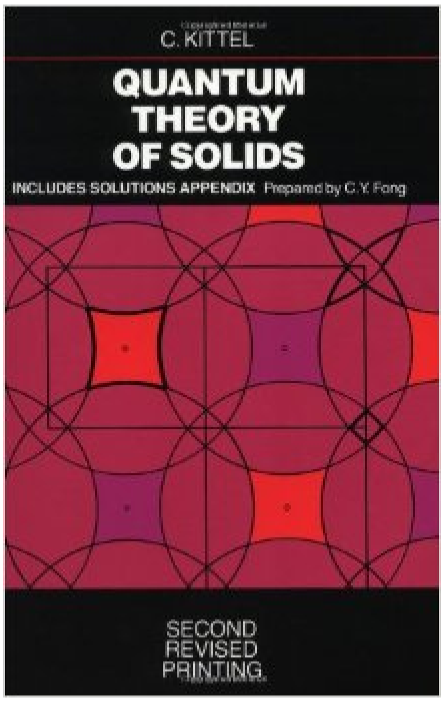
Quantum Theory Of Solids



Synopsis

A modern presentation of theoretical solid state physics that builds directly upon Kittel's Introduction to Solid State Physics. Treats phonon, electron, and magnon fields, culminating in the BCS theory of superconductivity. Considers Fermi surfaces and electron wave functions and develops the group theoretical description of Brillouin zones. Applies correlation functions to time-dependent effects in solids, with an introduction to Green's functions. With 110 problems, the text is well-suited for the classroom or for self-instruction.

Book Information

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Customer Reviews

It is too bad this book is out of print, for it gives a good introduction to the quantum theory as applied to condensed matter, despite the many advances that have taken place since the date of publication, such as high-temperature superconductivity, the fractional quantum Hall effect, and nanoscale physics. Therefore, if a copy can be found, it is still worth perusing and having on one's shelf. I only read the first 8 chapters of the book, so my review will be confined to them. After a brief introduction to the mathematics needed in the book, the author begins in chapter 2 with a treatment of acoustic phonons, which arise from the canonical quantization of the transverse motion of a continuous elastic line under tension. This object is handled using the Lagrangian formalism, and after finding the Hamiltonian density, employing a canonical transformation, the (bosonic) creation and annihilation operators are found: phonon excitations. Both longitudinal and transverse modes are shown to exist in general. Bogoliubov transformations are then used to show how phonons may arise in a system of weakly interacting particles. The author then derives the expression for the velocity of "second sound" in a phonon gas. Experimental evidence for second sound in liquid helium was known at the time of publication, but since then evidence has accumulated in Bose gases and in certain types of crystals, such as KTaO and SrTiO. The phenomenon of second sound has also been of considerable interest in the study of nonlinear optical phenomena in smectic liquid crystals. The author also discusses the occurence of van Hove singularities in the phonon frequency distribution function, and points to their connection with Morse theory.