

Solid State Physics I – FİZ 431E – Prof. Dr. Ferid Salehli

Quiz – 25%, Home work – 10%, Midterm – 25%, Final Exam – 40%

Syllabus

I. Crystal Structure and Interatomic Forces.

The crystalline state. Bravais lattices. Groups of symmetry. Interatomic forces. Type of bonding. Bragg's law. Scattering from atom and crystal. The reciprocal lattice and X-ray diffraction.

II. Lattice Dynamics.

Elastic waves. Lattice modes. Specific heat. The phonon. Lattice waves. Density of states. Specific heat and thermal conductivity. Scattering of X-rays, neutrons, and light by phonons. Lattice optical properties in the infrared.

III. Metals. The Free Electron Model.

Conduction electrons. The free electron gas. Electrical conductivity. Electrical resistivity versus temperature. Heat capacity of conduction electrons. The Fermi surface. Effects of Fermi surface on electrical conductivity. Thermal conductivity in metals. Motion in a magnetic field: cyclotron resonance and Hall effect. The AC conductivity and optical properties.

IV. Energy Bands in Solids.

Energy spectra in atoms, molecules, and solids. Energy bands in solids. The Bloch theorem. Band symmetry in k -space. Brillouin zones. The nearly free electron model. The energy gap and the Bragg reflection. The tight-binding model. Metals, insulators, and semiconductors. Density of states. The Fermi surface. Velocity of the Bloch electron dynamics in an electric field. The dynamical effective mass. Physical origin of the effective mass. The holes and conductivity. Experimental determination of band structures.

Books:

- M. Ali Omar – Elementary Solid State Physics: Principles and Applications, Addison-Wesley Public Company, 1993
- N.W. Ashcroft, N.D. Mermin, Solid State Physics.