University of Gdańsk

Subject card

Subject name and code	Elements of Solid-State Physics and Crystallography, PG_00210379						
Field of study	Medical Physics						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	Bachelor's studies		Subject group	Optional subject group 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	4		ECTS credits	4.0			
Learning profile	academic		Assessment form	credit			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Tadeusz Leśniewski				
	Teachers						
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	50.0	110	
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. Developing the ability to analyze radiation–matter interactions and to assess their significance in medical diagnostics and radiotherapy.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMEDL3_U10] Can independently plan and implement his/her own lifelong learning.	The student is able to independently acquire and critically analyze information concerning modern materials used in medical instrumentation, radiation detectors, and dosimetry. The student is able to use scientific and technical literature to expand knowledge of the physical foundations of diagnostic and therapeutic techniques employing radiation.	[SU3] text preparation/written work
[FIZMEDL3_W01] Knows and understands at an advanced level the phenomena, principles, laws and theories specific to physics and biophysics.	The student possesses knowledge of the structure and properties of solid-state materials, including crystal structure, electronic structure, and the fundamental electrical, magnetic, and thermal properties of materials. The student understands the mechanisms of electrical conductivity in metals and semiconductors, as well as the role of dopants and semiconductor junctions in electronic devices and radiation detectors. The student is familiar with the fundamental mechanisms of interaction between electromagnetic and ionizing radiation and matter and understands their significance in medical imaging, dosimetry, and radiation protection.	[SW4] test/exam - oral or written [SW3] text preparation/written work
[FIZMEDL3_U01] He can formulate, analyse, and solve complex problems in physics and medicine, using mathematical formalism, based on the physical phenomena, principles, and theories he has learned.	The student is able to apply the fundamental principles of solid-state physics to analyze material properties and describe phenomena occurring in metals, semiconductors, and dielectrics. The student is able to interpret relationships between material structure and physical properties and to analyze radiation–matter interactions using basic mathematical formalism.	[SU3] text preparation/written work [SU4] test/exam - oral or written

Subject contents

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.

Prerequisites and co-requisites

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.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
written tests	51.0%	90.0%
activity during classes	0.0%	10.0%

Recommended reading

Basic literature	Kittel, C. Introduction to Solid State Physics, John Wiley & Sons

	Supplementary literature	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
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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