Syllabus PHYS 624: Introduction to solid state physics (Fall 2012)

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Textbook: “Introduction to solid state physics” by Charles Kittel, eighth edition, John Wiley & Sons, Inc. It is also recommended to use “solid state physics” by Ashcroft and Mermin and “Electrical properties of materials” by Solymar and Walsh as references.

Lecture Hours: Tuesday and Thursday 12:30 pm – 1:45 pm Sharp Lab 105

Office Hours: 2pm – 3 pm, Tuesday

Pre-requisites: Basic knowledge of calculus, classical mechanics, electricity and magnetism, statistical mechanics, quantum mechanics.

Homework: due 5 pm, Friday of the following week. You are allowed to discuss with each other. BUT you have to write it down all by yourself. And you have to show reasonable amount of work, instead of only showing the final results. If there is evidence that your homework is a direct copy of others, or if there is only the final result without intermediate steps, your homework will be marked down.

Lectures: A combination of power-point presentations and blackboard notes. Some lecture notes are provided on course website.

Distribution of credits: homework: 25%; midterm: 30%; final: 45%.

Exams: A midterm and a final. Midterm will be assigned a letter grade to indicate your standing in the class. But only the numerical score of the midterm will contribute to your final grade.

Excuse from an exam: One can only be excused from an exam under a University of Delaware excused absence. More details about excused absence can be found at http://www.udel.edu/provost/fachb/III-1-l-attendance.html

Course Contents:

1. Crystal Structure: Bravais lattice, primitive cell, lattice with a basis, common crystal structures (simple cubic, face centered cubic, body centered cubic, diamond, and hexagonal), miller indices, and classification of Bravais lattice.
2. The reciprocal lattice: definition of reciprocal lattice, construction of a reciprocal lattice, reciprocal lattice and Fourier transformation, Brillouin zones, and lattice planes and reciprocal vectors.
5. The Drude theory of metals: basic assumptions of Drude model, DC electrical conductivity of a metal, Hall effect and magnetoresistance, and AC electrical conductivity of a metal.

6. The Sommerfeld theory of metals: ground state properties of electron gas, periodic boundary conditions, Fermi sphere and Fermi surface, thermal properties of free electron gas, and electronic specific heat.

7. Electron levels in a periodic potential - energy bands: periodic potential, Bloch’s theorem, Born-von Karman boundary condition, Kronig – Penny model,


9. Tight binding calculation of band structure.


11. Semiclassical model of electron dynamics: Bloch wave packet, description of the semiclassical model, effective mass, motion of electrons in a constant electric field, conductors and insulators, and holes.


13. Semiconductor crystal: band structures of semiconductors, intrinsic carrier concentration, and impurity conductivity.