



Subject card

Subject name and code	Fundamentals of modern physics, PG_00049441						
Field of study	Technical Physics						
Date of commencement of studies	October 2021	Academic year of realisation of subject			2022/2023		
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	dr hab. inż. Grażyna Jarosz					
	Teachers	dr hab. inż. Grażyna Jarosz					
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	<i>Student acquired knowledge of achievements of physics from the last century</i>						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_W01	The student learns about the discoveries of twentieth century physics and is able to indicate their application			[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		
	K6_U01	The student is able to solve problems in the field of modern physics, reaching for information available in various textbooks and internet sources.			[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment		
	K6_W02	The student has knowledge of the basics of modern physics.			[SW1] Assessment of factual knowledge		

Subject contents	<p>LECTURE Statistic Physics. Boltzmann Factor. Maxwell Distribution. Atomic Structure of Matter: Atom, Size of The Atom, Calculating Atomic Parameters Due to the Kinetic Theory of Gases, Barometric Formula, Transport Processes in Gases, Diffraction of X-Radiation, Determination of Avogadro Number, the Nucleus of the Atom, Determination of Atomic Mass, Passage of Alphas Particles Through Matter, Rutherford Formula, Cross Section, Determination of e/m for the Electron. Special Relativity. Basic Properties of Matter: Matter Waves, de Broglie Hypothesis, Davisson-Germer Experiment, Properties of Matter Waves, Wave-Particle Dualism, Photon, The Photoelectric Effect, The Compton Effect, The Heisenberg Uncertainty Relation, Statistic Description of Particles, Functions of Distribution, Distributions of Fermi-Dirac, Bose-Einstein, Boltzmann. Bohrs model of the Hydrogen Atom: Model and Theory of Bohrs Atom, Bohrs Postulates, Energy Levels of the hydrogen Atom, Absorption and Emission of Photon, Ionization, Hydrogen-Like Atoms, Muonic Atoms, Critique of the Bohrs Theory. Quantum Mechanics: Postulates of Quantum Mechanics. Wavefunctions. Operators of Energy and Momentum. The Schrödinger Equation. The Particle in Box. Eigenfunctions and Eigenvalues. Stream. Passage of Particles Through the Potential Barrier. The Tunnel Effect. Examples. The Quantum Mechanical Oscillator. The Hydrogen Atom in Quantum Mechanics: The Schrödinger Equation in Spherical Coordinates. Magnetic Moment of the Atom. Experiments Confirming Quantization in Space. Spin of the Electron. Total Angular Momentum. fine and Hyperfine Structure. Nuclear Resonance. Many-Electron Atoms: Periodic System of the Elements. Quantum Numbers. Pauli Principle. The Zeeman Effect. Spectra of Atoms: X-Radiation, Emission and Absorption of X-Radiation. Characteristic Radiation. Electron-Positron Pair Production. Mass Attenuation Coefficients for Electromagnetic Radiation. The Nucleus of the Atom: Size and Density of Nuclear Matter. Nucleons. Mass of the Nucleus. Models of the Nucleus. Liquid-Drop Model, Band Model and Collective Model. Nuclear Decay and Nuclear Reaction: Alpha Decay (α). Beta Decay (β). Gamma Emission (γ). Mean Lifetime. Radioactive equilibrium. The Mössbauer