GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of two-phase flows, PG_00064773						
Field of study	Power Engineering						
Date of commencement of studies	February 2025		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		Subject group		Specialty 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	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		3.0		
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		dr hab. inż. Rafał Andrzejczyk				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	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		7.0	38.0		75
Subject objectives	Presentation of basic information on two-phase flows in installations energy.						

Learning outcomes	<table><tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr><tr><td>[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Power Engineering, enabling modeling and analysis of energy systems, machines and devices, transmission grids and internal installations</td><td>demonstrates knowledge of the influence of key thermal and flow parameters on the phase change process</td><td>[SW3] Assessment of knowledge contained in written work and projects</td></tr><tr><td>[K7_U02] formulates and tests hypotheses concerning problems related to energy conversion processes, their efficiency, control, safety and impact on the environment, as well as simple research problems</td><td>can explain the differences between the approaches found in the literature in terms of modeling of two-phase flow pressure drops and the heat transfer coefficient, as well as methods for determining the void fraction and the quality. Can determine the impact of instability (fluctuations) of the heat transfer coefficient on the safety of the energy installation</td><td>[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information</td></tr><tr><td>[K7_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of energy systems, machines and devices, transmission grids and internal installations</td><td>demonstrates knowledge of modeling of two-phase pressure drops (frictional, acceleration, hydrostatic) and heat transfer coefficient in two-phase adiabatic and diabatic flow for simple geometric cases of flow channels, in the range of diameters characteristic for common energy installations</td><td>[SU1] Assessment of task fulfilment</td></tr><tr><td>[K7_W04] demonstrates knowledge encompassing selected issues in the field of advanced detailed knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Power Engineering</td><td>demonstrates knowledge of the physical phenomena accompanying pool boiling, film and drop condensation as well as flow boiling, flow condensation for conventional channels and mini-channels</td><td>[SW3] Assessment of knowledge contained in written work and projects</td></tr></table>
Subject contents	Lecture 1. Introduction, basic definitions, flow structures, flow boiling, and condensation maps (2) 2. Pressure drop in two-phase flows. Analytical modeling of two-phase pressure drop by using of two-phase pressure drop multiplier (6) 3. The void fraction in two-phase flows (4) 4. Mathematical modeling of two-phase flows - homogeneous model, separated model, two-fluid model (6h) 5. Flow boiling channels and small diameter channels (2) 6. Flow condensation (4) 7. Designing of heat exchangers with the change of phase (6).8. The influence of heat flux density on the efficiency of energy systems. 9. Modeling of two-phase flows in energetic systems(2). Classes 1. Use of flow maps in modeling two-phase flow (2) 2. Calculating pressure drop in two-phase flow using two-phase multiplier models(4) 3. Calculation of void fraction and quality during a phase change (2)4. Thermal flow calculations during boiling in conventional and small diameter channels (4) 5. Thermal flow calculations during condensation (3) 6. Analytical calculations for simple condensers and evaporators (2).
Prerequisites and co-requisites	mathematics I,II, heat transfer, thermodynamics, fluid mechanics
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>written exam lecture</td><td>56.0%</td><td>50.0%</td></tr><tr><td>written exam classes</td><td>56.0%</td><td>50.0%</td></tr></table>

Recommended reading	Basic literature	1. D. Mikielewicz, Wrzenie i kondensacja w przepływie w kanałach imikrokanałach, Wydawnictwo PG, Gdańsk 2009 2. Carey V. P., Liquid vapor phase change phenomena, Taylor andFrancis, 2008 3. Naterer G., Heat Transfer in Single and Multiphase Systems, CRCPress, 2003 4. Kandlikar S.G., Heat transfer and fluid flow in minichannels andmicrochannels, Elsevier, 2004 5. S. M. Ghiaasiaan, Two-Phase Flow,Boiling and Condensation, Cambridge University Press, 2008. 6.Pudlik, Wiesław, Wymiana i Wymienniki Ciepła, Gdańsk 2011 7.Yunus. A.Cengiel, Thermodynamics and Heat Transfer, Secomnd edition 2008
	Supplementary literature	1.D. Del Col, S. Bortolin, D. Torresin, A. Cavallini, Flow boiling of R1234yf in a 1mm diameter channel, Proceedings 23rdIIR International Congress of Refrigeration, Prague, Czech Republic, 2011. 2. D. Mikielewicz, J. Mikielewicz, J. Tesmar, Improved semi-empirical method for determination of heat transfer coefficient in flow boiling in conventional and small diameter tubes, Int. J. of Heat and Mass Transfer, vol. 50, (2007) 3949-3956 3..D. Mikielewicz, A new method for determination of flow boiling heat transfer coefficient in conventional diameter channels and minichannels, Heat Transfer Engineering, vol. 31, No. 4, (2010) 276-287 4.L. Wojtan, T. Ursenbacher, J.R. Thome, Investigation of flow boiling in horizontal tubes: Part II - Development of a new heat transfer model for stratified-wavy, dryout and mist flow regimes, Int. J. Heat Mass Transf. 48 (2005) 29702985. doi:10.1016/j.ijheatmasstransfer. 2004.12.013 5.. Moreno Quibén, J.R. Thome, Flow pattern based two-phase frictional pressure drop model for horizontal tubes, Part II: New phenomenological model, Int. J. Heat Fluid Flow. 28 (2007) 10601072. doi:10.1016/j.ijheatfluidflow.2007.01.004
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1.Determination of flow resistance in two phase flows in channels 2.Determination of heat transfer coefficient in flow boiling and flow condensation in channels 3.Physical dmening of boiling number. 4. Draw and describe boiling curve.	
Work placement	Not applicable	