, followed by chapters that deal with the physical applications. It also illustrates formal mathematical definitions and proofs with numerous concrete examples.

Within the Langlands program, endoscopy is a fundamental process for relating automorphic representations of one group with those of another. In this book, Arthur establishes an endoscopic classification of automorphic representations of orthogonal and symplectic groups . The representations are shown to occur in families (known as global -packets and -packets), which are parametrized by certain self-dual automorphic representations of an associated general linear group . The central result is a simple and explicit formula for the multiplicity in the automorphic discrete spectrum of for any representation in a family. The results of the volume have already had significant applications: to the local Langlands correspondence, the construction of unitary representations, the existence of Whittaker models, the analytic behaviour of Langlands -functions, the spectral theory of certain locally symmetric spaces, and to new phenomena for symplectic epsilon-factors. One can expect many more. In fact, it is likely that both the results and the techniques of the volume will have applications to almost all sides of the Langlands program. The methods are by comparison of the trace formula of with its stabilization (and a comparison of the twisted trace formula of with its stabilization, which is part of work in progress by Moeglin and Waldspurger). This approach is quite different from methods that are based on -functions, converse theorems, or the theta correspondence. The comparison of trace formulas in the volume ought to be applicable to a much larger class of groups. Any extension at all will have further important implications for the Langlands program.

Groups and Symmetries

Topics in Varieties of Group Representations

Theory of Group Representations and Applications

The Mathematical Legacy of Frobenius

This text systematically presents the basics of quantum mechanics, emphasizing the role of Lie groups, Lie algebras, and their unitary representations. The mathematical structure of the subject is brought to the fore, intentionally avoiding significant overlap with material from standard physics courses in quantum mechanics and quantum field theory. The level of presentation is attractive to mathematics students looking to learn about both quantum mechanics and representation theory, while also appealing to physics students who would like to know more about the mathematics underlying the subject. This text showcases the numerous differences between typical mathematical and physical treatments of the subject. The latter portions of the book focus on central mathematical objects that occur in the Standard Model of particle physics, underlining the deep and intimate connections between mathematics and the physical world. While an elementary physics course of some kind would be helpful to the reader, no specific background in physics is assumed, making this book accessible to students with a grounding in multivariable calculus and linear algebra. Many exercises are provided to develop the reader's understanding of and facility in quantum-theoretical concepts and calculations.

Whether called pressure groups, NGOs, social movement organisations or organised civil society, the value of 'groups' to the policy process, to economic growth, to governance, to political representation and to democracy has always been contested. However, there seems to be a contemporary resurgence in this debate largely centred on their democratising potential: can groups effectively link citizens to political institutions and policy processes? Are groups an antidote to emerging democratic deficits? Or do groups themselves face challenges in demonstrating their legitimacy and representativeness? This book debates the democratic potential and practice of groups; focussing on the vibrancy of internal democracies, and modes of accountability with those who join such groups and to the constituencies they advocate for. It draws on literatures covering national, European and global levels, and presents new empirical material from the UK and Australia

This book sets out an account of the tools which Frobenius used to discover representation theory for nonabelian groups and describes its modern applications. It provides a new viewpoint from which one can examine various aspects of representation theory and areas of application, such as probability theory and harmonic analysis. For example, the focal objects of this book, group matrices, can be thought of as a generalization of the circulant matrices which are behind many important algorithms in information science. The book is designed to appeal to several audiences, primarily mathematicians working either in group representation theory or in areas of mathematics where representation theory is involved. Parts of it may be used to introduce undergraduates to representation theory by studying the appealing pattern structure of group matrices. It is also intended to attract readers who are curious about ideas close to the heart of group representation theory, which do not usually appear in modern accounts, but which offer new perspectives.