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 2027

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 magnetism

Maxwell laws. Free and bounded currents. Magnetic dipoles. Applications of Biot-Savart, Ampere, and Faraday-Lenz laws. Eddy currents and skin effect.

2. Magnetism in matter

Diamagnetism. Paramagnetism. Ferromagnetism. Magnetostatic calculations. Force, torque, magnetic levitation. Galvanomagnetic effects in matter.

3. Magnetic field sensors sensors & actuators (principles, key-performance, applications, ...)

Hall sensors. Anisotropic magneto resistance (AMR) and giant magneto resistance (GMR) sensors. Fluxgates sensors. Superconducting quantum interference devices (SQUIDs). Mechanical cantilever-based magnetometers. Magneto-optical sensors. Inductive proximity sensors. RF and magnetic tags, other sensors.

4. Magnetic imaging

Magnetic force microscopy (MFM), scanning Hall probe microscopy (SHPM), Magnetic resonance imaging (MRI), other methods.

5. Nanomagnetism

Atomic magnetism. From magnetic atoms to magnetic solids. Exchange and anistropy. Superparamagnetism. Magnetic micro and nanoparticles. Magnetic data storage.

Keywords

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

Learning Prerequisites

Recommended courses

Basic knowledge in physics and mathematics

Resources

Moodle Link

- https://go.epfl.ch/MICRO-602