

Oral Qualifying Exam - Solid-State Physics

THIS EXAM REQUIRES A WORKING KNOWLEDGE OF SOLID STATE PHYSICS

USEFUL TEXTBOOKS

Solymar and D. Walsh, *Electrical Properties of Materials* (Oxford Science Publications, 1998)

S. O. Kasap, *Electronic Materials and Devices* (McGraw Hill), covers in particular electronic properties and devices

H. M. Rosenberg, *The Solid State* (Oxford U. Press, 1978), is an excellent mid-level book with good explanations.

C. Kittel, *Introduction to Solid State Physics* (John Wiley & Sons), is the standard reference book in the field.

THE EXAM IS ORAL

The student must have the ability to understand spoken questions from the examiners and to give responses, both in words and by writing equations or figures on the blackboard. The student is strongly advised to practice answering oral questions at the blackboard beginning as soon as possible.

THE FOLLOWING IS A NON-EXCLUSIVE LIST OF THE TOPICS WHICH MAY APPEAR

1. Electric transport in the Drude model, ac conductivity, Hall effect
2. Quantum mechanics: Schroedinger equation
3. Solutions of the time-independent Schroedinger equation for 1D potentials, expectation values, quantum numbers
4. Bonding in solids and total energy surface
5. Thermodynamics of the quantum-mechanical free-electron gas
6. Periodic potentials and Bloch waves: Empty-lattice approximation, nearly free electron
7. Band diagrams in one-dimension; effective mass; holes
8. Semiconductor band structures; carrier densities
9. Extrinsic semiconductors; dopant ionization
10. Schottky and p-n junctions; electrostatics, carrier densities, and transport
11. Phonons and thermal properties
12. Magnetic properties: diamagnetism, paramagnetism, ferromagnetism, superparamagnetism, adiabatic depolarization
13. Dielectric constants and index of refraction