

Physics 713 Solid State Physics

Professor Adrienn Ruzsinszky Perdew

Fall 2011

Prerequisites: Undergraduate quantum mechanics at the level of Physics 447, or permission of the instructor. Graduate students of physics, chemistry and engineering can benefit from this course, as can advanced undergraduate physics majors (for whom permission of the instructor is required to enroll). Questions related to the subject are welcomed and encouraged.

Mission: To understand the physics of solids. To do so, we will consider a sequence of models of increasing sophistication, from the classical free electron gas to a real crystal with quantized lattice vibrations.

Goals, objectives, and measurable outcomes: Students will learn about the types of solids, their properties, and the concepts and principles underlying solid state physics. The students' understanding will progress through a sequence of models or approximations, from the simplest to the more detailed and realistic, and their education will to some extent recapitulate the history of the development of solid state physics. This course serves as a last course in solid state physics for most graduate students, and as an entry to research in solid state physics and related subjects for some. Graded homework problems and exams will test the students' understanding of concepts and their ability to think and solve problems.

Text: N.W. Ashcroft and N.D. Mermin, Solid State Physics

Lecture times: TR 9:30-10:45 Room: Goldring/Woldenberg Hall II. Room 3101

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Topics: Drude classical theory of metals.
Sommerfeld quantum theory of metals.
Failures of the free-electron model.
Crystal lattices.
Reciprocal lattice.
Determination of crystal structures by X-ray diffraction.
Electron levels in a periodic potential.
Electrons in a weak periodic potential.

Tight-binding method.
Semiclassical model of electron dynamics.
Fermi surface.
Beyond the independent electron model.
Classical theory of the harmonic crystal.
Quantum theory of the harmonic crystal.
Semiconductors.

Course grade: homework	20%
midterm exam	35%
final exam	45%

midterm exam Thurs., October 20, 2011 in class

final exam Fri., December 16, 2011 8-noon
1/3 on material before the midterm,
2/3 on material after the midterm.