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 2020	Academic year of realisation of subject	2021/2022
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

Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=22314
Adresy na platformie eNauczanie:

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

Student acquired knowledge of achievements of physics from the last century

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	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
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.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
K6_W02	The student has knowledge of the basics of modern physics.	[SW1] Assessment of factual knowledge

Subject contents	LECTURE Statistic Physics. Boltzmann Factor. Maxwell Distribution. Atomic Structure of Master: 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 Avogadros 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. Basic Properties of Matter: Matter Waves, de Broglie Hypothesis, Davisson-Germer Experiment, Properties of Master Waves, Wave-Particle Dualism, Photon, The Photoelectric Effect, The Compton Effect, The Hiesenberg 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. Wavefuctions. 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 (). Beta Decay (). Gamma Emission (). 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 Dossimetry 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. 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. Fundaments 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 -Radiation on Matter: Passage of Particles Through Matter. Nuclear Reactions: Conversions in Nuclear Reactions.
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

Subject passing criteria	Passing threshold	Percentage of the final grade
Oral exam	50.0%	15.0%
Written exam	50.0%	40.0%
Midterm colloquium	50.0%	45.0%

Recommended reading

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. Szafliński, 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. Irdow, 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	

Example issues/ example questions/ tasks being completed	1. Atomic mass measurement. 2. Bohr's model 3. Schrödinger equation 4. Binding energy of the atomic nucleus 5. Nuclear reactions
Work placement	Not applicable