

PHYS 403/604 Fall 2018

Solid State Physics

Instructor Dr. Theodosia Gougousi

Phone 410 4556874

Office PHYS 317

E-mail gougousi@umbc.edu

Office Hours Tuesday-Thursday: 1:30-2:30 pm.

Course description (from the registrar)

An introductory course in solid state physics. Topics include specific heat, chemical bonding, crystal structures and lattice vibrations, free electron gas, energy bands, insulators, semiconductors and metals.

I will assume that you have a working knowledge of multivariable Calculus, special functions, vector analysis, differential equations, Fourier series and Taylor series.

Course Overview

In this course you will be given the opportunity to work on real world problems using toy models and utilizing some of the mathematical tools you have acquired in your physics and math courses. Solid state physics is an applied field that utilizes a lot of the knowledge you have already acquired in the lower level physics core courses as well as Statistical Mechanics. We will also use concepts and techniques of Quantum Mechanics. I understand that most of you have not yet completed this course. I will do my best to explain the concepts and provide as much background as needed but at some instances you will have to accept some facts until you are formally taught these techniques in the relevant class.

Learning Objectives:

After successfully completing this class, you should be able to:

Understand how solids are held together and how their structure is reflected in a number of macroscopic observations.

Use toy models of spheres and springs to describe the structure and vibrations in solids.

Understand what makes a material an insulator, metal or semiconductor and appreciate the utilization of these three types of materials in modern technology.

Textbooks

The Oxford Solid State Basics Paperback (August 16, 2013) by Steven H. Simon. The library copy is available on a 3-hour reserve.

Course grade

Homework: 25%

Homework discussion: 5%

2 Midterms: 20% each

Final (cumulative): 30%

In principle, everyone can get an A. I will not curve the grades but may change (lower) the limits depending on the difficulty of the exams and homework

score > 90 : A

score > 80: B

score > 70: C

score > 60: D

score < 60 : F

Course management

I will use **blackboard** to post course announcements, reading assignments and homework assignments, and post grades. Please do not use the digital dropbox. Send me an email instead.

Course policies

Reading assignments

Please come prepared to class. There is going to be a reading assignment for each lecture. I will not be able to cover every little part of the text book. I will try to cover the most difficult and important points of each chapter. You are responsible for all the material in the chapter unless it has specifically been excluded.

Homework

Homework should be turned in at the beginning of the class period on the due date. Late homework will not be accepted under any circumstances. You should turn in well organized and neat solutions not your scrap paper. **Equations and results that are subsequently used and/or referred to should be numbered. Final result should be placed in a box. I WILL NOT GRADE MESSY HOMEWORK.**

I will assign about 8-10 homework sets in the course of the semester. It is to your advantage to do all the homework problems and though tempting **not to use** the solutions that are available through various sources. This is the only way to develop your problem solving skills and be successful in the class. You can drop the lowest homework score. This should take care of any illness, job and family related emergencies or hangover issues.

I will grade homework for completeness and accuracy. In general, each part of a problem will be worth 3 points and the points will be assigned as follows:

3: complete solution and correct results is reached

2: mostly correct solution: start with the correct assumption but did not reach the correct result;

1: Valiant efforts but there are issues with the logic and understanding

0: had no clue but thought I should write anything related even tangentially

I will not provide complete solutions to the homework as I would like to use the same problems in the future iterations of the course. However, we will spend a minimum of 1 lecture hour per assignment discussing the graded and returned homework assignment. Each of you will take turns working through the problems on the board and we will all discuss approach and solution development.

Graduate students taking this as PHYS 604 will be asked to do some additional homework.

Use of Mathematica (or any other math software):

I expect you to be able to carry out all the mathematical operations required in your homework manually. You can use Mathematica to confirm your results if you like but the solution should have all the mathematical steps included in detail. If you use Mathematica to skip steps in your derivations you will get a zero for the whole problem.

Acceptable use of Mathematica:

You can use Mathematica as a reference tool, for example to look up integrals. I don't expect you to evaluate integrals analytically unless it is specifically asked. I use the "Schaum's Easy Outline of Mathematical Handbook of Formulas and Tables" routinely.

You can use Mathematica for plots.

Cell phone use:

Please turn off your cell phone as soon as you get in class and keep your phone in your pocket. You are welcome not to come to class; I will not hold it against you. But when in class you are not to check email, text or post on Facebook.

Exams

Exam solutions should be neat and organized, including explanations of what and why you are doing things (think **partial credit!!!**). Equations and results that are subsequently used and/or referred to should be numbered. **I will not grade sloppy solutions.**

All the exams are closed book. You will be given a formula sheet for each exam. You can only use a standard non-programmable calculator. The use of PDA's, portable CD players, ipod devices etc. is not allowed. Using such a device will be treated as cheating. Do not use any scrap paper of your own. You must turn off your cell phone during class and the exams. If you are caught using a cell phone during an exam you will asked to turn in your paper.

Midterms

There is going to be two midterm exams at dates to be announced. Since our class starts at 10:00 am I will try to reserve the class room at 9:00 am period to have a two hour exam. This is the absolute minimum time to have a reasonable exam on the subject. Make up exams will be given only if you miss the exam for a documented medical or legal problem or for a death in your immediate family. The instructor must be notified within 24 hours of the missed exam. Make up exams maybe oral or written.

Final Exam

The final exam will be cumulative but will be primarily based on the material covered after the midterm. No make-up exam will be given for the final (see note on incompletes below).

Incompletes

Please read carefully the catalog statement on acceptable grounds for incompletes. In this course, incompletes are given only if you miss the final exam due to a documented medical or legal problem or for a death in your immediate family. According to the catalog you must be doing "qualitatively satisfactory" work in order to qualify for an incomplete. For this course it means that your class averages is at least a C.

General guidelines.

In order to be successful in the course you should be able to handle the mathematical aspect with ease. If you are unsure about a concept or technique try to review it from your old textbook, notes or see me for help. Ignoring a weakness will come back to haunt you. Come to class prepared and ready to ask questions. I will not be able to cover every little topic but will focus on the most important points of each chapter.

Do not start on the homework the day before it is due. Giving yourself ample time to think about the problems and digest the material is important. Often you will catch yourself finding the solution to a "difficult" problem after thinking about it for some time, setting it aside and going back at it with a new approach. I do not discourage you from working in groups; however, to benefit the most you should go to your group's meeting prepared. Discuss with your classmates the merits of the various approaches to solve a problem and make sure that you understand why you are following the approach you have chosen. Remember that during exams you will not be able to bounce ideas off each other. If uncertain on how to get started on a problem go through the reading materials carefully. You will most certainly find hints to get you going. The best way to prepare for an exam is to go over the lecture notes and homework problems then attempt a few extra ones from the compilation at the end of each chapter.

Academic Integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Director.