UCLouvain

lmapr2015

2020

Physics of Nanostructures

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	37.5 h + 22.5 h	Q1

Teacher(s)	Charlier Jean-Christophe (coordinator) ;Gonze Xavier ;Piraux Luc ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	In this lecture, the main concepts required to understand the physics of systems structured at the nanometer scale are introduced, and several types of these nano-systems are investigated in details : fullerenes, carbon nanotubes, graphene, systems for spintronics, clusters, nanowires, ' Realization of a project dedicated to the physics of a certain class of nanostructures. Oral presentation (under the form of a mini-colloquium) and written report of the project (including a recent bibliography ' research state of the art).
Aims	**Contribution of the course to the program objectives** Axis Nº1 : 1.1, 1.3 Axis Nº3 : 3.1, 3.3 Axis Nº5 : 5.3, 5.4, 5.5, 5.6 Axis Nº6 : 6.1, 6.4 **Specific learning outcomes of the course** At the end of their classes, the students are expected to be able: 1 1. to explain what are the basic principles and properties of the most important systems structured at the nanoscale : structural, electronic, magnetic, optical, chemical aspects, as well as the transport properties (incuding spin-dependent transport); 2. to implement simple models to describe the physical properties of nanostructures; 3. to present a few applications and to be able to search for scientific informations related to the physics of nanostructures in the scientific litterature; 4. to present and defend their project orally under the form of a mini-colloquium, including questions related to the other pojects; 5. to write a report related to the research state-of-the'art (and applications) related to the project, including a recent bibliography. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Writing of a report ; oral presentation under the form of a mini-colloquium (with questions); personalized discussion with the teachers. The final certification is based on the quality of the written report, on the oral presentation, and on the intensive discussions during the mini-colloquium.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Ex cathedra lectures, project-based learning, discussions (formative and certificative) with the teachers. Due to the limited capacity of auditoria this year (COVID-19 crisis), some classes could be given remotely or co-modally.
Content	In the first part of the course, the ex-cathedra lectures are divided in three parts. In the first one, the atomic and electronic structures of clusters and nanowires are studied. The second part is dedicated to carbon-based nanostructures (fullerenes, carbon nanotubes, graphene), and their associated concepts. At last, the third part describes the main spintronics concepts and nanosystems (giant magnetoresistance, tunnel magnetoresistance, spin valves, spin transfer torque, ...) and other novel routes to spintronic devices. In the second part of the course, students choose and complete a project (individually or in groups of two): • They select a topic of study related to the physics of specific class of nanostructures, and discuss its relevance in a plenary session (at which time one of the three teacher is appointed for their personal coaching); • They study this subject, with regular interview with the coaching teacher in order to insure the project is well focused; • They then prepare a preliminary report, which is discussed with the teachers during a formative evaluation;

	• Finally, they submit the report, and defend it orally during a mini-colloquium where the different projects are presented in a pedagogic way to the other strudents. The discussion between students are encouraged during this meeting.
Inline resources	https://moodleucl.uclouvain.be/course/view.php?id=10025
Other infos	For this lecture, it is assumed that the students have already acquired the basic concepts of material sciences, quantum physics, statistical physics, and material physics (taught for example in the lectures LMAPR1805, LMAPR1491, and LMAPR1492).
Faculty or entity in charge	FYKI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Physical Engineering	FYAP2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Chemical and Materials Engineering	KIMA2M	5		
Advanced Master in Nanotechnologies	NANO2MC	5		
Master [120] in Physics	PHYS2M	5		