GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fundamentals of modern physics, PG_00049441		
Field of study	Technical Physics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle 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	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład Fizyki Organicznych i Perowskitowych Struktur Fotowoltaicznych -> Instytut Fizyki i Informatyki Stosowanej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor		
	Teachers		

Lesson types and methods of instruction

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	5.0	60.0	125

Subject objectives

The student has knowledge of the achievements of physics in the last century.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W02] Has systematized knowledge of the basics of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and particle physics, solid-state physics, nuclear and elementary particle physics.	The student has knowledge of the basics of modern physics.	[SW1] Assessment of factual knowledge
[K6_W01] Understands the importance of physics and its applications in connection to civilization.	The student becomes acquainted with the achievements of modern physics and understands its role in the development of technology.	[SW1] Assessment of factual knowledge
[K6_U01] Can learn independently, obtain information from literature, databases and other properly selected sources.	The student is able to independently use textbooks and selected scientific literature.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	LECTURE: 1. Basics of statistical physics. Macroscopic and microscopic parameters of the system. Thermodynamic probability of macrostate. Boltzmann chaos hypothesis. Statistical balance. Entropy of the system. 2. Maxwell-Boltzmann statistics. Classical statistics and quantum statistics. Phase space. Distribution function. Ergodic and quasiergodic hypothesis. Boltzmann distribution. Maxwell distribution. 3. Applications of Maxwell distribution. The problem of ideal gas in the field of external forces. Barometric formula. 4. Transport phenomena. Gas diffusion, thermal conductivity, gas viscosity, electrical conductivity. 5. Mass and dimensions of an atom. Determination of atom mass. Methods for determining Avogadro number. X-ray diffraction in crystals. Determining the size of the atom. Cross-section for the impact. 6. The atomic nucleus. Cathode rays. The passage of particles through matter, the Rutherford formula. The Rutherford model of the atom. 7. Electron. Methods of producing free electrons. Electron size and charge. Specific charge e/m of electron. The wave nature of the electron. 8. Quantum properties of radiation. Thermal radiation. Spectral distribution of blackbody radiation. Planck formula. The photoelectric effect. The Compton effect. 9. The Bohr model. Spectral analysis. Linear spectrum of the hydrogen atom. The Bohr postulates. Spectra of hydrogen-like atoms. Muon atoms. Extension of the Bohr model by Sommerfeld. Rydberg atoms. 10. Fundamentals of quantum theory. Quantum mechanics and its postulates. A particle in a potential well. Quantum mechanical harmonic oscillator. Tunnel phenomenon. The hydrogen atom in quantum mechanics. TUTORIALS: During the tutorials, problems which illustrate the issues discussed during the lectures are solved. The tasks concern among the others basics of statistical physics, thermal radiation, basics of quantum optics and quantum mechanics, as well as structure and linear spectra of hydrogen-like atoms.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Tests during the semester	50.0%	40.0%
Written exam	50.0%	60.0%

Recommended reading	Basic literature	1. H. H. Haken, H. C. Wolf, Atomy i kwanty, Wydawnictwo Naukowe PWN, Warszawa 1997. 2. K.Wróblewski, J. A. Zakrzewski, Wstęp do fizyki, t. 1, Wydawnictwo Naukowe PWN, Warszawa 1984. 3. J. Massalski, Fizyka dla inżynierów. Część II. Fizyka współczesna, WNT, Warszawa 2018.
	Supplementary literature	1. A. Gajewski, A. Foryś, A. Foryś, Zadania i przykłady z fizyki, Wydawnictwo PK, Kraków 2003. 2. W. Sadowski (kierownik projektu): Fizyka na Politechnice Gdańskiej, Materiały pomocnicze 2004/2005.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	The problems for tutorials: Using the energy distribution of molecules in an ideal gas, derive formulas for the energy corresponding to the maximum in the distribution and the mean energy of gas molecule. Calculate the values of these energies for the ideal gas in room temperature T=300 K. What is the frequency of the photon absorbed when the hydrogen atom makes the transition from the ground state (n=1) to the n=4 state? The exam questions: Draw and explain the Maxwell-Boltzmann speed distribution function. Show in the graph the shape of that function for a given temperature and present how the graph is changing when the gas temperature increases. Present the method of determining the specific charge e/m of electron in the Thomson experiment.	
Work placement	Not applicable	