



Subject card

Subject name and code	Heat & Mass Transfer in no Gravity Environment, E:41021W0						
Field of study	Space and Satellite Technologies						
Date of commencement of studies	February 2024		Academic year of realisation of subject		2023/2024		
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		English		
Semester of study	1		ECTS credits		2.0		
Learning profile			Assessment form		assessment		
Conducting unit	Division of Thermal Power Systems -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Paweł Szymański				
	Teachers		dr inż. Paweł Szymański				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	15.0	0.0	45
	E-learning hours included: 0.0						
	Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=6441						
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		0.0		0.0	45
Subject objectives	<p>The main objectives of the course:</p> <ul style="list-style-type: none">• To teach students the issues of passive methods of heat transfer;• The student will learn about heat transfer methods such as radiation, convection and conduction.• The students will solve numerical problems related to the above issues.• At the course will be presented the latest and most efficient methods of heat transfer, such as fins and heat sinks, heat pipes, thermosiphons, loop heat pipes, vapour chambers, Peltier cells (thermoelectric coolers), phase change materials (phase change materials) and the action of graphene to intensify heat transfer.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_K03] Can analyse and implement assigned tasks while maintaining high technical standards. Is able to work and interact in a group, taking on different roles. Adheres to the principles of professional ethics and respects the diversity of views and cultures.		He maintains high technical standards when implementing tasks from the area of passive methods of heat transfer.		[SK5] Assessment of ability to solve problems that arise in practice		
	K7_U08		The student is able to calculate and select heat exchange devices used in the space industry. He is able to solve basic heat transfer problems.		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment		
	K7_W03		Student has the knowledge on passive methods of heat transfer.		[SW3] Assessment of knowledge contained in written work and projects		

Subject contents	<ul style="list-style-type: none">• Introduction importance of passive methods of heat transfer;• Principles of HeatTransfer;• HeatTransfer Mechanisms;• Fins and Heat Sinks;• Thermal Resistance Network;• Thermal Specification of Microelectronic Packages;• Fundamentals of Convection Heat Transfer;• Natural Convection HeatTransfer;• Radiation HeatTransfer;• Advanced CoolingTechnologies (Heat Pipes, Thermosyphons, Loop Heat Pipes, Vapor Chambers, Thermoelectric Coolers, Phase-change materials, graphene);		
Prerequisites and co-requisites	Basic knowledge of mathematics, thermodynamics, physics and strength of materials		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Classes - a solving of a number of examples	56.0%	50.0%
	Lecture - exam	56.0%	50.0%
Recommended reading	Basic literature	<ul style="list-style-type: none">• Karam R. Satellite thermal control for systems engineers• Meseguer J. Spacecraft thermal control• Gilmore D. Spacecraft thermal control handbook• Miao J. Space Science and Technologies• Zohuri B. Heat Pipe Design and Technology a practical approach• Shabany Y. Heat Transfer: Thermal Management of Electronics	
	Supplementary literature	<ul style="list-style-type: none">• "Heat Pipes, Theory, Design and Applications" by David.Reay, Peter Kew	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	The multiple case studies, exaples and solved design problems from the field of heat transfer and the passive heat exchangers		
Work placement	Not applicable		

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