Course title: Magnetic measurements as method of materials investigation

Lecturer: Imre Gut

Required Course: elective

Number of ECTS: 15

Prerequisites: нема

Course Objective:

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

Course Outcome:

Upon completion of the course student should have developed:

- General skills: knowledge of metrology and ability to monitor 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.

Course Content:

Theoretical instruction

Units in magnetism. Magnetic magnitudes of the CGS and the SI system by Somerfeld and Kenely. Classification of materials in relation to magnetic properties. Diamagnetics. Paramagnetics. Superparamagnetics. Strong magnetics: ferro-, antifero-, ferrimagnetics and noncolinear 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. Kirkwoodd-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 etalhydrid or ...)

Student research

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

Readiing List:

1. С.В. Вонсовскии, *Магнетисм*, Наука, Москва, 1971.
2. K.H.J. Buschow, F.R. De Boer, *Physics of Magnetism and Magnetic Materials*, Kluwer Academic/Plenum Publishers, New York, 2003.
3. Ю.С. Тверьянович, М.С. Гутенев, *Магнетохимия стеклообразных полупроводников*, Изд. С-Петербургского Университета, 1997.
4. V. Antonov, B. Harmon, A. Yaresko, *Electronic Structure and Magneto-Optical Properties of Solid*, Kluwer Academic Publishers, Dordrecht, 2004

Total hours:		10	
Lectures: 5	Practicals:	Other:	Student research work: 5

Methods of instruction:

Theoretical instruction is realized using contemporary teaching method of presentation, with the active participation of students and practical instruction includes laboratory exercises and preparation and presentation of a seminar paper.

Assessment (maximum number of points 100)
Requirements Active participation in lectures 5 pts, Active participation in practicals 10 pts, Seminar work 25 pts Oral exam 60pts