UCLouvain

lphys1345

2020

Solid state physics

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).

4 credits	30.0 h + 22.5 h	Q2

Teacher(s)	Bruno Giacomo ;Delaere Christophe ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	LPHYS1241 or equivalent teaching unit from another programme. Having followed LPHYS1342 and having followed and passed LPHYS1221 are assets. *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
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.
Aims	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. - - - - *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.** 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	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** 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).

	• 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

Force majeure

Evaluation methods	The health crisis implies uncertainties as to the evaluation modalities, in particular for the June session. Two options are considered depending on the severity of the constraints related to the health crisis. A face-to-face plan A: • Oral exam A remote plan B: • Oral exam on Teams

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Physics	PHYS1BA	4	LPHYS1241	🔍
Minor in Physics	MINPHYS	4	LPHYS1241	🔍