PH2813
Advanced Materials and Novel Devices for Information Technologies

Professor: Brahim Dkhil

Language of instruction: English* – **Number of hours**: 36 – **ECTS**: 3

Prerequisites: Basic knowledge in solid state physics, electromagnetism, electronics, materials science

Period: S8 Elective 08 February to March IN28IE1, SEP8IE1

Course Objectives

The main goal of this interactive course is to present the state-of-the-art in research in the field of advanced electronic materials used in information and communication technologies. The novel devices considered are spintronics, mobile phones, sensor arrays and imaging systems, mass storage devices, random access memories, microwave communication systems or quantum computing.

On completion of the course, students should be able to

- Design a database suiting their needs
- Understand pros and cons of query tools; SQL and programming languages in dealing with databases

Course Contents

Research on new physical properties, ever more innovative, still unknown or not yet associated tpgether, permits the emergence of original materials because of a better control of matter at a nanoscale level, thus allowing novel nanostructures. Therefore, the knowledge and understanding of the physical mechanisms and phenomena involved in these physical properties, at different scale levels, should not be missed as they are a key step between the fabrication of the materials and their technological applications.

This course will highlight outstanding properties such as superconductivity, colossal magnetoresistance or giant piezoelectricity. The microscopic mechanism involved in these properties will be presented, by especially stressing the relationship between the structure (atomic, electronic, magnetic, nanometric, etc.) and the specific properties. The topics will address: dielectrics and ferroelectrics, magnetism and superconductivity, magnetoelectrics and multiferroics, optical phenomena and metamaterials, nano-objects: synthesis and characterization, collective phenomena and phase transition, electronic conduction and size effects.

Course Organization

Lectures: 18 hr, Tutorials: 9 hr, Labwork: 6 hr, Exam: 3 hr

Teaching Material and Textbooks

- Lecture notes: Advanced materials and novel devices for IT, B. Dkhil et al.
- Physics of solid state (C. Kittel)
- Solid State Physics (N.W. Aschcroft and N.D.Mermin)
- Nanomaterials (J. Chen)

Evaluation

Quiz (0.5 hr), report on team project, oral defense on the project (2.5 hr)