



## Subject card

Subject name and code	Molecular physics, PG_00064443						
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2024/2025		
Education level	second-cycle studies		Subject group		Optional subject group Specialty 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	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Jan Franz				
	Teachers		dr hab. Jan Franz  dr Małgorzata Franz				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	0.0	0.0	45
	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	45		5.0		25.0	75
Subject objectives	The aim of the course is to familiarize the student with selected issues of molecular physics.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_K01] is ready to create and develop models of proper behaviour in the work and life environment; undertake initiatives; critically evaluate actions of their own, teams and organisations they are part of; lead a group and take responsibility for its actions; responsibly perform professional roles taking into account changing social needs, including: - developing the achievements of the profession, - observing and developing rules of professional ethics and acting to comply to these rules		The student is able to prepare a presentation on molecular physics in relation to modern trends in biomedical engineering.		[SK4] Assessment of communication skills, including language correctness		
	[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study		The student knows and understands the basics of molecular physics.		[SW1] Assessment of factual knowledge		
	[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science		The student is able to use the acquired knowledge in the applications of molecular spectroscopy.		[SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	1. Introduction to the lecture: photons and waves, atomic structure. 2. Fundamentals of quantum mechanics: wave-particle duality, wave function, Schrödinger equation, Heisenberg uncertainty principle, free particle motion, particle in a square-well, tunnelling phenomenon, hydrogen atom, atomic orbital, hydrogen ion. 3. Electric and magnetic properties of molecules. 4. Molecular solid: types of crystal bonds and their characteristics. 5. Interaction of electromagnetic radiation with particles: forms of particle energy, quantization of energy, energy distribution in the state of thermal equilibrium, probability of absorption and emission of radiation, types of spectroscopy. 6. The rotational energy of molecules. 7. The vibrational energy of molecules. 8. The interaction of electromagnetic radiation with vibrating molecules: Raman spectrum. 9. Molecular electronic transitions: electronic states and the energy of electronic states.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	calculational tasks	50.0%	20.0%
	presentation	50.0%	20.0%
	passing the lecture	50.0%	60.0%
Recommended reading	Basic literature	Z. Kęcki, "Podstawy spektroskopii molekularnej", Wydawnictwo Naukowe PWN, Warszawa 2013  G. Ślósarek, Biofizyka molekularna, Wydawnictwo Naukowe PWN Warszawa 2011.  H. Haken, H. Ch. Wolf, Fizyka molekularna z elementami chemii kwantowej, Wydawnictwo Naukowe PWN Warszawa 1998.	
	Supplementary literature	P. W. Atkins, R. S. Friedman, "Molecular quantum mechanics", Oxford University Press, 1997.	
	eResources addresses	Adresy na platformie eNauczanie:	
	Example issues/ example questions/ tasks being completed	The examples of lecture assignments:  Represent and describe the forms of internal energy of molecules.  Represent and describe the physical quantities which characterizing the magnetic properties of molecules.	
Work placement	Not applicable		

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