Effect. Radioactive Decays. Cross Section. Excited States of Nuclei. Nuclear Fusion. Thermonuclear Reaction. Natural and Artificial Radioactivity. Application of Isotopes in Medicine, Geology and Other Fields. Nuclear Energy: Nuclear binding energy. Isotopes. Isotope Selection. Uranium Splitting. Nuclear Reactors. Reaction of thermonuclear fusion. Nuclear and Thermonuclear Bombs. Detection and Dosimetry of Radiation: Detection of Nuclear Radiation. Detectors of Particles and High-Energy Radiation. Ionization Detectors. Geiger-Muller Counter. Cherenkov Counter. Scintillation Counter. Semiconductor Detectors. Complex Systems of Detection. Radiation Effect on Body. Exposure Dose. Lethal Dose. Toxic Radioactive Atoms. Classification of Particles and Elements of Astrophysics.</p> <p>TUTORIALS Kinetic Theory of Gases: Maxwell Distribution. Barometric Formula. Particle Nature of Electromagnetic Radiations: Thermal Radiation. Compton Effect. Photoelectric Effect. Rutherford-Bohr Model of Atom: Scattering of Alpha Particles. Bohrs model of the Hydrogen Atom. Hydrogen-Like Atoms. Fundamentals of Quantum Mechanics: Quantum Mechanical Operates. The Schrödinger Equation. Passage of Particles Through the Potential Barrier. Central Field. Hydrogen Atom. Spin-Orbit Coupling: Fine Structure. Atom in Magnetic Field: Normal and Anomalous Zeeman Effect. X-Radiation: Production of X-Radiation. Characteristics Radiation. Absorption of X-Radiation. Natural Radiation: Laws of Radioactive Decay. Effect of γ-Radiation on Matter: Passage of Particles Through Matter. Nuclear Reactions: Conversions in Nuclear Reactions.</p>														
Prerequisites and co-requisites	Course credit "Mechanics and heat" (FIZ1B002), "Mathematical analysis" (FIZ1B001), "Electricity and magnetism" (FIZ1B008) and "Waves and optics" (FIZ1C102)														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Midterm colloquium</td> <td>50.0%</td> <td>45.0%</td> </tr> <tr> <td>Written exam</td> <td>50.0%</td> <td>40.0%</td> </tr> <tr> <td>Oral exam</td> <td>50.0%</td> <td>15.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Midterm colloquium	50.0%	45.0%	Written exam	50.0%	40.0%	Oral exam	50.0%	15.0%
Subject passing criteria	Passing threshold	Percentage of the final grade													
Midterm colloquium	50.0%	45.0%													
Written exam	50.0%	40.0%													
Oral exam	50.0%	15.0%													
Recommended reading	<table border="1"> <tbody> <tr> <td>Basic literature</td> <td colspan="2">1. H. H. Haken, H. C. Wolf, Atomy i kwanty, PWN, W-wa 1997 2. R. Eisberg, R. Resnick, Fizyka kantowa atomów, cząsteczek, ciał stałych, jąder i cząsteczek elementarnych, PWN, W-wa 1983 3. H. A. Enge, M.R. Wehr, J. A. Richards, Wstęp do fizyki atomowej, PWN, W-wa 1983 4. V. Acosta, C. L. Cowan, B. J. Graham, Podstawy fizyki współczesnej, PWN, W-wa 1987 5. E. Skrzypczak, Z. Szaflński, Wstęp do fizyki jądra atomowego i cząstek elementarnych, PWN, W-wa 2002</td> </tr> <tr> <td>Supplementary literature</td> <td colspan="2">1. A. A. Czerwiński, Energia jądrowa i promieniotwórczość, Oficyna edukacyjna, W-wa 1998 2. Sz. Szczeniowski, Fizyka doświadczalna, tom V (fizyka atomu); tom VI (fizyka jądra i cząstek elementarnych), PWN, W-wa 1974 3. E. Irodow, I. W. Sawiljew, I. O. Zamsza: Zbiór zadań z fizyki, PWN W-wa 1976 4. E. Irodow: Zadania z fizyki atomowej i jądrowej, PWN W-wa 1974 5. C. Szmytkowski, W. H. Roznerski, Zadania rachunkowe z wybranych działów fizyki, skrypt PG, Gdańsk 1971 6. W. Sadowski (kierownik projektu): Fizyka na Politechnice Gdańskiej, materiały pomocnicze na CD. 7. Matwiejew, "fizyka cząsteczkowa", W-wa 1989, PWN.