



## Subject card

Subject name and code	, PG_00052096						
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	6	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Energy and Industrial Apparatus -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Janusz Cieśliński					
	Teachers	prof. dr hab. inż. Janusz Cieśliński dr inż. Bartosz Dawidowicz					
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	15.0	45
	E-learning hours included: 0.0						
	Address on the e-learning platform: <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=22244">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=22244</a>						
	Additional information: Power Point presentation. Discussion.						
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	45	5.0		50.0	100	
Subject objectives	Basic concepts of nanofluids. Methods of fabrication of nanofluids. Thermal and physical properties of nanofluids. Peculiarities of heat transfer in single phase and two-phase convection.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_K05	Student knows fundamental definitions, equations and schemes that allow discussion about properties and potential applications of nanofluids			[SK4] Assessment of communication skills, including language correctness		
	K6_U02	Student is able to solve problems regarding application of nanofluids in cooling/heating system			[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information		
	K6_W06	Student knows mechanisms of influence of nanoparticles on thermal, electro-magnetic and optical properties of nanofluids			[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	K6_U04	Student is able to measure basic thermal properties of nanofluids as well as convective heat transfer coefficient			[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools		
Subject contents	Technological challenges. Heat transfer intensification. Nanofluids. Nanoscale. Nanoparticles. Nanoparticle concentration. Fabrication of nanofluids. Thermal conductivity mechanisms of improvement. Viscosity. Flow resistance. Coefficient of thermo-hydraulic enhancement. Zeta potential. Stability of nanofluids. Contact angle. Critical heat flux. Single phase convection heat transfer.						
Prerequisites and co-requisites	Thermodynamics, heat transfer						

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Test	56.0%	30.0%
	Testy	56.0%	30.0%
	Seminar	56.0%	40.0%
Recommended reading	Basic literature	1. S.K. Das, S.U.S. Choi, W. Yu, T. Pradeep: Nanofluids. Science and technology, j. Wiley, 2008.  2. H.M. Ali: Hybrid nanofluids for convection heat transfer, Elsevier, 2020	
	Supplementary literature	1. Experimental Thermal and Fluid Science  2. Int. J. Heat Mass Transfer  3. Int. J. Heat and Fluid Flow  4. Energies  5. Nanomaterials	
	eResources addresses	Adresy na platformie eNauczenie:	
Example issues/ example questions/ tasks being completed	1. Methods of nanofluids fabrication - advantages and disadvantages  2. Explanation of thermal conductivity enhancement  3. Factors influencing stability of nanofluids  4. Influence of nanoparticles on boiling process		
Work placement	Not applicable		