

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. <i>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.</i>
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	<p><b>a. Contribution of the teaching unit to the learning outcomes of the programme</b></p> <p>AA1 : 1.1, 1.4, 1.6                      AA2 : 2.4                      AA3 : 3.2, 3.5                      AA6 : 6.3, 6.4.</p> <p><b>b. Specific learning outcomes of the teaching unit</b></p> <p>At the end of this teaching unit, the student will be able:</p> <p>1</p> <ol style="list-style-type: none"> <li>1. to identify the main crystalline structures and their symmetries, both for the spatial and reciprocal networks;</li> <li>2. to compare the different types of crystalline bonds;</li> <li>3. to apply analytical mechanics to periodic structures to deduce their thermal properties;</li> <li>4. to describe the vibrations of a crystal in terms of phonons;</li> <li>5. to apply statistical mechanics to a gas of electrons to deduce their thermal and electrical properties;</li> <li>6. to establish how a periodic potential produces an energy band structure;</li> <li>7. to deduce the properties of semi-conductors in the solids band structure;</li> <li>8. to explain the behaviour of a diode and a transistor starting from the properties of semi-conductor crystals;</li> <li>9. to discuss the properties of superconductors in the light of different phenomenological and/or microscopic models.</li> </ol> <p>-----</p> <p><i>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".</i></p>
Evaluation methods	Oral exams including immediate preparation questions, preparation on a subject chosen by the student and unprepared discussion on the two previous points.
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	<ul style="list-style-type: none"> <li>• Crystalline structure. Reciprocal network. Crystalline bond and elastic constants.</li> <li>• Phonons: network vibrations and thermal properties.</li> <li>• Fermi's gas of free electrons, quasi-free electrons, energy bands.</li> <li>• Semi-conductor crystals: basic properties and devices (diode and transistor).</li> <li>• Superconductivity: experimental facts and theoretical approaches.</li> </ul>

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

**Programmes containing this learning unit (UE)**

Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Physics	<a href="#">PHYS1BA</a>	4	<a href="#">LPHYS1241</a>	
Minor in Physics	<a href="#">LPHYS100I</a>	4	<a href="#">LPHYS1241</a>	