Physics 195 **Fall 2003**

INTRODUCTION TO SOLID STATE PHYSICS

Instructor Eugene Demler
email: demler@cmt.harvard.edu
Office hours: Monday 2:00 - 3:00 pm in Lyman 329.
The instructor will be happy to discuss course issues after each lecture in the lecture room, **or** in his office during the office hours, **or** on a "drop-in" basis, **or** by appointment
Teaching Fellow Daniel Podolsky email: podolsky@gphys1.harvard.edu
Discussion Sections: Wednesday 3:00 - 4:00 in Lyman 330.
The Teaching Fellow will also hold office hours on Wednesday 4:00 - 5:00 in Lyman 332.
Course Meetings: TTh, 10:00 - 11:30 in Lyman 330
Problem Sets: Weekly problem sets
Examination: There will be one midterm in early November during the regular class hour and a 3 hour final exam. These will be closed book exams, unless otherwise announced.
Grading Basis: Problem sets 25%, Midterm 25%, Final exam 50%. There will be no make-up midterm exams; instead, the 25% weight for a missed midterm exam will be added to the final exam.

The text for the course is Ashcroft & Mermin, *Solid state physics*, which is available at Harvard Coop. We will follow the general order of presentation of topics, but will skip the more more advanced sections aimed at graduate students. Toward the end of the course we will also discuss topics from the modern research, which are not covered in A&M. References for this material will be given during the lectures.

Students are encouraged to read other classic books on Solid State Physics

1. A. Abrikosov. *Fundamentals of the theory of metals.*
2. E. Kaxiras, *Atomic and Electronic Structure of Solids.*
3. C. Kittel, *Introduction to Solid State Physics.*
4. M. P. Marder, *Condensed matter physics.*
5. R. Turton, *The Physics of Solids.*
6. J.M. Ziman, *Theory of Solids.*

Tentative Course Outline

I. Electrons in crystals

- The Drude theory of metals.
- The Sommerfeld quantum theory of metals.
- Crystal structure of solids: Bravais lattice and primitive vectors. Reciprocal lattice. Monoatomic lattices. Compounds. Symmetries.
- Electronic energy levels in a periodic lattice: Energy bands.
- Semiclassical model of electron dynamics in electric and magnetic fields, and determination of the Fermi surface
- Classification of solids: cohesive energy.

II. Lattice vibrations in crystals

- Classical theory of harmonic vibration of a crystal; elastic constants.
- Quantum theory of harmonic vibration of a crystal: phonons.

III. Condensed Matter Physics of Modern Technologies

- Semiconductors and their applications.
- Magnetism. Ordered magnetic structures.
- Magnetoelectronics.
- Nanotechnology.