Summary
The students understand the relevant experimental and theoretical concepts of the nanoscale science. The course move from basic concepts like quantum size effects to "hot fields" such as spin transport for data storage applications (spintronics), carbon electronics, or nanocatalysis.

Content
1. Introduction to the concepts of nanoscale science
2. The art of making nanostructures:
   a. Bottom-up assembly
   b. Top-down fabrication
3. Quantum structures and devices:
   a. Current at the nanoscale
   b. Quantum technology
4. Carbon nanotechnology:
   a. From fullerenes to graphene
   b. Molecular electronics and machines
5. Microscopy and manipulation tools:
   a. Electron microscopy
   b. Scanning probe microscopy: STM, AFM, MFM
6. Spectroscopy tools:
   a. Electron and photon spectroscopy: XPS, XAS, Auger
   b. Electron and photon diffraction: LEED, TEM, SXRD
   c. Synchrotron radiation
7. Magnetism at the nanoscale:
   a. Orbital and spin magnetic moment
   b. Superparamagnetic limit in magnetic data storage
8. From electronics to spintronics:
   a. 2D electron gas at heterogeneous semiconductor interfaces
   b. Single electron transistor
   c. Spin transport: spin valve, GMR and TMR effects

Learning Prerequisites

Recommended courses
Solid state physics

Learning Outcomes
By the end of the course, the student must be able to:
• 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 visiting of laboratories at EPFL and the Max-Planck-Institute for Solid State Research in Stuttgart, Germany

Assessment methods
oral exam (100%)

Resources
Ressources en bibliothèque
• Quantum Transport, Atom to Transistor / Datta
• Physics of surfaces and interfaces / Ibach
• Physics at surfaces / Zangwill
• Introduction to Nanoscience / Lindsay
• Surfaces and interfaces of solids / Lüth

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