GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Heat Transfer, PG_00055400		
Field of study	Mechanical Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Dariusz Mikielewicz	
	Teachers		

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						

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	2.0	18.0	50

Subject objectives

Presentation of the main mechanisms and laws of heat transfer. The lecture introduces methods of solving heat conduction, heat transfer and radiative heat transfer problems occurring in technology. The basis for calculations of heat exchangers iare provided/.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W09] possesses basic knowledge within the range of thermodynamics and fluid mechanics, construction and operation of heat generating devices, process equipment, including renewable energy sources, cooling and air conditioning	Understands issues related to thermal and refrigeration technology. Can formulate a problem and analyze it.	[SW1] Assessment of factual knowledge
[K6_U06] is able to use mathematical and physical models for analysing the processes and phenomena occurring in mechanical devices within the range of material strength, thermodynamics and fluid mechanics	Has the basics for designing recuperators. Knows how to determine the average temperature difference in a heat exchanger. Is familiar with the procedure of HX design	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_U07] is able to design a typical construction of a mechanical device, component or a testing station using appropriate methods and tools, adhering to the set usage criteria	Has the basics for designing recuperators. Knows how to determine the average temperature difference in a heat exchanger.	[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information

Subject contents

Presentation of the main mechanisms and laws of heat transfer. Methods of solving problems occurring in technology in terms of conduction, heat transfer and radiation heat transfer. Methods of heat transfer intensification. Boiling and condensation. Fundamentals of heat exchanger design.

Prerequisites and co-requisites

THermodynamics I, Fluid mechanics I, Mathematics

Assessment methods and criteria	<table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>lecture</td><td>60.0%</td><td>65.0%</td></tr><tr><td>laboratory</td><td>60.0%</td><td>35.0%</td></tr></table>

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1.Mikielewicz D., Heat transfer - lecture notes.

2.F. Incropera, D. deWitt, Fundamentals of heat and mass transfer, 5th edition, CRC Press, 2007.

3.Wiśniewski S., Wiśniewski T., Wymiana ciepła, WNT, 2007.

4.Pudlik W., Heat transfer and heat exchangers, Wydawnictwo PG, Gdańsk 1996</td></tr>
<tr><td>Supplementary literature</td><td>Any heat transfer textbook</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1. illustrate the known modes of heat transfer using the example of heat transfer through a multilayer wall separating two fluids at different temperatures. 2. derive Peclet's equation for heat transfer through a single wall separating two fluids. 3. Define the thermal resistance of conduction, transfer, and convective heat transfer. 4. Provide a definition of heat flux density in a two-dimensional temperature field. 5. Discuss examples of geometric similarity, state why geometric similarity is not sufficient in physical modeling of phenomena. 6. Derive the concept of Biot's number from the definition, explain how it differs from Nusselt's number. What can be assumed when Biot's number goes to zero? 7. critical radius of insulation. Derive the relationship for the minimum radius of insulation. 8. derive the definition of the Nusselt number, explain how it differs from the Biot number. 9. derive the relationship for calculating the time-varying temperature in a system of low heat conduction resistance, assuming that the body is cooled in a medium of constant temperature. Bring an expression describing the temperature distribution to dimensionless form. 10. derive the differential equation of the time-varying temperature field for the general case of a system with low heat conduction resistance considering radiative heat transfer and constant heat flux. 11. Give the formula for heat flux through a one-sided finned surface from a sketch with explanation. 12. Fourier-Kirchoff equation - discuss the forms of this equation arising from appropriate assumptions, i.e. Fourier equation, Poisson equation, Laplace equation. 13. Derive the differential equation for the temperature distribution in a rod, and state the assumptions under which a rectangular rib can be analyzed in this manner. State the assumptions under which these equations are derived. 14. hydrodynamic and thermal boundary layer. Purpose of using the approximation. When are the layers of equal thickness and when are they of different thickness. 15. Analogies between heat and momentum transfer. Purpose of their use. Give an example. 16. List and discuss the methods of determining the heat transfer coefficient. 17. state the mechanism of forced convection and free convection. Give a set of criterion numbers describing this type of heat transfer. Define these numbers. 18. droplet and film condensation. State the assumptions for Nusselt's theory. 19. Pool boiling . Conditions of bubble growth. Give the division with respect to fluid temperature and geometry. Discuss the boiling curve. 20. boiling in flow. Discuss the structures that occur when a fluid flows through a heated channel with a low heat flux density. Give the temperature distribution of the fluid and the wall and an example of the application of this case. 21. give the division of heat exchangers and assumptions for theoretical analysis of heat exchangers of recuperator type. 22. give a general algorithm for heat exchangers sizing. 23. give a method for determining the effect of deposits in an exchanger on total heat transfer resistance. 24. logarithmic mean temperature difference. State the temperature distribution under co-current and counter-current flow. State the heat exchanger balance equations for co-current and counter-current case.

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<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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