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Prime Condition -- 4.3 Normal Subgroups of Prime Index -- 4.4 The Case of Index Two Subgroups -- 5 Examples and Applications -- 5.1 Representation Theory and Conjugacy Classes of the Symmetric Groups  $S_n$  -- 5.2 Conjugacy Classes of  $A_n$  -- 5.3 The Irreducible Representations of  $A_n$  -- 5.4 Ambivalence of the Groups  $A_n$  -- 5.5 An Application to Isaacs' Going Down Theorem -- 5.6 Another Application: Analysis of  $p^2$ -Extensions -- 5.7 Representation Theory of Finite Metacyclic Groups -- 5.8 Examples: Dihedral and Generalized Quaternion Groups -- 6 Central Extensions and the Orbit Method -- 6.1 Central Extensions. 6.2 2-Divisible Abelian Groups, Equalized Cocycles, and Schur Multipliers -- 6.3 Lie Rings -- 6.4 The Cocycle Decomposition -- 6.5 The Malcev Correspondence -- 6.6 The Orbit Method -- 6.7 More on the Orbit Method: Induced Representations -- 6.8 More on the Orbit Method: Restricting to a Subgroup -- 6.9 The Orbit Method for the Finite Heisenberg Group -- 6.10 Restricting from  $H_{q,t}$  to  $H_q$  -- 6.11 The Little Group Method for the Heisenberg Group -- 7 Representations of Finite Group Extensions via Projective Representations -- 7.1 Mackey Obstruction -- 7.2 Unitary Projective Representations -- 7.3 The Dual of a Group Extension -- 7.4 Central Extensions and the Finite Heisenberg Group -- 7.5 Analysis of the Commutant -- 7.6 The Hecke Algebra -- 8 Induced Projective Representations -- 8.1 Basic Theory -- 8.2 Mackey's Theory for Induced Projective Representations -- 9 Clifford Theory for Projective Representations -- 9.1 Preliminaries and Notation -- 9.2 Basic Clifford Theory for Projective Representations -- 9.3 Projective Unitary Representations of a Group Extension -- 10 Projective Representations of Finite Abelian Groups with Applications -- 10.1 Bicharacters and 2-Cocycles on Finite Abelian Groups -- 10.2 The Irreducible Projective Representations of Finite Abelian Groups -- 10.3 Representation Theory of Finite Metabelian Groups -- 10.4 Representation Theory of Finite Step-2 Nilpotent Groups -- A Notes -- A.1 Group Extensions and Cohomology -- A.2 Clifford Theory -- A.3 The Little Group Method and Its Applications -- A.4 Lie Rings and the Orbit Method -- A.5 Projective Representations -- References -- Subject index -- Index of authors.

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## Sommario/riassunto

This monograph adopts an operational and functional analytic approach to the following problem: given a short exact sequence (group extension)  $1 \rightarrow N \rightarrow G \rightarrow H \rightarrow 1$  of finite groups, describe the irreducible representations of  $G$  by means of the structure of the group extension. This problem has attracted many mathematicians, including I. Schur, A. H. Clifford, and G. Mackey and, more recently, M. Isaacs, B. Huppert, Y. G. Berkovich & E.M. Zemud, and J.M.G. Fell & R.S. Doran. The main topics are, on the one hand, Clifford Theory and the Little Group Method (of Mackey and Wigner) for induced representations, and, on the other hand, Kirillov's Orbit Method (for step-2 nilpotent groups of odd order) which establishes a natural and powerful correspondence between Lie rings and nilpotent groups. As an application, a detailed description is given of the representation theory of the alternating groups, of metacyclic, quaternionic, dihedral groups, and of the (finite) Heisenberg group. The Little Group Method may be applied if and only if a suitable unitary 2-cocycle (the Mackey obstruction) is trivial. To overcome this obstacle, (unitary) projective representations are introduced and corresponding Mackey and Clifford theories are developed. The commutant of an induced representation and the relative Hecke algebra is also examined. Finally, there is a comprehensive exposition of the theory of projective representations for finite Abelian groups which is applied to obtain a complete description of the irreducible representations of finite metabelian

groups of odd order.

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