



Subject card

Subject name and code	, PG_00052094						
Field of study	Nanotechnology						
Date of commencement of studies	October 2021	Academic year of realisation of subject			2023/2024		
Education level	first-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	3	Language of instruction			Polish		
Semester of study	5	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Materials Engineering and Bonding -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Dionizy Czekaj					
	Teachers	dr inż. Michał Bartmański dr inż. Magda Rościszewska prof. dr hab. inż. Dionizy Czekaj					
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 Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=8024						
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	5.0		40.0		75
Subject objectives	Getting knowledge on application of nanotechnology in developing of advanced structural materials.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_U04	The student is able to plan a simple experiment in the laboratory.			[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		
	K6_U02	The student can solve a simple scientific and engineering problem. He is able to analyze the results of the experiment, formulate and save conclusions resulting from the analysis.			[SU3] Assessment of ability to use knowledge gained from the subject		
	K6_W06	The student can indicate the essential properties of metals, ceramics, polymers and composite materials.			[SW1] Assessment of factual knowledge		
Subject contents	<i>The genesis of nanotechnology and basic concepts. Different ways of perceiving nanotechnology, Development forecasts for the construction materials nanotechnology. Examples of engineering nanomaterials; Classification of engineering materials based on the nature of bonds between atoms. Structure of engineering materials; Arrangement of atoms in the crystal. Close packing structures. Simple ideas of crystallography. Selected spatial groups of structural materials: FCC, BCC and HCP. Ceramic crystals, diamond cubic spatial group. Oxides with the structure of rock salt, corundum and fluorite. Polymer crystals. Elements of material microstructure. Material structure hierarchy. Structural nanomaterials. The most important mechanical properties in applications of structural nanomaterials. Modulus of elasticity of nanostructured materials. Linear and nonlinear elasticity; elastic properties. Load-elongation diagrams for inelastic materials; Stress-actual strain curves for plastic flow. Static strength, yield strength. Stretching curve. Tensile strength of nanocrystalline materials; Dislocations in metals; Deformation strengthening of nanostructured materials; Influence of nanocrystallinity on yield strength.</i>						
Prerequisites and co-requisites	Basic knowledge in the field of materials engineering						

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory	100.0%	50.0%
	Written exam - sets of 3 questions	51.0%	50.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. K. Kurzydłowski, M. Lewandowska (Red), Nanomateriały inżynierskie, konstrukcyjne i funkcjonalne, Wydawnictwo Naukowe PWN, Warszawa, 2011 2. M. Kaczorowski, A. Krzyńska, Konstrukcyjne materiały metalowe, ceramiczne i kompozytowe, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2017. 3. A. Świdarska-Środa, W. Łojkowski, M. Lewandowska, K. Kurzydłowski, (Red), Świat nanocząstek, Wydawnictwo Naukowe PWN SA, Warszawa, 2016 4. K. Zelechowska (Red), Nanotechnologia w praktyce, Wydawnictwo Naukowe PWN SA, Warszawa, 2016 5. Kelsall R.W., Haley J.W., Geghegan M., Nanotechnologie, Wyd. PWN, Warszawa 2008; 6. Jurczyk M., Nanomateriały: wybrane zagadnienia. Wydaw. Politechniki Poznańskiej, 2001 7. M.Ashby, H.Shercliff, D.Cebon, Inżynieria materiałowa, T1, T2, Wydawnictwo Galaktyka, Łódź, 2011 8. Dobrzański L. A., Podstawy nauki o materiałach i metaloznawstwo. Materiały inżynierskie z podstawami projektowania materiałowego., WNT Warszawa, 2002 9. Blicharski M., Wstęp do inżynierii materiałowej, Wydawnictwo Naukowo Techniczne, Warszawa 2001 10. Głowacka M., Zieliński A., <i>Podstawy materiałoznawstwa</i> Praca zbiorowa, Politechnika Gdańska 2011 	
	Supplementary literature	<ol style="list-style-type: none"> 1. Alain Nouailhat, An Introduction to Nanoscience and Nanotechnology, John Wiley & Sons, Inc, 2008 2. R.W. Kelsall, I. W. Hamley, M. Geoghegan, (Eds.)Nanoscale Science and Technology, John Wiley & Sons Ltd, 2005 3. Hofmann K.H: Smart Materials, 2003 4. Schwartz M. Encyclopedia of Smart Materials t.1 i 2 , 2003 5. Scanning Probe Microscopy: Characterization, Nanofabrication and Device Application of Functional Materials, P.M.Vilarinho, Y.Rosenwaks, A.Kingon (Eds.), NATO Science Series, II. Mathematics, Physics and Chemistry, vol.186, Kluwer Academic Publishers, Dordrecht, Boston, London 2002. 	
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Nanotechnologie w materiałach konstrukcyjnych, W, NwIMiK, sem.05, zimowy 23/24 - Moodle ID: 33566 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33566</p> <p>Nanotechnologie w materiałach konstrukcyjnych, W, NwIMiK, sem.05, zimowy 23/24 - Moodle ID: 33566 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33566</p>	
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. Development forecasts for construction materials nanotechnology. 2. Construction of engineering materials 3. Tensile strength of nanocrystalline materials 4. Deformation strengthening of nanocrystalline materials 		
Work placement	Not applicable		