UCLouvain

lphys1345

2023

Solid state physics

4.00 credits	30.0 h + 22.5 h	Q2

Teacher(s)	Cortina Gil Eduardo ;
Language :	French > English-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended that students master the notions of quantum physics as developed in the course LPHYS1241. Having followed LPHYS1342 and having followed and passed LPHYS1221 are assets.
Main themes	This teaching unit is an introduction to solid state physics. As such, we will deal with the different thermal and electric properties of solids. We will focus upon the application of basic concepts to semi-conductors (micro-electronic and technical applications for detecting charged particles) and to superconductivity.
Learning outcomes	**At the end of this learning unit, the student is able to :** a. **Contribution of the teaching unit to the learning outcomes of the programme** AA1 : 1.1, 1.4, 1.6 AA2 : 2.4 AA3 : 3.2, 3.5 AA6 : 6.3, 6.4. b. **Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able : 1 1. to identify the main crystalline structures and their symmetries, both for the spatial and reciprocal networks; 2. to compare the different types of crystalline bonds; 3. to apply analytical mechanics to periodic structures to deduce their thermal properties; 4. to describe the vibrations of a crystal in terms of phonons; 5. to apply statistical mechanics to a gas of electrons to deduce their thermal and electrical properties; 6. to establish how a periodic potential produces an energy band structure; 7. to deduce the properties of semi-conductors in the solids band structure; 8. to explain the behaviour of a diode and a transistor starting from the properties of semi-conductor crystals; 9. to discuss the properties of superconductors in the light of different phenomenological and/or microscopic models.
Evaluation methods	As long as the number of students enrolled allows it, the evaluation will take the form of oral exams comprising questions with immediate preparation, and a discussion without preparation which may cover the entire course. The possible laboratory report might contribute up to 10% in the evaluation.
Teaching methods	Lectures with short hands-on learning activities (e.g.: supervised questions, citing applications,). Exercises on Moodle. Individual exercise sessions which are supervised. Practical experiments.
Content	• Crystalline structure. Reciprocal network. Crystalline bond and elastic constants. • Phonons: network vibrations and thermal properties. • Fermi's gas of free electrons, quasi-free electrons, energy bands. • Semi-conductor crystals: basic properties and devices (diode and transistor). • Fermi surface and metals. • Superconductivity: experimental facts and theoretical approaches.
Inline resources	A moodle page includes the slides used in the class and self-assessment exercises.

Bibliography	Charles Kittel,Physique de l'état solide, EAN13 : 9782100497102 http://www.dunod.com/sciences-techniques/sciences-fondamentales/physique-et-astrophysique/master-et-doctorat-capes-agreg/physique-de-letat-solide David L. Sidebottom,Fundamentals of Condensed Matter and Crystalline Physics, ISBN: 9781107017108 http://www.cambridge.org/be/knowledge/isbn/item6687763/?site_locale=nl_BE Neil William Ashcroft et N. David Mermin, Physique des solides, ISBN : 2-86883-577-5 http://www.edition-sciences.com/physique-solides.htm
Other infos	Participation in both laboratory sessions is mandatory.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Physics	MINPHYS	4		🔍
Bachelor in Physics	PHYS1BA	4		🔍