



## Subject card

Subject name and code	, PG_00058864						
Field of study	Nanotechnology						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
Education level	second-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			English		
Semester of study	3	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Michał Winiarski					
	Teachers	dr inż. Michał Winiarski					
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 aim of the class is to introduce students to the topic of analysis of electronic structure of solids and nanostructures.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K7_U01	Student can perform electronic structure calculations of solids and nanostructures			[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		
	K7_W04	Student understands the possibilities of relating the results of experimental and calculational methods of electronic structure analysis			[SW1] Assessment of factual knowledge		
	K7_W02	Student has a deepened knowledge of electronic structure calculational methods			[SW1] Assessment of factual knowledge		
Subject contents	1. Electronic structure of atoms, Atomic models  2. Chemical bonding theories: valence bond theory & molecular orbital theory  3. Methods of ab initio calculations: Hartree-Fock and related methods, density functional theory  4. Tight binding model  5. Analysis of results of electronic structure calculations						

Prerequisites and co-requisites	Course in modern physics		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	final test	50.0%	50.0%
	mid-term test	50.0%	50.0%
Recommended reading	Basic literature	(1)Hoffmann, R. How Chemistry and Physics Meet in the Solid State. <i>Angewandte Chemie International Edition in English</i> <b>1987</b> , 26 (9), 846878. <a href="https://doi.org/10.1002/anie.198708461">https://doi.org/10.1002/anie.198708461</a> .(2)Marzari, N.; Ferretti, A.; Wolverton, C. Electronic-Structure Methods for Materials Design. <i>Nat. Mater.</i> <b>2021</b> , 20 (6), 736749. <a href="https://doi.org/10.1038/s41563-021-01013-3">https://doi.org/10.1038/s41563-021-01013-3</a> .	
	Supplementary literature	(1)Dronskowski, R. Chemical Bonding: From Plane Waves via Atomic Orbitals; De Gruyter, 2023.	
	eResources addresses	Uzupełniająca Adresy na platformie eNauczenie: Theoretical Principles of Nanotechnology - Moodle ID: 33695 <a href="https://enauczenie.pg.edu.pl/moodle/course/view.php?id=33695">https://enauczenie.pg.edu.pl/moodle/course/view.php?id=33695</a>	
Example issues/ example questions/ tasks being completed	Describe briefly the basic ideas of the density functional theory  Draw schematically the band structure of a 1D hydrogen atom chain		
Work placement	Not applicable		