Rutgers University Department of Physics and Astronomy

PHYSICS 601-602
SOLID STATE PHYSICS
BOOK LIST

Required texts for Physics 601 (Fall Semester)

Kaxiras, *Atomic and Electronic Structure of Solids* (2003).

A good text, but a bit ideosyncratic about its coverage of material. Note the useful appendices that review many things you are "supposed to know".

Ziman, *Principles of the Theory of Solids* (2nd Edit., 1972).

An older book, with only a few topics, but these are done with excellent pedagogical clarity.

Optional additional text for Physics 601 (Fall Semester)

Altmann, *Band Theory of Solids: An Introduction from the Point of View of Symmetry* (1991).

A shorter, more elementary, and more pedagogical treatment of the topics listed in the title.

Required text for Physics 602 (Spring Semester)

Taylor and Heinonen, *A Quantum Approach to Condensed Matter Physics* (2002).

A text that focuses mainly on topics that involve electron-electron interactions. I like the choice of mathematical level: makes frequent use of second-quantized notation, but avoids heavy diagrammatic perturbation theory and greens-function methods.

Older graduate-level or near-graduate-level texts

Ashcroft and Mermin, *Solid State Physics* (1976).

This is one of the best-known books in the field. But it has two important drawbacks. (i) It was originally designed to be somewhere between undergraduate and graduate levels. (ii) It has never been updated, and has become out-of-date in some respects. Still, a very good book.

Madelung, *Introduction to Solid-State Theory* (1978).

I like this book, because of (i) its emphasis on elementary excitations, and (ii) the mathematical level including second quantized notation but not Greens functions. However, students find it dry, and there are topics missing.

Callaway, *Quantum Theory of the Solid State* (2nd Edit., 1974).

An older book, rather dry in style, but with many advanced topics treated carefully in a way that is hard to find elsewhere.

Older undergraduate-level texts

Kittel, *Introduction to Solid-State Physics*.

Probably the best-known text in the field. There are many editions; the newest editions are not necessarily the best.

Ibach and Lüth,*Solid State Theory* (1991).

More modern; good on experimental methods; not very thorough coverage of material.

Newer texts

Marder, *Condensed Matter Physics* (2000).

A good general text, often used as a primary text for a course of this kind.

Grosso, *Solid State Physics* (2000).

A good general-purpose text.

O'Reilly, *Quantum Theory of Solids* (2002).

A nice shorter, lighter, paperback text; not very thorough.

Books covering more specialized or advanced topics

Martin, *Electronic Structure* (2004).

This is an advanced presentation of modern computational methods for treating the electronic structure of solids, but with a careful and often nicely pedagogical treatment of the theoretical background needed to understand these methods.

Bassani and Parravicini, *Electronic States and Optical Transitions in Solids* (1975).

A much older book on the theory of electronic bandstructure and optical properties of crystals, with an excellent and quite thorough treatment of symmetries.

Harrison, *Electronic Structure and the Properties of Solids: The Physics of the Chemical Bond* (1980).

A book on the electronic structure of crystals, emphasizing simple models that give correct qualitative and semiquantitative descriptions of the physics and chemistry.

Philips, *Advanced Solid State Physics* (2003).

Similar to Taylor and Heinonen, but focuses even more exclusively on electron

many-body problems.

Chaiken and Lubensky, *Principles of Condensed Matter Physics* (2003).

Emphasis is almost entirely on structural, thermodynamic, and dynamical properties; good coverage of theory of "soft matter".

Dove, *Structure and Dyamics; An Atomic View of Materials* (2003).

Emphasis is on crystal structures, crystal symmetry, lattice dynamics, and structural phase transitions.

Ziman, *Models of Disorder* (1979).

Focuses on ways to treat disordered and amorphous materials.

Kohanoff, *Electronic Structure Calculations for Solids and Molecules* (2006).

A nicely written modern introduction to computational electronic structure theory.

Books on Superconductivity

Tinkham, *Introduction to Superconductivity* (2nd edition, paperback, 2004).

Emphasizes experimental aspects.

Schrieffer, *Theory of Superconductivity* (Reprinted 1983).

Emphasizes the microscopic theory.

Lynton, *Superconductivity* (1971).

Emphasizes the phenomenological Landau theory.

Parks, *Superconductivity* (1969).

Early two-volume set of review papers.

Rickayzen, *Theory of Superconductivity* (1965).

More advanced and formal.

There are also numerous books, such as that by Taylor and Heinonen, that have good chapters on superconductivity. There are also some books that have appeared in the last 10 years, but I am not so familiar with them. On the other extreme, you may wish to look at the original BCS paper: Phys. Rev. **108**, 1175 (1957).

Please send any comments on this page to dhv@physics.rutgers.edu.