GDAŃSK UNIVERSITY OF TECHNOLOGY

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	Zakład Systemów i Urządzeń Energetyki Cieplnej -> 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

The main objectives of the course:

- 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 form 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

<table>
<tr><td>Subject contents</td><td>• 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);</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basic knowledge of mathematics, thermodynamics, physics and strength of materials</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Classes - a solving of a number of examples</td><td>56.0%</td><td>50.0%</td></tr>
<tr><td>Lecture - exam</td><td>56.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>• 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</td></tr>
<tr><td>Supplementary literature</td><td>• "Heat Pipes, Theory, Design and Applications" by David.Reay, Peter Kew</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>The multiple case studies, exaples and solved design problems from the field of heat transfer and the passive heat exchangers</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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