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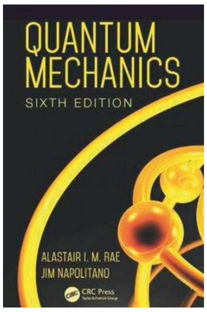

ALASTAIR I. M. RAE, JIM NAPOLITANO

QUANTUM MECHANICS
Sixth Edition

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The sixth edition of Alastair Rae's "Quantum Mechanics" (co-authored by Jim Napolitano) is a valid undergraduate-level introductory text. Well suited for students in Chemistry, Materials Science, and Engineering, it probably calls for some extensions if used as reference text for the main Quantum Mechanics course for Physics students.

While the overall content is analogous to the previous edition, now the book is divided into 5 conceptual "Parts", which helps teachers in selecting only the topics which are more suitable for the background of their students.

Part I (Waves, Electromagnetism, and the Limits of Classical Physics) is composed of 4 chapters. The first three aim at reviewing some key topics in classical physics and mathematics which students should be already familiar with, while Chapter 4 includes a brief summary of the main experiments which lead to the formulation of the wave-particle duality. Concepts are introduced directly at a rather deep level of complexity.

Part II (Elementary Wave Mechanics) introduces the Schrödinger equation, and it is characterized by the typical sequence of topics found also in several other textbooks: 1D problems such as particle in a well and harmonic oscillator – variable separation in Cartesian and spherical coordinates – hydrogen atom.

Part III (Formal Foundations) is also rather standard. Postulates of Quantum Mechanics are introduced together with the concept of dynamical variable and operators, and a demonstration of the generalized uncertainty principle is provided. The two following chapters are dedicated to the angular momentum operator. Here the formal and conceptual level of the book is considerably raised, and the discussion, ending with Pauli Matrices and the Stern and Gerlach experiment, is very complete. Part III ends with a treatment of Spin-orbit coupling and the Zeeman Effect. The effect of spin-orbit coupling on the hydrogen energy levels (and the Zeeman effect) is indeed tackled by exploiting the vectorial model but without – oddly enough – applying perturbation theory.

Time-independent perturbation theory is instead introduced in Part IV (Extensions and Approximation Schemes) and immediately exploited to compute interesting quantities such as hydrogen polarizability, the energy shift produced by an electric field (Stark effect), and even for solving a 1D model of solids (electrons in a periodic potentials). The variational principle is also introduced, before tackling time-dependent perturbation theory and discussing transitions in the dipole approximation. Part IV also includes a rather advanced introduction to scattering in one and three dimensions, before ending with a key section on indistinguishable particles. The energy levels of the He atom are discussed, but only at a rather colloquial level.

Finally, Part V (Advanced Topics) deals with advanced subjects. Authors expose the main formal complications arising when trying to extend Quantum Mechanics to tackle relativistic effects. The Dirac equation is introduced along with the concept of antiparticle and the definition of "field theory" is given. While I find most of the discussion difficult to follow for non-experts, I am convinced that students are going to enjoy what follows. Chapter 15, indeed, provides an accessible introduction to present-day "hot" research areas (quantum cryptography, quantum computing, teleportation), even working out some simple but intriguing examples, likely to stimulate further interest in Quantum Mechanics.

Finally, the last chapter of the book deals with conceptual problems in Quantum Mechanics. Here authors present a beautiful, in-depth analysis of the concept of quantum measurement, analyzing consequences also at the philosophical level.

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