

# Solid State Physics

3 credits

**Bulletin Description:** Crystal structure and binding, reciprocal lattices and x-ray diffraction, lattice vibrations, thermal properties, free electron model, band theory, magnetism, superconductivity. Prereq. Phys 485/685.

**Instructor:** Andrei Kryjevski, South Engineering 318D  
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**Meetings:** Tue Th 11:00-12:15      **Office Hours:** W 14:00-16:00  
South Engineering 318D      (or by arrangement)

**Goal:** To master the foundations of solid state physics, including fundamental concepts and basic theoretical methods.

**Student Responsibilities:** Complete assignments on time. Come prepared for discussion. Ask questions and give feedback.

**This course has no single textbook: attending lectures and taking notes is encouraged.**

**Literature:**

N. W. Ashcroft, and N. D. Mermin, **Solid State Physics**, (Brooks/Cole, 1976)  
J. M. Ziman, **Principles of the Theory of Solids**, 2nd ed. (Cambridge, 1979)  
C. Kittel, **Introduction to Solid State Physics**, (Wiley, 2004)

**Major Topics:**

- **Translational Symmetry in Periodic Solids**
- **Properties of the Reciprocal Lattice:** Miller Indices
- **Lattice Dynamics:** Properties of Lattice Waves, Brillouin Zone, Lattice Specific Heat, Debye Approximation
- **Classification of solids:** Covalent, Molecular, Ionic Crystals
- **Diffraction by an Ideal Crystal**
- **Electron States:** Adiabatic Approximation, One-electron approximation
- **Bloch's Theorem**
- **Approximating Electron States:** Free Electrons, The Nearly-free-electron Model, The Tight-Binding Approximation
- **Quasi-classical Dynamics**
- **Electrons and Holes in Crystals, Band Structure:** Donor and Acceptor Levels in Semiconductors, Excitons
- **Electron Surface States** (if time permits)
- **Electron-electron Interactions:** Screening, Plasma Oscillations (if time permits)

**Evaluation:** homework assignments (60%); 2 exams (midterm 15%, final 25%)

**Homework and Lateness:** Group discussion of homework is strongly encouraged, but written solutions must be your own. Late work will be accepted with a 20% penalty/day until next class.

**Grading:** A: 90-100%, B: 70-89.9%, C: 60-69.9%, D: 50-59.9%, F: < 50%

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*Any students with disabilities who need accomodation in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements.*