



## Subject card

Subject name and code	Nanotechnology, PG_00039822						
Field of study	Materials Engineering, Materials Engineering, Materials Engineering, Materials Engineering						
Date of commencement of studies	October 2020		Academic year of realisation of subject		2022/2023		
Education level	first-cycle studies		Subject group		Obligatory subject group in the field of study 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	3		Language of instruction		Polish		
Semester of study	6		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Zakład fizyki nanomateriałów -> Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Wojciech Sadowski				
	Teachers		prof. dr hab. inż. Wojciech Sadowski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	15.0	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		1.0		19.0	50
Subject objectives	To familiarize students with the properties of materials at the transition from the macro to nano techniques manufacturing of nanomaterials and their applications.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K6_U08		The ability to prepare typical written works in Polish and English, appropriate for nanotechnology and materials science, concerning specific issues, using basic theoretical approaches, as well as various sources.		[SU1] Assessment of task fulfilment		
	K6_W03		Has basic knowledge in the field of materials science, nanotechnology and is able to connect the properties of materials with their structure and composition, knows the theoretical description of phenomena occurring in materials.		[SW1] Assessment of factual knowledge		
	K6_K01		Demonstrates the need to improve professional and personal competences; is aware of its own limitations and knows when to turn to experts, is able to find the right source material.		[SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills		
	K6_U06		The ability to integrate information, interpret it, as well as draw conclusions related to the science of materials.		[SU2] Assessment of ability to analyse information		

Subject contents	<p>1. Historical Introduction to Nanotechnology</p> <p>2. Elements of solid state.</p> <p>3. The physical basis of nanotechnology and size effects - the structure of a 3D, 2D , 1D , 0D .</p> <p>4. Nucleation and crystallization.</p> <p>5. Methods for the preparation of nanomaterials : thin layer and the thin film structure , quantum wires and dots , nanopowders.</p> <p>6. Methods of examination of the nanomaterials.</p> <p>7. Fullerenes and nanotubes .</p> <p>8. Elements of superconductivity.</p> <p>9. Nanotechnology applications.</p>		
Prerequisites and co-requisites	Physics of materials, Functional materials		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Examination of the seminar	100.0%	30.0%
	Credit lecture	50.0%	70.0%
Recommended reading	Basic literature	<p>Nanostructures and Nanomaterials. Synthesis, Properties and Applications. Imperial College Press. Guozhong Gao. 2004.</p> <p>Introduction to Nanotechnology. Ch.P.Poole Jr., F.J.Owens. Wiley. 2003.</p> <p>Nanoelectronics and Information Technology. Advanced Electronic Materials and Novel Devices. Reiner Waser (Ed.) Wiley-VCH. 2003.</p> <p>Nanomaterials: Synthesis, properties and Applications. Ed. by Edelstein A.S and Commarta R.S. IOP London 1996.</p> <p>F.E. Fujita. Physics of New Materials. Springer 1999.</p>	
	Supplementary literature	<p>Nanomaterials: Synthesis, properties and Applications. Ed. by Edelstein A.S and Commarta R.S. IOP London 1996.</p> <p>F.E. Fujita. Physics of New Materials. Springer 1999.</p>	
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Nanotechnologia - Moodle ID: 29227</p> <p><a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29227">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29227</a></p>	

Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> <li>1. Elements of the structure of a solid (crystallography, chemical bonds, band stature)</li> <li>2. Physical basis of nanotechnology and size effects - 3D, 2D, 1D, 0D structures.</li> <li>3. Fundamentals of the synthesis of nanostructures, nucleation and crystallization.</li> <li>4. Methods of obtaining nanomaterials: thin layers and thin-layer structures, quantum wires and dots, nanopowders,</li> <li>5. Electrical, magnetic, optical and mechanical properties of nanostructures.</li> <li>6. Methods of studying nanomaterials. STM microscopy, AFM.</li> <li>7. Fullerenes and nanotubes.</li> <li>8. Nanotechnology in applications</li> </ol>
Work placement	Not applicable