



## Subject card

Subject name and code	New technologies of nanomaterials, PG_00061569						
Field of study	Nanotechnology						
Date of commencement of studies	February 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			Polish		
Semester of study	2	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	0.0	0.0	0.0	30.0	0.0	30
	E-learning hours included: 0.0						
	Additional information: <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33616">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33616</a>  - lectures on the physico-chemical basis of nanomaterials production and new technological trends in the production of nanomaterials;  - preparation of a project regarding the development of technology for the production of nanomaterials;  - visit to the laboratories of leading research institutes related to nanotechnology						
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	0.0	0.0	30		
Subject objectives	The aim of the course is to familiarize students with the latest trends in nanomaterials technology.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K7_U05	Student is able to plan and conduct experimental research, critically analyze their results and draw conclusions.			[SU3] Assessment of ability to use knowledge gained from the subject		
	K7_U02	Student is able to plan and conduct experimental research, critically analyze their results and draw conclusions, providing students with the latest trends in nanomaterials technology.			[SU4] Assessment of ability to use methods and tools		
	K7_W04	Student has in-depth practical and theoretical knowledge of physical and chemical experimental methods of nanotechnology and materials science in general.			[SW2] Assessment of knowledge contained in presentation		
	K7_W02	Student has in-depth knowledge in the selected field of nanotechnology.			[SW1] Assessment of factual knowledge		

Subject contents	<p>lectures on the physico-chemical basis of nanomaterials production and new technological trends in the production of nanomaterials;</p> <p>preparation of a project regarding the development of technology for the production of nanomaterials;</p> <p>visit to the laboratories of leading research institutes related to nanotechnology.</p>		
Prerequisites and co-requisites	selection of the topic of M.Sc. thesis		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Design presentation	100.0%	70.0%
	Participation in lectures.	60.0%	30.0%
Recommended reading	Basic literature	<p><b>1. Springer Handbook of Nanomaterials.</b> Ed. Robert Vajtai. Springer-Verlag Berlin Heidelberg 2013</p> <p><b>2. Introduction to Nano. Basics to Nanoscience and Nanotechnology.</b> Ed. Amretashis Sengupta. Springer-Verlag Berlin Heidelberg 2015</p> <p><b>3. Basic Principles of Nanotechnology.</b> Wesley C. Sanders. 2019 by Taylor &amp; Francis Group, LLC, CRC</p>	
	Supplementary literature	<p><b>Topical Review. Nanomaterials by design: a review of nanoscale metallic multilayers.</b> Nanotechnology 31 (2020) 292002 (30pp) <a href="https://doi.org/10.1088/1361-6528/ab803f">https://doi.org/10.1088/1361-6528/ab803f</a> . A.Saaenz-Trevizo and A. M. Hodge</p> <p><b>Nanotechnology and Green Nanotechnology: A Road Map for Sustainable Development, Cleaner Energy and Greener World.</b> Volume 3, Issue 1, January 2018 International Journal of Innovative Science and Research Technology. Palak K. Lakhani, Neelam Jain</p> <p><b>Nanotechnology: The New Features.</b> Gang Wang. arXiv: 1812.04939v1 [cs.ET] 8 Dec 2018</p> <p><b>Thermodynamics at the nanoscale: A new approach to the investigation of unique physicochemical properties of nanomaterials.</b> Chun Cheng Yang *, Yiu-Wing Mai. Materials Science and Engineering R 79 (2014) 140</p> <p><b>Thermodynamics versus Kinetics in Nanosynthesis</b> . Yawen Wang, Jiating He, Cuicui Liu, Wen Han Chong, and Hongyu Chen. Nanoparticle Synthesis DOI: 10.1002/anie.201402986</p> <p><b>The passivity of lithium electrodes in liquid electrolytes for secondary batteries.</b> Nature Reviews   1036   November 2021   volume 6   1037</p> <p><b>Nanoparticle synthesis assisted by machine learning.</b> REVIEWS. Nature Reviews   Materials volume 6   August 2021</p>	
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Nowe technologie nanomateriałów 2023 - Moodle ID: 33616 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33616">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33616</a></p>	

<p>Example issues/ example questions/ tasks being completed</p>	<p>New nanomaterial technologies - Design topics - 2013</p> <p>Show in the project: Principle of operation, manufactured, examples of applications, research trends towards increasing work efficiency, literature references.</p> <ol style="list-style-type: none"> <li>1. Josephson junction and its application in electronics.</li> <li>2. Energy storage devices - lithium batteries.</li> <li>3. Photonic crystals and their application in electronics.</li> <li>4. Flat nanostructured lenses (metalens, metalenses) [e.g. art. review: Pan et al. Light: Science &amp; Applications (2022)11:195 ; <a href="https://doi.org/10.1038/s41377-022-00885-7">https://doi.org/10.1038/s41377-022-00885-7</a>]</li> <li>5. 2D semiconductors in electronic applications. [e.g. <a href="http://www.nature.com/npj2dmaterials">www.nature.com/npj2dmaterials</a>]</li> <li>6. Nanoengineering of catalytic materials for renewable energy. [e.g. Nature Nanotechnology, v.16, 2021, p. 129-139]</li> <li>7. Application of the MBE technique to produce nanostructures.</li> <li>8. Student's own topic.</li> </ol>
<p>Work placement</p>	<p>Not applicable</p>