GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Funamentals of modern physics, PG_00062728		
Field of study	Technologies for Industry 5.0		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	first-cycle 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	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Physics of Disordered Systems -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Michał Winiarski	
	Teachers	dr inż. Michał Winiarski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	15.0	0.0	0.0	60

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=4550

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	5.0	35.0	100

Subject objectives

The aim of the course is to familiarize students with the basic issues of modern physics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U01] applies knowledge of mathematics, physics, chemistry, IT tools and other engineering disciplines to solve theoretical, engineering and technological problems	The student applies the laws of physics to solve theoretical, engineering and technological problems.	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W01] demonstrates knowledge and understanding of mathematics, physics, chemistry and IT tools at the level necessary to formulate and solve typical engineering and technological problems	The student formulates and solves engineering and technological problems based on the achievements of modern physics	[SW1] Assessment of factual knowledge
[K6_K01] is aware of the need to constantly update and enrich knowledge and practical skills, and improve professional, personal and social competences	The student is aware of the progress of science and technology and the resulting need to update and expand their knowledge and competences.	[SK4] Assessment of communication skills, including language correctness

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Older quantum theory: Planck's distribution; Einstein's law of photoemission; Bohr's model of the atom.

Introduction to quantum physics: Basic assumptions of quantum physics; matter waves; Schrödinger's equation; Heisenberg's uncertainty principle; Elementary particles and their properties; particle statistics - fermions and bosons. Pauli's exclusion principle.

Fundamentals of atomic and molecular physics: Atomic structure and the periodic table; Bonds; energetic rotational and vibrational states of molecules; Nuclear structure

Introduction to lasers: Spontaneous and stimulated emission; optical resonators; the principle of operation of the maser and laser; Basic types of lasers and their structure.

Introduction to solid state physics: Bloch's theorem and energy bands in solids; semiconductors; Theses and results of Einstein's special and general theory of relativity.

Course content – exercises
1. Introduction to Analytical Mechanics
2. Planck's Distribution and the Blackbody model
3. Atomic Models and Emission/Absorption Spectra
4. Schroedinger's Equation: Example Models and Solutions
5. Relativistic Phenomena
6. Band Model of Solids
Course content – laboratory
1. Determining the electron e/m ratio
2. Investigating the Hall effect
3. Determining the energy gap width in a semiconductor
4. Measuring emission spectra</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Course in Classical Physics and Mathematics</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 test on calculation exercises</td><td>50.0%</td><td>34.0%</td></tr>
<tr><td>laboratory exercise reports</td><td>50.0%</td><td>33.0%</td></tr>
<tr><td>written test of the lecture part</td><td>50.0%</td><td>33.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Kittel, Charles (2005). Introduction to solid state physics (8th ed.). New York: Wiley</td></tr>
<tr><td>Supplementary literature</td><td>given during lectures</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>• Describe the correspondence principle using the Bohr model of the atom as an example.
• Write down the Schroedinger equation for a particle in a vacuum.
• How do the results of experiments on the photoelectric effect confirm quantum theory?</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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