Course Profile - Department of Physics

Course Number : PHYS 454	**Course Title :** Solid State Physics
Required / Elective : Elective	**Pre / Co-requisites :** PHYS 333, PHYS 344
Catalog Description: Crystal diffraction; crystal binding; phonons and lattice vibrations; thermal, acoustic and optical properties; free electron model; quantum theory of solids, energy bands, tight binding approximation; semiconductors; diamagnetism and paramagnetism; ferromagnetism and anti-ferromagnetism.	**Textbook / Required Material :** Charles Kittel, *Introduction to Solid State Physics, 8th Edition*, John Wiley & Sons, 2005.
Course Structure / Schedule : (3+0+0) 3 / 5 ECTS	
Extended Description : Crystal structure: periodic array of atoms, fundamental types of lattices, crystal planes, simple crystal structures. Diffraction of waves by crystals: Bragg law, reciprocal lattice, Brillouin zones. Crystal binding: crystals of inert gasses, ionic crystals, covalent crystals, metals, hydrogen bonds. Phonons: l vibrations of crystals with one and two atoms per primitive cell. Thermal properties: phonon heat capacity, thermal expansion, thermal conductivity. Free electron gas: energy levels, heat capacity, thermal conductivity, electrical conductivity and Ohm's law, Hall effect. Energy bads: nearly free electron model, Bloch functions, Kronig-Penney model, wave equation of electron in a periodic potential. Semiconductor: band gap, equations of motion, holes, effective mass, intrinsic carrier concentration, impurity conductivity, thermoelectric effects. Fermi surfaces: reduced and periodic zone schemes, construction of Fermi surfaces, tight binding method. Magnetic properties: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism.	
Design content : None	**Computer usage**: Students use computational and graphics software to recognize the qualitative behavior of macroscopic quantities describing solids.

Course Learning Outcomes [relevant program outcomes in brackets]**:**

On successful completion of this course students will be able to

1. identify the lattice and crystal structures in one, two and three dimensions [1];
2. interpret the phonon dispersion curves of monatomic and diatomic chains [1,2];
3. demonstrate a knowledge of how the presence of the periodic crystal potential changes the band structure of electrons in solids [1,2,6];
4. describe the electrons' and phonons'contributions to electrical and thermal properties of solids [1,6];
5. compare free electron and nearly free electron theories in terms of their strengths and weaknesses [6];
6. develop an understanding of the basic properties of semiconductors [1,7];
7. discuss the basic magnetic properties of solids [1,5, 6].

Recommended reading:

Neil W. Ashcroft and N. David. Mermin, *Solid State Physics,* Saunders College Publishing, 1976.

Teaching methods:

Lectures of approximately 3 hours per week, pre-readings, and homework problems.

Assessment methods:

Two mid-term examinations, a final examination, weekly homework assignments, and quizzes.

Student workload:

Pre-reading	7 hrs
Lectures, discussions	45 hrs
Exercise sessions	0 hrs
Homework	25 hrs
Independent work	46 hrs
Laboratory work	0 hrs
Examinations	4 hrs

TOTAL ……………………………… 125 hrs … to match 25 x 5 ECTS

Prepared by : İsmail Karakurt , 01.02.2010	**Revision Date :**