

1.	Field of study	Physics
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2025/2026 (winter term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

7.	General information about the module	
Module name		Solid State Physics
Module code		W4-FZ-NM-S2-1-22-14
Number of the ECTS credits		5
Language of instruction		English
Purpose and description of the content of education		<p>During the lecture, the student becomes familiar with the following issues:</p> <ol style="list-style-type: none"> <li>1. Elementary Crystallography, Solid materials (crystalline, polycrystalline, amorphous), Crystal Lattice, Crystal Structure, Types of Lattices, Unit Cell, Typical Crystal Structures, Bravais Lattices.</li> <li>2. Diffraction, diffraction condition, Bragg's law, reciprocal lattice, Reciprocal lattice vectors, Brillouin zones, the Structure Factor, Lattice planes, Miller indices.</li> <li>3. Crystal Dynamics, Lattice vibrations of 1D and 3D crystals, Phonons, Heat capacity from lattice vibrations, Anharmonic effects, Thermal conduction by phonons, Models of Heat Capacity (Einstein, Debye).</li> <li>4. Interatomic forces, Types of bonds in crystals, Ionic, Covalent, Metallic, Van der Waals, Hydrogen.</li> <li>5. Free electron Fermi gas, Fermi-Dirac Statistics, The Fermi energy, Electron Gas at <math>T = 0</math> and at <math>T &gt; 0</math>. Total Energy of a Gas of <math>N</math> Electrons, The electronic heat capacity.</li> <li>6. Band Theory of Solids, electrons in a periodic potential, bands and energy gaps, weakly and strongly bound electrons, Conductors, Insulators, Semiconductors.</li> <li>7. The crystal electron under the influence of an external force, the effective mass of an electron, Energy spectrum of crystal electrons in an external magnetic field, Landau levels.</li> <li>8. Transport Phenomena, Electrical and thermal conductivity in solids, the Wiedemann-Franz law, Thermoelectrical and Galvanomagnetic Effects,</li> <li>11. Magnetic properties of solids, diamagnetism, paramagnetism, ferro and antiferromagnetism, Atomistic Description of the Magnetic Moments, spin and orbital moment, spin-orbit coupling, Russell-Saunders coupling, 3d and 4f elements, types of magnetic interactions.</li> <li>12. Magnetic resonances (ESR, NMR)</li> <li>13. Nanocrystalline solids</li> </ol>
List of modules that must be completed before starting this module (if necessary)		not applicable

8.	Learning outcomes of the module			
	Code	Description	Learning outcomes of the programme	Level of competenc (scale 1-5)
	E1	has in-depth knowledge of selected areas of theoretical and experimental physics		

		KF_U01	3
		KF_W02	3
E2	has extensive knowledge of quantum mechanics and statistical physics	KF_W03	4
E3	has in-depth knowledge of condensed phase physics	KF_W04	4
E4	knows and understands the description of physical phenomena within the selected theoretical models; can independently recreate the basic physical laws	KF_U02	4
		KF_W05	4
E5	knows the mathematical formalism useful in the construction and analysis of physical models with an average level of complexity; understands the consequences of using approximate methods	KF_W06	4

9. Methods of conducting classes		
Code	Category	Name (description)
a01	Lecture methods / expository methods	Formal lecture/ course-related lecture <i>a systematic course of study involving a synthetic presentation of an academic discipline; its implementation assumes a passive reception of the information provided</i>
a05	Lecture methods / expository methods	Explanation/clarification <i>explication involving the derivation of a predetermined theorem from other, already known ones, in the number of steps specified by the person teaching the course</i>
b07	Problem-solving methods	Activating methods: a case study <i>a comprehensive description of a phenomenon connected with the selected discipline; reflecting the reality, presenting the 'what', 'where' and 'how' of the phenomenon, i.e., all of its key aspects to be discussed in class; used as a reproduction, presentation, discussion or diagnosis of factors that shape the phenomenon or interact with it; an in-depth qualitative analysis and evaluation of a selected phenomenon</i>

10. Forms of teaching					
Code	Name	Number of hours	Assessment of the learning outcomes of the module	Learning outcomes of the module	Methods of conducting classes
FZ1	lecture	25	exam	E1, E2, E3	a01
FZ2	discussion classes	25	course work	E4, E5	a05, b07

11. The student's work, apart from participation in classes, includes in particular:			
Code	Category	Name (description)	Is it part of the BUNA?
a02	Preparation for classes	Literature reading / analysis of source materials <i>reading the literature indicated in the syllabus; reviewing, organizing, analyzing and selecting source materials to be used in class</i>	No
a03	Preparation for classes	Developing practical skills <i>activities involving the repetition, refinement and consolidation of practical skills, including those developed during previous classes or new skills necessary for the implementation of subsequent elements of the curriculum (as preparation for class participation)</i>	Yes
b01	Consulting the curriculum and the organization of classes	Getting acquainted with the syllabus content <i>reading through the syllabus and getting acquainted with its content</i>	No

c02	Preparation for verification of learning outcomes	Studying the literature used in and the materials produced in class <i>exploring the studied content, inquiring, considering, assimilating, interpreting it, or organizing knowledge obtained from the literature, documentation, instructions, scenarios, etc., used in class as well as from the notes or other materials/artifacts made in class</i>	Yes
c03	Preparation for verification of learning outcomes	Implementation of an individual or group assignment necessary for course/phase/ examination completion <i>a set of activities aimed at performing an assigned task, to be executed out of class, as an obligatory phase/element of the verification of the learning outcomes assigned to the course</i>	Yes
d01	Consulting the results of the verification of learning outcomes	Analysis of the corrective feedback provided by the academic teacher on the results of the verification of learning outcomes <i>reading through the academic teacher's comments, assessments and opinions on the implementation of the task aimed at checking the level of the achieved learning outcomes</i>	No

Information on the details of the module implementation in a given academic year can be found in the syllabus available in the USOS system: <https://usosweb.us.edu.pl>.