APPLIED PHYSICS 295a Spring 2003

INTRODUCTION TO QUANTUM THEORY OF SOLIDS

Instructor Eugene Demler

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Office hours: Wednesday 3:00 - 4:00 pm

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Course Meetings: WF, 1:00 - 2:30 in Pierce 307

Homework: Biweekly problem sets, 2/3 of grade

Final Exam: 1/3 of grade

Tentative Course Outline

1. Crystal structure of solids: Bravais lattice and primitive vectors. Monoatomic lattices. Compounds. Symmetries.

2. Electrons in a periodic lattice: Free electrons. Translational symmetry - Bloch's theorem. Consequencies of point group symmetries for Schroedinger's equation.

3. Electron-electron interactions: Hartree and Hartree-Fock approximations. Density functional theory. Thomas-Fermi theory. Kohn-Sham equations.

4. Band structures: The tight binding model. General band structure methods. Band structure of representative metals.

5. Phonons: Lattice vibrations. The force constant model. Vibrations of a quantum mechanical lattice.

6. Electron transport: Dynamics of Bloch electrons. Boltzmann equation. Onsager relations. Thermoelectric phenomena.

7. Collective phenomena in electron systems. Magnetism. Superconductivity.

8. Semiconductors and their applications.

Primary references

1. A. Abrikosov. *Fundamentals of the theory of metals.*

2. **N.W. Ashcroft and N.D. Mermin**. **Solid state physics**.

3. W.A. Harrison, *Electronic structure and the properties of solids.*

4. E. Kaxiras, *Atomic and Electronic Structure of Solids.*

5. C. Kittel, *Introduction to Solid State Physics.*

6. C. Kittel, *Quantum Theory of Solids.*

7. Landau and Lifshitz course on theoretical physics. *Statistical physics*, part 2.

8. **M. P. Marder**, **Condensed matter physics**.

9. P. Nozieres and D. Pines, *The theory of quantum liquids.*

10. J.M. Ziman, *Theory of Solids.*