MICRO-602 **Micro-magnetic field sensors and actuators**

Boero Giovanni

Cursus	Sem.	Type
Microsystems and Microelectronics		Opt.

Language of teaching	English
Credits	1
Session	
Exam	Oral
Workload	30h
Hours	**14**
Courses	14
Number of positions	**20**

Frequency

Every 2 years

Remark

Next time: Spring 2022

Summary

The course provides the basis to understand the physics, the key performance, and the research and industrial applications of magnetic sensors and actuators. Together with a detailed introduction to magnetism, several magnetic sensors and actuators are studied.

Content

1. Basics of magnetostatics

Maxwell laws. Magnetostatic. Magnetic dipoles and currents. Equations in matter. Calculations methods for magnetostatics. Magnetic field concentration. Magnetic screening. Eddy currents. Skin and proximity effect. Phenomenological description of matter. Diamagnetism. Paramagnetism. Ferromagnetism. Material conductivity under electric and magnetic fields.

2. Sensors & Actuators (principles and selected topics)

Basic principles, design and characteristics of following selected sensors and actuators:

- Micromachined sensors.
- Hall effect devices.
- Anisotropic (AMR) and giant (GMR) magneto resistors.
- Flux-gates Microsystems.
- Magnetic resonance methods (NMR and ESR) and their applications in magnetometry, spectroscopy and imaging.
- Magnetic force microscopy (MFM).

Discussion of following topics: sensitivity, noise, accuracy, magnetic field resolution, electronic interfaces, applications.

3. Case studies

Study and discussion of examples of micro-magnetic sensors from the current scientific literature that illustrate the usefulness of the previously introduced concepts. Opportunities for scaling down, integration, and new applications.

Keywords

Magnetostatics, Hall effect devices, magnetic resonance, magnetometry, magnetic sensors

Learning Prerequisites

Recommended courses

Basic knowledge in physics and mathematics