Announcement

Magnetism

Prof. Herr, apl. Prof. Koslowski

Description

Magnetism is a phenomenon which has been applied early after its discovery. The origin are magnetic moments contributed by a magnetic material, or electrical currents. The lecture will introduce types and concepts of magnetism in materials, based on quantitative physical models. Special emphasis will be on applications such as hard and soft magnets, data storage, magnetic resonance imaging, and magnetic sensors. The lecture is accompanied by a set of practical lab experiments focussing on selected aspects of magnetism and its applications.

Instruction language

English

Duration

1 semester

Allocation to study programmes

Physics M.Sc., elective module, 1st or 2nd semester

Prerequisites

Formal prerequisites: None

Recommended prerequisites: fundamentals of electrodynamics, solid state physics (crystallography, electronic structure), statistical physics

Learning Outcomes

Students who completed this course will be able to understand and apply important concepts of magnetism and up-to-date magnetic materials and devices. They will learn to use concepts of solid state and statistical physics to magnetic problems. In hands-on experiments they will acquire expertise in magnetic characterization of materials using modern measurement techniques.

Content

Lecture

- Magnetic Phenomena: Fundamentals and Units
- Diamagnetism and Paramagnetism
- Ferro-, Ferri- and Antiferromagnetism
- Magnetic Anisotropy
- Magnetic Domains and the Magnetisation Process
- Magnetoresistance and Hall Effect
- Micromagnetism
- Magnetic Data Storage
- Magnetic Sensor Devices
- Magnetic Resonance Imaging

Lab

- Vibrating Sample Magnetometer

- SQUID Magnetometer
- MOKE Magnetometer and Kerr Microscopy
- Fluxgate Magnetometer
- GMR Sensors
- MRI Demonstrator
- Micromagnetic simulations

Literature

- J.M.D. Coey, Magnetism and Magnetic Materials, Cambridge University Press, 2010
- D. Jiles, Introduction to Magnetism and Magnetic Materials, Chapman and Hall/CRC
- J. Stöhr, H.C. Siegmann, Magnetism from fundamentals to nanoscale dynamics, Springer, 2006
- B.D. Cullity, C.D. Graham, Introduction to magnetic materials, Wiley, 2009
- R. Gross, A. Marx, Festkörperphysik, De Gruyter, 2014

Teaching and learning methods

Lecture (3 hours/week)

Lab (4 hours/week)

Assessment

Oral examination

6 ECTS credits

Lecturer

Prof. Herr (Institute of Micro and Nanomaterials)
apl.Prof. Koslowski, (Institute of Solid State Physics)