



Subject card

Subject name and code	Nanoceramics and materials for extreme conditions, PG_00071223						
Field of study	Nanotechnology						
Date of commencement of studies	February 2027	Academic year of realisation of subject			2027/2028		
Education level	second-cycle studies	Subject group			Specialty 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	Division of Ceramics -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Sebastian Wachowski				
	Teachers		dr inż. Sebastian Wachowski				
Lesson types	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	1.0	19.0	50		
Subject objectives	The aim of this course is to familiarize students with materials and nanostructures operating under extreme conditions, such as those encountered in the aerospace industry, nuclear power, and other technological areas where operating conditions are particularly challenging (e.g., high temperatures, radiation, highly corrosive environments). The course encompasses both the expansion of engineering knowledge and the development of practical skills in the laboratory.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W01] has broadened and well-structured knowledge in the field of materials science, including material fabrication or control of processes accompanying fabrication, with particular emphasis on materials and structures at the nanoscale.	The student has knowledge of methods for producing protective nanostructures.			[SW1] Assessment of factual knowledge		
	[K7_W03] has knowledge of current development trends and the latest discoveries in the fields of physics, chemistry, technology, and applications of nanostructures	The student has knowledge of nanotechnology in the context of structures resistant to extreme conditions and the use of nanomaterials as protective measures against such conditions.			[SW1] Assessment of factual knowledge		
	[K7_U02] has advanced skills in the design of nanomaterials and in conducting laboratory work related to the fabrication and characterization of nanostructures	The student possesses skills related to the characterisation of nanoceramics and other materials resistant to extreme conditions.			[SU5] Assessment of ability to present the results of task		

Subject contents	<p>Course content – lecture</p> <p>Extreme conditions in selected technological industries: radiation, temperature, pressure, chemical activity</p> <p>Nanoceramics and their properties</p> <p>Nano- and mesoporous ceramic structures</p> <p>Stability and physical degradation processes of nanomaterials temperature, pressure</p> <p>Thermal barriers, thermal shields, refractory materials</p> <p>Radiation-resistant materials</p> <p>Corrosion and nanoscale methods of anticorrosion protection</p>											
	<p>Course content – laboratory</p> <p>Each student's lab includes several selected components related to the content presented below:</p> <ol style="list-style-type: none"> 1. Synthesis of nanoceramics or other materials used in extreme conditions 2. Methods for characterizing ceramic nanostructures 3. Thermal analysis of ceramics 4. Water barriers, thermal conductivity, thermal conductivity 5. Methods for characterizing corrosive products 6. Application and testing of intercorrosion layers 7. Compatibility testing of ceramics 8. Chemical compatibility testing of ceramics 											
Prerequisites and co-requisites	<ol style="list-style-type: none"> 1. Knowledge of crystallography, materials physics, and basic chemistry 2. Knowledge of basic chemical laboratory methods and materials characterization techniques (XRD, SEM, EIS, thermal analysis methods). 											
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Laboratory report</td> <td>50.0%</td> <td>50.0%</td> </tr> <tr> <td>Test from theory</td> <td>50.0%</td> <td>50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Laboratory report	50.0%	50.0%	Test from theory	50.0%	50.0%
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	Laboratory report	50.0%	50.0%									
Test from theory	50.0%	50.0%										
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Eswarappa Prameela, S., Pollock, T.M., Raabe, D. et al. Materials for extreme environments. Nat Rev Mater 8, 8188 (2023). https://doi.org/10.1038/s41578-022-00496-z 2. Kiani, A., Rahmani, M., Sivakumar, M., & Tan, B. (2014). Nanoceramics: Synthesis, characterization, and applications. Journal of Nanomaterials, 2014. https://doi.org/10.1155/2014/528348 										
	Supplementary literature	none										
	eResources addresses											
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. List examples of materials used to increase fire resistance. 2. Discuss the properties required for a thermal barrier material. 3. Discuss the applications of meso- and nanoporous ceramics. 											
Practical activities within the subject	Not applicable											

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