Course Syllabus

Ve509

Semiconductor physics

Fall 2018

Course Description:

The main objective of this course is to convey insight into why semiconductors are peculiar compared to metals and insulators. In this respect, Starting with these two extreme materials is of fundamental importance to understanding semiconductors. There will be some overlap with Ve504 and because the course covers several aspects of solid states physics, I believe it is very useful offering the students different points of view about the same concepts, which are neither trivial nor intuitive.
I attempt in this course to establish a bridge between two different and often separated conceptions of material science, the engineering and physics approaches.

Instructor:

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Phone: ----------
Office: Room ----------
Office hour: From 10:00 to 12:00 on Thursday

Textbook (Author, Book Title, Publisher, Publication Year, ISBN):

C. Kittel: Introduction to Solid State Physics, 8th edition, John Wiley & Sons, 2005, ISBN #0-471-41526-X
N.W. Ashcroft and N.D Mermin: Solid State Physics, Saunders College, 1976, ISBN #0-03-083993-9
A. Rocket: The Materials Science of Semiconductors, Springer, 2008, ISBN #978-0-387-25653-5
S.M. SZE and K. Ng. Kwok: Physics of Semiconductor Devices, 3rd edition, John Wiley & Sons, 2007, ISBN #13-978-0-471-14323-9

The choice of a book is question of "taste". The students may appreciate differently the same book. The list of reference indicated above is not exhaustive. I strongly advise the students to search by their own other books related to the subject.

Course Prerequisites:

Advanced mathematics

Grading Policy (Assignments %, Project, Exams, etc.):

The evaluation will consist of a number of quizzes, two midterm and a final exam. The assignments will not be graded. However, some problems will be picked up for the exams.
The grading policy is as follows:

- Quizzes 20%
- Midterm I and II 25% + 25%
- Final exam 30%

Honor Code Policy:

- Homework assignments should be taken very seriously. You will never fully understand the technical material unless you work on enough problems by yourself. The lecture notes must be considered as guide lines.
- Quizzes and exams will be given under the JI's Honor Code and will require individual efforts. Quizzes and exams will be ***closed book and closed room***. Scientific calculators can be used for the exams. The use of other electronic devices such as electronic dictionary and cell phone during exams will constitute an Honor Code violation. If you miss an exam, real documentation is required stating why you could not attend (severe disease, for example).

Course Objectives

- Teaching the fundamental principles in semiconductor physics with a ***special emphasis on understanding*** rather than simply learning. The instructor will put a ***major focus on understanding*** the concepts sustaining fundamental principles and laws.
- The instructor will be carrying live questions (a kind of oral quiz) along with lectures. The objective is to initiate permanent exchanges and interactions with the students to improve the process of understanding.
- The instructor may decide randomly to give a quiz to help getting a glimpse on the understanding process.
- Solving typical problems during class is of fundamental importance to complete the understanding of difficult concepts
- Office hours intend at strengthening the discussions engaged during class.

Teaching Schedule:

Week	NO.	Date	lectures and Exams	Comments
1	1		Highlights and approach to VE509: Engineering vs Physics	Make up
	2		Semiconductors: A quick ride along basic properties	Make up
2	3		Where do the difficulties come from in studying solid physics and in particular semiconductors?	
	4		Systems with large numbers of particles: Classical statistics I	
3	5		Systems with large numbers of particles: Classical statistics II	
	6		Early theory of electrical and thermal properties of solids: Drude model	HW1
4	7		National holiday	
	8		National holiday	
5	9		Useful concepts imported from quantum mechanics	
	10		Thermal vibration of atoms: Semiconductors versus metals	
6	11		Beyond classical statistics: The concept of Fermi level	
	12		Beyond classical statistics: The concept of Fermi level (continued)	
7	13		Semi-classical theory of conduction: Sommerfeld model	HW2
	14		**Midterm I**	
8	15		Difficulties of free electron model: Crystals structure I	
	16		Difficulties of free electron model: Crystals structure II	
9	17		Wave and matter: Concept of reciprocal lattice	
	18		Brillouin zone and the origin of the band gap	HW3
10	19		Semiconductor properties: Concept of holes and effective masses	
	20		Quasi-particles in semiconductors: Phonons and excitons	
11	21		**Midterm II**	
	22		Light-semiconductor interaction	
12	23		Doping and diffusion	
	24		The key role of elementary defects in semiconductors	HW4
13	25		Practical issues of Fermi level in semiconductors	
	26		pn junction and Schottky barriers	
14	27		Carrier statistics: Generation and recombination	
	28		**Final**	

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