Level: PhD

Course title: Magnetic measurements as method of materials investigation

Status: elective

ECTS: 15

Requirements:

Learning objectives

Introducing students to the magnetic phenomena of materials. Introducing the magnetic structure of materials and the possibility of their applications. Mastering modern experimental techniques in the study of magnetic properties.

Learning outcomes

Upon completion of the course, students should have developed:
- General skills: knowledge of metrology and ability to follow professional literature.
- Subject-specific skills: Knowledge of the experimental techniques for determining the magnetic properties of materials. Mastering the experimental technique of determining the magnetic properties of specific materials and interpretation of these results.

Syllabus

Theoretical instruction

Units in magnetism. Magnetic magnitudes of the CGS and the SI system by Sommerfeld and Kennelly. Classification of materials in relation to magnetic properties. Diamagnetics. Paramagnetics. Superparamagnetics. Strong magnetics: ferro-, antifero-, ferrimagnetics and noncollinear magnetic. The dependence of magnetization and susceptibility of the sample composition, temperature and field. Magnetism of ionic compounds. Magnetism of metals and alloys. Measurements of magnetization and susceptibility in stationary and alternating mode. Induction method. Vibrating magnetometer. Faraday method. Gouy method. SQUID. The spontaneous magnetization and Curie points based on experimental data. Nuclear - magnetic resonance. Electron paramagnetic resonance. Determination of g-factors. Material's testing by hyperfine interactions method. Neutrons. Neutron diffraction as a method of determining magnetic structures. Non-elastic scattering and magnons. Determination of magnetic anisotropy and magnetostriction. Magnetostriction of materials. Hard magnetic and soft magnetic materials. Determination of domains and domain walls. Magnetic properties of semiconductors. Pauli paramagnetism. Diamagnetism by Landau. Langevin's diamagnetism. Van Vleck's induced paramagnetism. Paramagnetic properties of the orientation type: Curie-Weiss law, Neel's temperature. Kirkwood-Dorfman's method of separating components of magnetic semiconductors. The influence of doping atoms on magnetic properties of semiconductors. Subsystems in ferromagnetic semiconductors. Application of magnetic measurements for testing one type of magnetic material (e.g. doped semiconductor, ferrite or intermetal or metallhydrid or ...)

Practical instruction

Numerical and experimental exercises that follow the content of lectures; making presentations and seminars.

Weekly teaching load				Other:
Lectures: 6	Exercises:	Other forms of teaching:	Student research: 4	