



Subject card

Subject name and code	, PG_00058862						
Field of study	Nanotechnology						
Date of commencement of studies	October 2023	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	1	Language of instruction			English		
Semester of study	2	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Leszek Piotrowski					
	Teachers	dr hab. inż. Leszek Piotrowski dr hab. inż. Jacek Ryl					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	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	30	2.0		18.0		50
Subject objectives	The aim of the course is to familiarize students with the issues related to the fact of the existence of a surface limiting material objects. Discussion of the consequences of surface energy. Analysis of the possibilities of using surface phenomena in industrial technologies. Awareness of the problems and benefits that arise when reducing the size of objects, with particular emphasis on the modification of the band structure of semiconductors resulting from the existence of a near-surface charge layer.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	K7_U10		The student is able to search through available literature databases, analyze the text of the article in terms of key information, is able to prepare a multimedia presentation illustrating the issues discussed			[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information	
	K7_W02		The student knows the problems and benefits resulting from the progressive miniaturization of components and devices, with particular emphasis on the impact of surface phenomena. He/she has systematic knowledge in all branches of general physics.			[SW1] Assessment of factual knowledge	
Subject contents	Perfect and real surface. Surface crystallography. Relaxation and reconstruction of surface layers. Surface tension and thermodynamic surface description. Physical adsorption. Chemisorption and its effect on surface properties. Surface physics of semiconductors. Surface phenomena in industrial technologies (flotation, detergency, etc.). Friction - basic theories of dry friction, boundary friction. Natural and artificial coatings. Phenomena in colloidal systems. Selected technologies of the production of thin films.						
Prerequisites and co-requisites							

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	written work	50.0%	50.0%
	laboratory reports	50.0%	50.0%
Recommended reading	Basic literature	K. W. Kolasinski: Surface Science - Foundations of Catalysis and Nanoscience, Wiley, 2019, ISBN: 978-1-119-54661-0 G. Bracco, B. Hols: Surface Science Techniques, Springer, 2013, ISBN: 978-3642342424	
	Supplementary literature	Gabor A. Somorjai; Yimin Li, Introduction to Surface Chemistry and Catalysis, John Wiley & Sons, 2010, ISBN: 9780470508237	
	eResources addresses	Adresy na platformie eNauczenie: Surface Science - 2023/2024 - Moodle ID: 30547 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=30547	
Example issues/ example questions/ tasks being completed	Give a definition of surface energy and surface tension. Discuss the effect of the surface on the band structure of semiconductors. Discuss surface phenomena in industrial technologies. Describe the phenomenon of adsorption. Analyze the causes of segregation in alloys		
Work placement	Not applicable		