</td> </tr> <tr> <td>eResources addresses</td> <td colspan="2">Adresy na platformie eNauczanie: Podstawy Fizyki Współczesnej - Moodle ID: 29904 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29904</td> </tr> </tbody> </table>			Basic literature	1. H. H. Haken, H. C. Wolf, Atomy i kwanty, PWN, W-wa 1997 2. R. Eisberg, R. Resnick, Fizyka kantowa atomów, cząsteczek, ciał stałych, jąder i cząsteczek elementarnych, PWN, W-wa 1983 3. H. A. Enge, M.R. Wehr, J. A. Richards, Wstęp do fizyki atomowej, PWN, W-wa 1983 4. V. Acosta, C. L. Cowan, B. J. Graham, Podstawy fizyki współczesnej, PWN, W-wa 1987 5. E. Skrzypczak, Z. Szaflński, Wstęp do fizyki jądra atomowego i cząstek elementarnych, PWN, W-wa 2002		Supplementary literature	1. A. A. Czerwiński, Energia jądrowa i promieniotwórczość, Oficyna edukacyjna, W-wa 1998 2. Sz. Szczeniowski, Fizyka doświadczalna, tom V (fizyka atomu); tom VI (fizyka jądra i cząstek elementarnych), PWN, W-wa 1974 3. E. Irodow, I. W. Sawiljew, I. O. Zamsza: Zbiór zadań z fizyki, PWN W-wa 1976 4. E. Irodow: Zadania z fizyki atomowej i jądrowej, PWN W-wa 1974 5. C. Szmytkowski, W. H. Roznerski, Zadania rachunkowe z wybranych działów fizyki, skrypt PG, Gdańsk 1971 6. W. Sadowski (kierownik projektu): Fizyka na Politechnice Gdańskiej, materiały pomocnicze na CD. 7. Matwiejew, "fizyka cząsteczkowa", W-wa 1989, PWN.		eResources addresses	Adresy na platformie eNauczanie: Podstawy Fizyki Współczesnej - Moodle ID: 29904 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29904				
Basic literature	1. H. H. Haken, H. C. Wolf, Atomy i kwanty, PWN, W-wa 1997 2. R. Eisberg, R. Resnick, Fizyka kantowa atomów, cząsteczek, ciał stałych, jąder i cząsteczek elementarnych, PWN, W-wa 1983 3. H. A. Enge, M.R. Wehr, J. A. Richards, Wstęp do fizyki atomowej, PWN, W-wa 1983 4. V. Acosta, C. L. Cowan, B. J. Graham, Podstawy fizyki współczesnej, PWN, W-wa 1987 5. E. Skrzypczak, Z. Szaflński, Wstęp do fizyki jądra atomowego i cząstek elementarnych, PWN, W-wa 2002														
Supplementary literature	1. A. A. Czerwiński, Energia jądrowa i promieniotwórczość, Oficyna edukacyjna, W-wa 1998 2. Sz. Szczeniowski, Fizyka doświadczalna, tom V (fizyka atomu); tom VI (fizyka jądra i cząstek elementarnych), PWN, W-wa 1974 3. E. Irodow, I. W. Sawiljew, I. O. Zamsza: Zbiór zadań z fizyki, PWN W-wa 1976 4. E. Irodow: Zadania z fizyki atomowej i jądrowej, PWN W-wa 1974 5. C. Szmytkowski, W. H. Roznerski, Zadania rachunkowe z wybranych działów fizyki, skrypt PG, Gdańsk 1971 6. W. Sadowski (kierownik projektu): Fizyka na Politechnice Gdańskiej, materiały pomocnicze na CD. 7. Matwiejew, "fizyka cząsteczkowa", W-wa 1989, PWN.														
eResources addresses	Adresy na platformie eNauczanie: Podstawy Fizyki Współczesnej - Moodle ID: 29904 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29904														

Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none">1. Atomic mass measurement.2. Bohr's model3. Schrödinger equation4. Binding energy of the atomic nucleus5. Nuclear reactions
Work placement	Not applicable