SOLID STATE PHYSICS

M. S. Dresselhaus

6.732
Fall, 2001

Oded Rabin – Head TA; Room 13-3025
Marcie Black – TA assistant; Room 13-3041
Yu-Ming Lin – TA assistant; Room 13-3037
Laura Doughty – Support; Room 13-3005
Lectures: MWF 9-10
Room 13-4101
Recitation: F 11-12
Room 38-136
10 problem sets
3 quizzes

Prereq: 6.730 or 8.231

Course Outline

Part I: Transport Properties

- Review of Energy Dispersion Relations in Solids
- Examples of Energy Bands in Solids
- Time–Independent Perturbation Theory
- Effective Mass Theory
- Transport Phenomena
- Thermal Transport
- Electron and Phonon Scattering
- Harmonic Oscillators, Phonons, and Electron-Phonon Interaction
- Two Dimensional Electron Gas, Quantum Wells & Semiconductor Superlattices
- Transport in Low Dimensional Systems
- Ion Implantation and RBS

Part II: Optical Properties

- Review of Fundamental Relations
- Drude Theory–Free Carrier Contribution to the Optical Properties
- Interband Transitions
- Time Dependent Perturbation Theory
- The Joint Density of States and Critical Points
- Absorption of Light in Solids
- Optical Properties of Solids Over a Wide Frequency Range
- Impurities and Excitons
- Luminescence and Photoconductivity
- Harmonic Oscillators, Phonons, and the Electron-Phonon Interaction
- Optical Study of Lattice Vibrations
- Non-Linear Optics
- Electron Spectroscopy and Surface Science
- Amorphous Semiconductors

Part III: Magnetic Properties

- Review of Topics in Angular Momentum
- Magnetic Effects in Free Atoms
- Diamagnetism and Paramagnetism of Bound Electrons
- Magnetism in Solids
- Paramagnetism of Nearly Free Electrons
- Landau Diamagnetism
- The Quantum Hall Effect
- Magnetic Ordering
- Magnetic Devices

Part IV: Superconducting Properties of Solids

- Review of Superconducting Properties of Solids
- Macroscopic Quantum Description of the Supercurrent
- Microscopic Quantum Description of the Supercurrent
- Superconductivity in High Transition Temperature Cuprate Materials