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Displacements -- 10.4.1 Kramers Degeneracy -- 11. Space Groups -- 11.1 Translational Symmetry of Crystals -- 11.2 Symmetry Operations in Space Groups -- 11.3 Structure of Space Groups -- 11.4 Bravais Lattices -- 11.5 Nomenclature of Space Groups -- 11.6 The Reciprocal Lattice and the Brillouin Zone -- 11.7 Irreducible Representations of the Translation Group… -- 11.8 The Group of the Wavevector k and Its Irreducible Representations -- 11.9 Irreducible Representations of a Space Group -- 11.10 Double Space Groups -- 12. Electronic States in Crystals -- 12.1 Bloch Functions and E(k) Spectra -- 12.2 Examples of Energy Bands: Ge and TlBr -- 12.3 Compatibility or Connectivity Relations -- 12.4 Bloch Functions Expressed in Terms of Plane Waves -- 12.5 Choice of the Origin -- 12.5.1 Effect of the Choice on Bloch Wavefunctions -- 12.6 Bloch Functions Expressed in Terms of Atomic Orbitals -- 12.7 Lattice Vibrations -- 12.8 The Spin-Orbit Interaction and Double Space Groups…. -- 12.9 Scattering of an Electron by Lattice Vibrations -- 12.10 Interband Optical Transitions -- 12.11 Frenkel Excitons in Molecular Crystals -- 12.12 Selection Rules in Space Groups -- 12.12.1 Symmetric and Antisymmetric Product Representations -- 13. Time Reversal and Nonunitary Groups -- 13.1 Time Reversal -- 13.2 Nonunitary Groups and Corepresentations -- 13.3 Criteria for Space Groups and Examples -- 13.4 Magnetic Space Groups -- 13.5 Excitons in Magnetic Compounds; Spin Waves -- 13.5.1 Symmetry of the Hamiltonian -- 14. Landau's Theory of Phase Transitions -- 14.1 Landau's Theory of Second-Order Phase Transitions -- 14.2 Crystal Structures and Spin Alignments -- 14.3 Derivation of the Lifshitz Criterion -- 14.3.1 Lifshitz's Derivation of the Lifshitz Criterion -- 15. The Symmetric Group -- 15.1 The Symmetric Group (Permutation Group) -- 15.2 Irreducible Characters -- 15.3 Construction of Irreducible Representation Matrices -- 15.4 The Basis for Irreducible Representations -- 15.5 The Unitary Group and the Symmetric Group -- 15.6 The Branching Rule -- 15.7 Wavefunctions for the Configuration (nl)x -- 15.8 D(J) as Irreducible Representations of SU(2) -- 15.9 Irreducible Representations of U(m) -- Appendices -- A. The Thirty-Two Crystallographic Point Groups -- B. Character Tables for Point Groups -- Answers and Hints to the Exercises -- Motifs of the Family Crests -- References.

Sommario/riassunto

This book has been written to introduce readers to group theory and its ap- plications in atomic physics, molecular physics, and solid-state physics. The first Japanese edition was published in 1976. The present English edi- tion has been translated by the authors from the revised and enlarged edition of 1980. In translation, slight modifications have been made in. Chaps. 8 and 14 to update and condense the contents, together with some minor additions and improvements throughout the volume. The authors cordially thank Professor J. L. Birman and Professor M. Car- dona, who encouraged them to prepare the English translation. Tokyo, January 1990 T. Inui . Y. Tanabe Y. Onodera Preface to the Japanese Edition As the title shows, this book has been prepared as a textbook to introduce readers to the applications of group theory in several fields of physics. Group theory is, in a nutshell, the mathematics of symmetry. It has three main areas of application in modern physics. The first originates from early studies of crystal morphology and constitutes a framework for classical crystal physics. The analysis of the symmetry of tensors representing macroscopic physical properties (such as elastic constants) belongs to this category. The sec- ond area was enunciated by E. Wigner (1926) as a powerful means of handling quantum-mechanical problems and was first applied in this sense to the analysis of atomic spectra. Soon, H.

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