

Department of Physics and Astronomy

PHY 525 Solid State Physics II Fall 2005

I. The Course

Instructor: Kwok-Wai Ng
Office CP 385
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Office hour: Monday 9:00-10:00 a.m.

Time: Monday, Wednesday 2:00-3:15 p.m.

Place: CP 183

Text book: Introduction to Solid State Physics, 8th edition
Charles Kittel
Published by John Wiley in 2005.

II. Goal

Solid state physics is the study of properties of matter in solid phase. To form a solid, the atoms are not free to move with respect to each other as in liquid or gas. They can form a periodic crystal, or non-periodic structure, depending on the conditions of synthesis. We will mostly consider crystalline materials in this class. The electrons in the solid will distribute accordingly and give rise to a variety of interesting material properties and phenomena. You have learned in PHY 524 on how these electrons behave as independent entities in the periodic crystal potential. In this class, we will pay more attention to the interaction among these electrons and also the interaction between these electrons and other particles like photons and phonons. These interactions can give rise to many interesting phenomena such as superconductivity. Many of these phenomena have also lead to breakthrough in modern technologies. The goal of this course is to introduce you to some of these interesting phenomena and understand the physics behind.

Many students have already acquired basic knowledge in crystal structure, electron bands and phonons in PHY 524. Following the textbook, the present course is organized into five major topics according to the physical properties of materials: (i) mechanical properties (ii) thermal properties (iii) electrical properties, (iv) optical properties and (v) magnetic properties.

III. Grading Policy

There will be about one homework set of six to seven problems every week. The homework is due on the dates indicated. Late homework will not be accepted. The solutions handed in should be complete and comprehensive. They should also be neat and legible, with the solutions presented in an ordered and logical fashion. Solutions not satisfying these criteria will suffer a severe

reduction in grade. The homework will count for 30% of your total grade. Each homework problem will be weighted equally.

There will be two hourly tests, listed in the class schedule below. Each test will contribute 20% towards your total grade. This component will therefore constitute 40% of the final grade. The tests will cover all materials covered prior to their schedule dates, but after the previous test. This material will include what is covered in the readings, in the lectures, and in the assigned homework.

There will be a two hours final examination that will be comprehensive, covering all materials studied in this course this semester. This final examination will constitute 30% of your final grade. The examination will take place on Monday, December 12, from 10:30 am to 12:30 pm in CP 183.

In general, all tests and the final examination will be closed book. You will need to bring your own scientific calculator, and your own writing tools. You are not allowed to use any programs stored in the memory of the calculator.

Homework	30%
Test I	20%
Test II	20%
Final Examination	30%
Total	100%

Undergraduate and graduate students will have the same homework and examinations. However, graduate student work will be examined for greater comprehension.

IV. *Course evaluation*

Course evaluations are an important (and mandatory!) component of our Department's instructional program. An on-line course evaluation system was developed to allow each student ample time to evaluate each component of the course and instructor, thus providing the Department with meaningful numerical scores and detailed commentary while minimizing the loss of instructional time in the classroom. The evaluation window for Fall 2005 will open on Thursday, 17 November 2005 and close on Wednesday, 7 December 2005. To access the system during this time, simply go the Department of Physics Web page at <<http://www.pa.uky.edu>> and click on the link for Course Evaluations; then follow the instructions. You will need to use our student ID# to log into the system, and this will also allow us to monitor who has filled out evaluations. However, when you log-in you will be assigned a random number that will keep all your comments and scores anonymous.

IV. *Class schedule*

We will not have a fix schedule on the materials to be covered, but the topics will be introduced in the following order:

- I. Mechanical properties
 - Chapter 1 Crystal structure
 - Chapter 2 Wave diffraction and the reciprocal lattice
 - Chapter 3 Crystal binding and elastic constants
 - Chapter 20 Point defects
 - Chapter 21 Dislocations

- II. Thermal properties
 - Chapter 4 Phonons I. Crystal vibrations
 - Chapter 5. Phonons II. Thermal properties

- III. Electrical properties
 - Chapter 6 Free electron Fermi Gas
 - Chapter 7 Energy bands
 - Chapter 9 Fermi surfaces and metals
 - Chapter 8 Semiconductor crystals
 - Chapter 17 Surface and interface physics
 - Chapter 18 Nanostructure
 - Chapter 10 Superconductivity

- IV. Optical properties
 - Chapter 14 Plasmons, Ppolaritons, and polarons
 - Chapter 15 Optical process and Excitons
 - Chapter 16 Dielectrics and ferroelectrics

- V. Magnetic properties
 - Chapter 11 Diamagnetism and paramagnetism
 - Chapter 12 Ferromagnetism and antiferromagnetism
 - Chapter 13 Magnetic resonance

We will only briefly review materials in chapter 1 to chapter 7.

Dec 12 (M) Final examination. 10:30 am to 12:30 pm in CP 183