GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Heat exchangers, PG_00055941
Field of study	Wymienniki ciepła

Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
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	2.0
Learning profile	general academic profile	Assessment form	assessment

Conducting unit	Division of Thermal Power Systems -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej
Name and surname of lecturer (lecturers)	Subject supervisor — dr inż. Michał Pysz Teachers — dr inż. Michał Pysz

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	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 principal mechanisms and laws of heat transfer. Lecture familiarises with methods of solving problems in technical applications, conduction and heat transfer problems as well as rtadiative heat transfer. Presents foundations to sizing of heat exchangers. The project classes prepare student how to design heat exchangers in real life industrial scenarios.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U04] is able to design a simple device structure and prepare the accompanying technical documentation, conduct a basic technical and economic analysis of energy systems, including technologies using renewable and pro-ecological energy sources as well as conventional and nuclear energy, design energy installations for them and their basic elements (including electric lighting)); select, operate and control the most commonly used electrical devices and drive systems.	The student will be familiar with classical and perspective energy technologies, the principles of selection and operation of thermalenergy equipment and installations, basic principles of operation of energy systems, environmental effects of applied energy technologies, ways of using renewable energy sources.	[SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania [SU4] Ocena umiejętności korzystania z metod i narzędzi [SU1] Ocena realizacji zadania
	[K6_W06] knows classic and developmental energy technologies, rules for the selection and operation of heat and energy devices and installations, basic principles of energy systems operation, basic issues regarding the reliability of energy devices and diagnostics, environmental effects of energy technologies used, methods of using renewable energy sources	The student will be familiar with classical and perspective energy technologies, the principles of selection and operation of thermalenergy equipment and installations, basic principles of operation of energy systems, environmental effects of applied energy technologies, ways of using renewable energy sources.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym [SW1] Ocena wiedzy faktograficznej
	[K6_W09] knows the dangers of electrical devices and the principles of protection against them, has basic knowledge of heat exchangers, has basic knowledge of power equipment such as pumps, compressors, turbines, combustion engines, boilers, pipelines and their accessories and methods of their selection depending on the needs	The student has a basic knowledge of heat exchangers, and methods of selecting them according to demand	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym [SW1] Ocena wiedzy faktograficznej

Subject contents	Course content – lecture Lecture Presentation of major mechanisms and laws governing the flow of heat. Presentation of methods of solving of technical problems incorporating heat conduction, heat convection and radiative heat transfer. Methods of heat transfer intensification. Basics of heat exchanger design.
	Course content – project Design and analysis of a heat exchanger for a specified technological system, taking into account the heat balance, selection of the exchanger type, and operating parameters. Students will develop a computational model, select construction materials, and prepare a 3D model of the proposed solution.

Prerequisites and co-requisites	maths I, II, III, physics, fluid mechanics, thermodynamics		

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Project	60.0%	40.0%
	Lecture final test	60.0%	60.0%

Recommended reading	Basic literature	1.Mikielewicz J., Grochal B., Gumkowski S., Polesek-Karczewska S., Mikielewicz D., Wymiana ciepła, Wydawnictwo IMP PAN, 1996 2.F. Incropera, D. deWitt, Fundamentals of heat and mass transfer, 5th edition, CRC Press, 2007. 2.Wiśniewski S., Wiśniewski T., Wymiana ciepła, WNT, 2007. 4.Pudlik W., Wymiana i wymienniki ciepła, Wydawnictwo PG, Gdańsk 1996.
	Supplementary literature	Flynn A. M., Akashige T., Theodore L., Kern's Process Heat transfer, Scrinvener Publishing LLC, 2019 Sekulic, D. P., Shah R. K., Fundamentals of Heat Exchanger Design, 2024 John Wiley & Sons Inc.
	eResources addresses	

Example issues/ example questions/ tasks being completed	1. Present and discuss known mechanisms of heat transfer on the example of overall heat transfer through a multilayer wall separating two fluids with different temperatures. 2. Derive the Peclet equation for overall heat transfer through a single layer wall separating two fluids. 3. Derive the expression for temperature distribution and rate of heat in a cylinder and a sphere. 4. Define the thermal resistance due to conduction, convection and overall heat transfer. 5. Present a definition of heat flux in a two-dimensional temperature field. 6. Discuss the examples of geometric similarity; why geometrical similarity is not sufficient for physical modeling of phenomena. 7. Derive the form of Biot number; explain in what way it is different from the Nusselt number. What can be assumed if the Biot number tends to zero? 8. Derive the form of the Nusselt number; explain in what way is it different from the Biot number. 9. Derive the relation enabling calculation of variable in time temperature in a body featuring a small thermal resistance. Conduct the analysis to the form expressing the temperature distribution in terms of non-dimensional numbers. 10. Derive the differential equation for a variable in time temperature field for the general case with small thermal resistance with account of radiative heat transfer and a constant heat flux. 11. Thermal-electric analogy. Explain the basics. 12. Write the expression for the rate of heat through a wall featuring fins on external side. Give the schematic of the problem with relevant explanations. 13. Fourier-Kirchoff equation discuss forms of that equation arising as a result of different assumptions, i.e. Fourier, Poisson and Laplace forms of that equation. 14. Derive the differential equation for temperature distribution in the pin fin, give the boundary conditions enabling solution of that equation. Subsequently give the assumptions when the rectangular fin can be analysed using that theory. 15. Hydrodynamic and thermal boundary layers. 16. Momentum-energy analogies for solution of conservation equations. 17. Discuss known ways of determination of heat transfer coefficient. 18. Give the mechanism of forced and natural convection. Give a set of non-dimensional numbers describing the respective mode of convection. 19. Give a major groups of heat exchangers. Present the assumptions for the analysis of recuperators. 20. Present a general algorithm for calculation of heat exchanger size. 21. Logarithmic mean temperature difference. Give the temperature distribution in cocurrent and countercurrent flow
Practical activites within the subject	Not applicable

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