Spring 2021

PHYS 446-002: Solid State Physics

Tao Zhou

Syllabus of Physics 446
Solid State Physics

A Short Introduction:

- This is a junior or senior undergraduate 3 credits course, 2 times per week, 1 hour 20 minutes each.

Lecture Faculty:

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Office hours: Monday 1:00 – 2:30 pm, Wednesday 1:00 – 2:30 pm.

Pre- and Co-requisite Courses:

Physics 335 Students are encouraged to take **Phys 442** (Introduction to quantum mechanics) first, or concurrently.

Course Textbooks:

Introduction to Solid State Physics, C. Kittel, 7th edition or later, John Wiley & Sons, 1996

Grade Decomposition:

Total course grade = 30% Home work + 30% Midterm + 40% Final

Course material outline:

This course introduces the basics of solid state physics, which forms the core of condensed matter physics, the biggest branch of physics currently. Students are expected to already have basic knowledge of thermal physics and quantum mechanics. The course will start with the basic building block of crystal, the periodic lattice, and emphasize the fundamental feature of solid state physics is wave behavior in periodic structures. This includes the lattice vibration, or phonons, as well as electron wave and energy band. In the second half of the course, we move to specific materials, and apply the basic concepts learned on the first half onto these materials, which include metals, semiconductors, superconductors and magnetic materials. We also discuss specific elementary excitations such as plasmons, polaritons, polarons and excitons.

Course Schedule:

Week 1 Crystal structure and reciprocal lattice (chap. 1 & 2)

Week 2 Crystal binding and elastic constants (chap. 3)

Week 3 Phonons (chap 4 & 5)

Week 4 Free electron Fermi gas (chap. 6)

Week 5 Energy band (chap. 7)

Week 6 mid-term exam and Semiconductor crystals (chap. 8)

Week 7 Fermi surfaces and metals (chap. 9)

Week 8 Plasmons, polaritons and polarons (chap. 10)

Week 9 Optical processes and excitons (chap. 11)

Week 10 Superconductivity (chap. 12)

Week 11 Dielectrics and ferroelectrics (chap. 13)

Week 12 Diamagnetism and paramagnetism (chap. 14)

Week 13 Ferromagnetism and antiferromagnetism (chap. 15)