UCL Université catholique de Louvain

LMAPR2015

2014-2015

Physics of Nanostructures

5.0 credits	37.5 h + 22.5 h	1q

Teacher(s) :	Gonze Xavier ; Charlier Jean-Christophe ; Piraux Luc ;
Language :	Anglais
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=MAPR2015
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: 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); to implement simple models to describe the physical properties of nanostructures; to present a few applications and to be able to search for scientific informations related to the physics of nanostructures in the scientific litterature; to present and defend their project orally under the form of a mini-colloquium, including questions related to the other pojects; 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 :	Redaction of a report ; oral presentation under the form of a mini-colloquium (with questions); personalized discussion with the teachers.
Teaching methods :	Ex cathedra lectures, project-based learning, discussions (formative and certificative) with the teachers.
Content :	In the firstpart 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 regularly consultation of the designed teacher in order to insure the project to be 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 strudents are encouraged during this meeting. 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.
Bibliography :	On icampus, the students will find : the directives, the supporting slides.
Other infos :	For this lecture, it is assumed that the students have already acquired the basic concepts of materials sciences, quantum physics, statistical physics, and materials physics, taught in bac 2 and in bac 3 (for example, in the lectures LMAPR1805, LMAPR1491, and LMAPR1492).

Cycle and year of study :	> Master [120] in Electrical Engineering > Master [120] in Physical Engineering > Master [120] in Chemical and Materials Engineering > Master [120] in Electro-mechanical Engineering
Faculty or entity in charge:	FYKI