University of Gdańsk

Subject card

Subject name and code	Solid State Physics, PG_00168487		
Field of study	Nuclear safety and radiological protection		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	5.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Tadeusz Leśniewski	
	Teachers	dr Natalia Górecka	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	60	0.0	65.0	125

Subject objectives	1. Understanding at an academic level the basic knowledge of crystallography, the band structure of solids, and the electrical and thermal properties of solids.2. Understanding the processes of interaction between radiation and solids.3. The ability to independently predict the effects of interactions between radiation and matter and their practical applications.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[BJORL3_U01] can formulate the basic laws of physics and chemistry using mathematical formalism	The student is able to formulate the laws governing the crystal structure of solids and mathematically describe phenomena such as diffraction, magnetization, electronic conductivity. The student uses mathematical formalism to analyze the relationship between fundamental laws governing the constituents of matter and the microstructure of a material, and its physical properties (e.g., thermal and electrical conductivity, magnetic properties).	[SU3] text preparation/written work [SU4] test/exam - oral or written
[BJORL3_W02] Understands the role of physical and chemical experimentation, mathematical theoretical models approximating reality, and computer simulations in scientific research methodology; is aware of technological, apparatus, and methodological limitations in scientific research	The student understands the importance of physical experiments in studying the structure and properties of solids and is able to interpret basic measurement results, such as X-ray diffraction and conductivity measurements. The student is familiar with fundamental theoretical models used in solid-state physics and understands their limitations in describing real materials. The student is able to identify the role of computer simulations and numerical methods in the analysis of electronic structure and material properties.	[SW4] test/exam - oral or written [SW3] text preparation/written work
[BJORL3_W05] has knowledge of the elementary components of matter and the types of fundamental interactions between them, the manifestations of these interactions in phenomena occurring at scales ranging from subatomic to subatomic, knows the time and energy scales associated with these phenomena; knows the basics of biology and ecology in understanding the biological and ecological aspects of nuclear safety and radiation protection	The student has basic knowledge of crystallography, including the structure and classification of crystal lattices, as well as the importance of lattice order for the physical properties of solids. The student is able to identify the relationships between the physical properties of materials and their atomic composition and microstructure, taking into account fundamental interactions (electromagnetic and nuclear). The student understands the electronic structure of solids in the context of intermolecular and interatomic interactions and the resulting physical properties of materials. The student is familiar with the mechanisms of interaction between ionizing radiation and solid matter, as well as their consequences on both atomic and macroscopic scales.	[SW4] test/exam - oral or written [SW3] text preparation/written work

<table>
<tr><td>Subject contents</td><td>1. Structure of solids – chemical bonding and crystal structures.
2. X-ray diffraction in crystals.
3. Growth of crystals and thin films.
4. Electromagnetic properties of matter.
5. Electrical properties of metals and insulators – band structure and electrical conductivity.
6. Intrinsic and doped semiconductors – charge carriers, doping, Hall effect.
7. p–n junctions – charge transport, photovoltaic effect.
8. Interaction of electromagnetic and nuclear radiation with matter.
9. Thermal properties of solids, superconductivity.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>1. Basic knowledge of general physics, particularly mechanics, thermodynamics, and electromagnetism.
2. Basic mathematical skills (differential and integral calculus, linear algebra).
3. Knowledge of general chemistry fundamentals (atomic structure, chemical bonding).
4. Ability to analyze simple physical phenomena and interpret experimental data.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>written tests</td><td>50.1%</td><td>50.0%</td></tr>
<tr><td>oral exam</td><td>50.1%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>Kittel, C. Introduction to Solid State Physics, John Wiley & Sons</td></tr>
<tr><td>Supplementary literature</td><td>S. Tavernier, A. Getkin, B. Grinyov, W. W, Moses, Radiation detectors for Medical Applications, Springer

S. Cherry, J. Sorenson, M. Phelps, Physics in Nuclear Medicine, Elsevier

M. L'Annunziata, Handbook of Radioactivity Analysis, Elsevier</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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