PHYS-407

Frontiers in nanosciences

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Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The students understand the relevant experimental and theoretical concepts of nanoscale science. The course covers basic concepts like quantum size effects and their characterization techniques, and hot fields like nanoscale magnetism and spintronics for data storage applications, and 2D materials.

Content

1. Introduction to the concepts of nanoscale science
2. From atoms to bulk: electronic states
3. Imaging and manipulation at the atomic scale: scanning probe techniques
4. Magnetism at the nanoscale: magnetic data storage concepts (hard disk drive)
5. Spin transport: spin valve, GMR and TMR effects
6. Electron trasport in low-dimansional systems
7. Making the nanostructures: top-down and bottom-up approaches
8. Characterization of structural and electronic properties, for example by TEM, XPS, XAS
9. 2D materials

Learning Prerequisites

Recommended courses

Solid state physics

Learning Outcomes

- Explain the differences between nanoscopic and macroscopic scale
- Analyze the results of a scientific experiment
- Design a scientific experiment

Transversal skills

- Summarize an article or a technical report.
- Access and evaluate appropriate sources of information.
- Use a work methodology appropriate to the task.

Teaching methods

Ex cathedra with exercises in class

Assessment methods

oral exam (100%)

Resources

Bibliography

Introduction to Nanoscience, S.M. Lindsay, Oxford University Press
Physics of Surfaces and Interfaces, H. Ibach, Springer
Simple Models of Magnetism, R. Skomski, Oxford University Press
Quantum Transport: Atom to Transistor, S. Datta, Cambridge University Press

Ressources en bibliothèque

- Quantum Transport, Atom to Transistor / Datta
- Simple Models of Magnetism / Skomski
- Introduction to Nanoscience / Lindsay
- Physics of surfaces and interfaces / Ibach

Websites

- http://moodle.epfl.ch/course/view.php?id=7781

Moodle Link

- https://go.epfl.ch/PHYS-407