



COURSE TITLE/SECTION: Solid State Physics I (Physics 7337)

TIME: 2.30-4.00 PM, Tuesday and Thursday (Fall Semester, 2010)

Instructor: Haibing Peng

OFFICE HOURS: By appointment.

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I. Course Catalog Description

7337: Solid-State Physics I: Cr. 3. (3-0). Prerequisites: [PHYS 6315](#), [PHYS 6316](#) and [Phys 6327](#); or consent of instructor. Periodic structures, lattice dynamics, specific heat, one-electron theory of solids, band structure, electron dynamics.

II. Course Objectives

Upon completion of Phys 7337 and 7338, students will be able to have a comprehensive understanding of modern solid state physics, critical for graduate students working in the areas of semiconductors, magnetic materials, superconductivity and nano-physics.

III. Course Content ([Tentative](#)):

Chapter 1 Lattice Structures

Lattice, reciprocal lattice and the determination of crystal structure by X-Ray diffraction.

Chapter 2 Electrons in Crystal Potential

The Hamiltonian of the solid, single-particle approximation, periodicity - Bloch states, symmetries of band structures, the tight-binding approximation.

Chapter 3 Lattice Waves

Lattice dynamics, quantization of lattice waves, phonons, lattice specific heat, diffraction by crystal with lattice vibrations, Debye-Waller factor.

Chapter 4 Static Properties of Solid

Types of solids: band and bond pictures, cohesion, rigid band model and density of states, Fermi statistics of electrons, and electron specific heat.

Chapter 5 Electron-Electron Interaction

The Hartree and Hartree-Fock approximations, linear response theory, Lindhard dielectric response function, Thomas-Fermi static screening, screened impurity, Kohn anomaly, the Friedel sum rule.

Chapter 6 Dynamics of Electrons

k , p expansion and effective mass theory, crystal electrons in an electric field, Wannier representation, the equivalent Hamiltonian: impurity levels, Excitons, Zener breakdown: tunneling, scattering of electron by impurities, renormalization of sound velocity, the electron-phonon interaction.

Chapter 7 Transport Properties (If time does not allow, it will be covered in Phys 7338)

Classical Drude model, the semi-classical Boltzmann equation, the quantum approach: linear response theory for conductivity and dielectric function.

IV. Text Books and References

-Required textbook: J. M. Ziman, "Principles of the Theory of Solids" (2nd Edition, Cambridge

University Press)

-Recommended textbook:

1. Neil W. Ashcroft, N. David Mermin, "Solid State Physics"
2. Eftimios Kaxiras, "Atomic and Electronic Structure of Solids" (Cambridge University Press, 2003)

V Course Requirement

Quantum Mechanics and Statistical Physics.

A. Reading Assignments

Read the part of the textbook and the provided lecture notes before lecture is given

B. Written Assignments

Homework problems will be assigned for each chapter.

C. Projects (as needed)

There will be no projects

D. Exams (as needed)

There will be one mid term and one final examination in each semester.

Class attendance: Student attendance to all classes is mandatory. A student may be dropped or assigned with a grade F if he or she is absent in more than 5 classes without a valid excuse. For the absence in class with a valid excuse, students must notify the instructor in time.

VII. Evaluation and Grading

Homework counts 20%

Mid term counts 40%

Final counts 40%

85 above = A, 75 above = A⁻, and 74-65 =B⁺, 64-50 =B. Below 50 =C.

Policy on grades of I (Incomplete): The temporary grade of I (incomplete) is a conditional and temporary grade given when students (a) are currently passing a course or (b) still have a reasonable chance of passing in the judgment of the instructor, but for non-academic reasons beyond their control have not completed a relatively small part of all requirements. Incompletes will be given only when documentation has been submitted to support the need to receive an incomplete, i.e., medical statements.

VIII. Consultation

Office hours are listed in page 1. (office: HSC 370; phone: 713-743-8233; email: haibingpeng@uh.edu)

IX. Bibliography

See textbook info.

The university requires all syllabi to have the following paragraph:

Addendum: Whenever possible, and in accordance with 504/ADA guidelines, the University of Houston will attempt to provide reasonable academic accommodations to students who request and require them. Please call 713-743-5400 for more assistance.

It is each student's responsibility to read and understand the Academic Honesty Policy found in the Student Handbook, which can be found at <http://www.uh.edu/dos/hdbk/acad/achonpol.html>.

Academic Dishonesty: Please see following website for information regarding academic dishonesty. www.uh.edu/honpol.

Standard Disclaimer: This syllabus is subject to change at the discretion of the instructor.