UCL Université catholique de Louvain

LMAPR2471

2013-2014

Transport phenomena in solids and nanostructures

5.0 credits	30.0 h + 30.0 h	2q

Teacher(s) :	Charlier Jean-Christophe ; Piraux Luc (coordinator) ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	The covered topics include : electrical and thermal conductivities, thermoelectricity, experimental aspects, effects of temperature and magnetic field, spin polarized transport, electrical transport in two-dimensional and one-dimensional systems and molecular transport.
Aims :	This lecture provides a description of the main electrical and thermal transport phenomena in materials. It also gives an introduction to the specific transport properties in nanostructures and low dimensional systems, including quantum effects. Finally, the students become acquainted with experimental set-up used for transport measurements. *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".*
Content :	Content : A : Macroscopic Materials Electrical conductivity : Theory - Comparison between metals, semiconductors and semi-metals - Scattering mechanisms and temperature dependence - Links with band structure Thermal conductivity: Theoretical expressions for electrical and lattice contributions Scattering mechanisms and temperature dependence - Examples Thermoelectric effects : Theoretical expressions for Seebeck et Peltier effects - Examples - thermoelectric conversion Experimental aspects: set-up for electrical and thermal measurements Magnetic field effects : Influence of a magnetic field on the density of states and electrical transport B : Nanostructured materials and low-dimensional systems Magnetic nanostructures : spin polarized currents, giant magnétorésistance in magnetic multilayers, introduction to spin electronic 2D systems : examples of 2 dimensional electron gas, density of states, influence of a magnetic field, Quantum Hall effect, weak localization 1D systems: examples of 2 dimensional electron gas, density of states, influence of a magnetic field, ballistic transport, universal quantum fluctuations, Coulomb blockade, conductance qunatization, Aharonoc-Bohm effect. 0D systems: examples of quantum dot, molecular transport Methods : Ex-cathedra courses, laboratories (synthesis of materials and nanostructures, various characterization, experimental set-up, electrical and thermal transport measurements), analysis of the results.
Other infos :	MAPR 1492 Physique des Matériaux (or an equivalent course) MAPR 1491 Compléments de Physique (or an equivalent course) MAPR 1805 Introduction à la Science des Matériaux (or an equivalent course)
Cycle and year of study :	> Master [120] in Physical Engineering > Master [120] in Chemical and Materials Engineering > Master [120] in Electro-mechanical Engineering > Master [120] in Electrical Engineering
Faculty or entity in charge:	FYKI