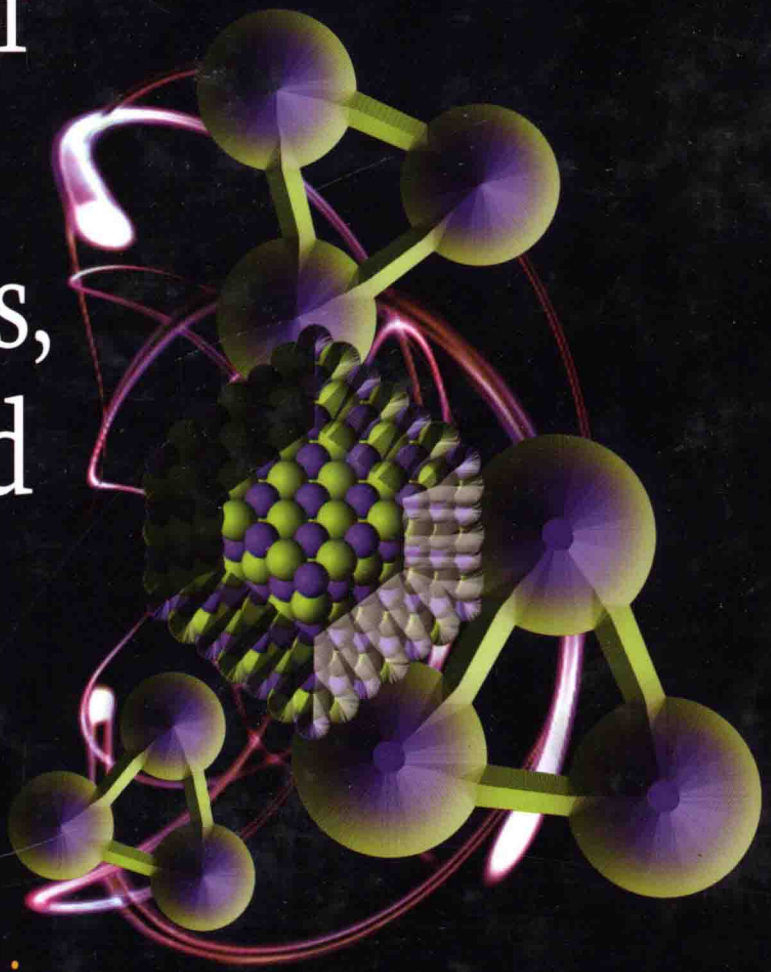
Physics of Atoms, Molecules, Solids and Nuclei



Vimal Kumar Jain

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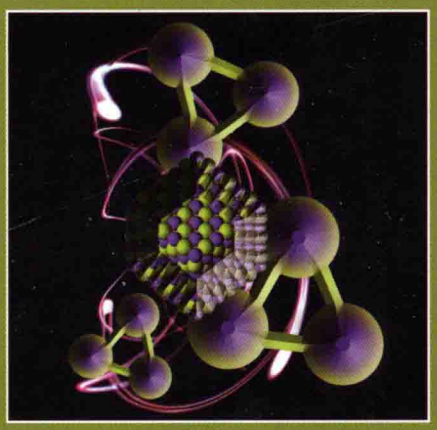

Vimal Kumar Jain

Physics of atoms, molecules, solids and nuclei provides the foundation for much of one's future work in atomic, molecular, solid state and nuclear physics. The topics include – The Schrödinger wave equation and its simple applications, Atomic spectra of hydrogen atom, One valence system, Two valence system and the effect of external field, X-ray spectra, Molecular spectra of diatomic molecule, Raman effect, Essential of laser action, Crystal structure, Chemical bonding, Thermal properties of solids, Free electron and band theory of solids , magnetic and superconducting properties. The book also describe the basic properties of Nuclei, Radioactivity, Alpha, Beta and Gamma decay, Nuclear models, Nuclear reactions, detectors, and elementary particles.

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PHYSICS OF ATOMS, MOLECULES, SOLIDS AND NUCLEI

To

Ira Piyush, Seeyal, Manu Manish

PREFACE

'Physics of atoms, molecules, solids and nuclei' has been prepared to serve as a text for graduate and postgraduate students of physics and chemistry as well as of B.Tech. It provides a comprehensive treatment of important concepts of quantum mechanics, atomic and molecular physics, solid state physics and nuclear physics.

This book begins with the review of the physical basis of quantum mechanics. Schrödinger equation is developed in chapter 2. The applications of Schrödinger equation to free particle, particle in a box, potential wells and barriers, angular momentum, harmonic oscillator and hydrogen atom is described in chapter 3. Atomic spectra of hydrogen atom, one valence system, helium atom , alkaline atom and the effect of magnetic field is presented in chapters 4-6. Chapter 7 deals with X-ray spectra. Raman Effect, rotational, vibrational and electric spectra of diatomic molecules is described in chapter 8. The idea of laser is developed in chapter 9 with special emphasis on the basic concepts. The Maxwell-Boltzmann distribution and quantum statistics is developed in chapter 10. The chapter 11-16 deals with the solids. Chapter 11-12 describes the basic concepts of crystal structure, reciprocal lattice and determination of crystal structure. Various kinds of binding of solids are given in chapter 13. Chapter 14 gives the model of specific heat of solids while chapter deals with the free electron theory as well as band theory of solids which leads to classification of solids as conductor, insulator and semiconductor. The dielectrics, magnetic and superconducting properties of materials are introduced in chapter 16. Chapter 17-20 deals with the nuclear properties. Chapter 17 introduces the basic concepts while Chapter 18 deals with alpha beta and gamma decay. Liquid drop model and shell model with their application in nuclear physics are discussed in chapter 19. Nuclear reactions, gas and solid based nuclear detectors, reactors forms the part of chapter 20. Chapter 21 gives a short description of elementary particles and their classification, conservation laws, quark model and standard model of the elementary particles.

A large number of solved and unsolved examples based on the articles given at the end of each chapter to supplement the text. For the preparation of the book a large number of books by various authors have been consulted and to them I am grateful. A list of some of these is given at the end of the book. The person whom I must acknowledge is my wife Minakshi who patiently supported and encouraged when at times I felt like giving up.

Finally, I must thank Mr. N. K. Mehra, Managing Director, Narosa Publishing House for readily agreeing to undertake this project.

Vimal Kumar Jain

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Chapter 3 Simple Applications of Schrödinger Equation

Chapter 4 Atomic Spectra of Hydrogen Atom

Chapter 5 Atomic Spectra of One Valence System