Level: master

Course title: Advanced course of physics of condensed matter

Status: obligatory

ECTS: 8

Requirements: Contemporary experimental physics II, Physics of condensed matter

Learning objectives

Acquisition of up-to-date knowledge about models and physical characteristics of condensed state matter and the application of advanced materials.

Learning outcomes

After completing and mastering the course, students should possess:

- Scientifically based understanding of physical processes and interpretation of physical phenomena in condensed matter physics;
- Ability to read professional literature and prepare scientific presentations;
- Ability to independently perform measurements and experiments for characterization of materials;
- Ability to participate in teaching as a demonstrator in this area;
- Ability to transfer the acquired knowledge to other individuals and groups.

Syllabus

Theoretical instruction

Vibrations in crystals. Monatomic lattice. First Brillouin zone. Group velocity. Diatomic lattice. Long wave limit. Quantization of elastic vibrations - phonons. Moment of phonon. Inelastic scattering of phonons. The generalization of the 3D lattice. Charge carrier statistics. The density of quantum states. Effective mass of charge carriers. Zone theory of crystalline state. The energy levels in real crystals. Transport processes. Electronic states in amorphous systems.

Superconducting theory: macroscopic (London and Ginzburg-Landauva) and microscopic (BSC). Superconductors type I and type II. Low-temperature and high-temperature superconductors. Modern theories of high-temperature superconductors. Josephson effect in superconducting materials. Macroscopic theory of dielectrics. Microscopic polarization. Local field. Frequency dependence of the dielectric constant. Dielectric losses. Imperfections in dielectrics. Ferroelectricity. Piezoelectricity. Dielectric function, plasmons and polarons. Magnetism. Langevin theory of diamagnetism. Quantum theory of diamagnetism and paramagnetism. Ferromagnetic arrangement. Magnons and spin waves. Ferrimagnetic and antiferromagnetic arrangement. Ferromagnetic domains. Single-domain particles.

Practical instruction

Experimental and calculation exercises that follow the content of lectures.

Weekly teaching load				Other:
Lectures: 3	Exercises: 1	Other forms of teaching: 3	Student research:	