

GDAŃSK UNIVERSITY

Subject card

Subject name and code	Basic thermodynamic analysis in energy conversion processes, PG_00060863								
Field of study	Chemical Technology								
Date of commencement of studies	October 2023		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	2		Language of instruction			Polish			
Semester of study	4		ECTS credits			2.0			
Learning profile	general academic profile		Assessment form			assessment			
Conducting unit	Department of Energy Conversion and Storage -> Faculty of Chemistry								
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Ewa Klugmann-Radziemska							
	Teachers		dr inż. Anna Kuczyńska-Łażewska						
		prof. dr hab. Ewa Klugmann-Radziemska				ska			
Lesson types and methods	Lesson type	Lecture	Tutorial	Laboratory	Projec	ct Seminar SU		SUM	
of instruction	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 ir classes include plan		I didactic Participation in consultation hours		Self-study SUM				
	Number of study hours	30		2.0		18.0		50	
Subject objectives	To familiarize students with energy conversion processes, measurement and calculation methods, and the basics of thermodynamic analysis.								
Learning outcomes	Course outcome		Subject outcome			Method of verification			
	[K6_K05] is aware of the social role of a technical university graduate, and in particular understands the need to formulate and communicate to the public, in particular through the mass media, information and opinions on the achievements of technology and other aspects of engineering activity		understands the need to formulate and communicate to society information and opinions on technological achievements			[SK5] Assessment of ability to solve problems that arise in practice			
	occurring in the life cycle of equipment and facilities and has knowledge of mechanical engineering, chemical apparatus, technical thermodynamics and chemical engineering and chemical reactor engineering necessary to analyse technological processes and correctly design installations and systems in the chemical industry [K6_U04] performs basic design calculations of selected processes and unit operations, is able to calculate and select the basic apparatus of chemical industry in		thermodynamics and chemical engineering necessary to analyze technological processes and properly design installations and systems in the chemical industry performs basic calculations of the energy balance of phenomena and devices; performs calculations of individual and project processes			[SU1] Assessment of task fulfilment			

Subject contents	Lecture:analysis of heat exchange issues (conduction, convection, absorption, penetration) and conversion of thermal energy into other types of energy in devices and their efficiency. Contents: 1. Basic concepts and the ability to apply them 2. Basic concepts of general thermodynamics: internal energy, thermodynamic state, state function, process function, thermodynamic potentials, pressure, temperature, volume, heat, specific heat, enthalpy, entropy, exergy, thermodynamic potentials, pressure, temperature, volume, heat, specific heat, enthalpy, entropy, exergy, thermodynamic processes. 4. Technical thermodynamic calculations. Real and ideal and semi-perfect gases. 5. Temperature scales. Equivalence of the thermodynamic temperature scale and the temperature scale of an ideal gas, absolute temperature scale. 6. Methods of measuring temperature 7. Characteristic processes of semi-perfect gases. Thermodynamic cycles. Carnot engine, Carnot engine efficiency 8. Clausius-Rankine cycle - conventional or nuclear steam power plants, chillers and heat pumps 9. Otto cycle - spark-ignition piston internal combustion engines 10. Atkinson engine - increasing the expansion ratio regarding the Otto cycle 11. Diesel cycle 12. Seiliger-Sabathé cycle - high-speed diesel engine with injection pump 13. Brayton-Joule cycle - gas turbine 14. Joule refrigeration cycle 15. Heat exchange by radiation 16. Heat exchange by conduction 17. Heat exchange by convection 18. Principles of thermal insulation efficiency 19. Theory of similarity and dimensional analysis Laboratories: 1. Determining the efficiency of a heat pump 5. Determining the efficiency of a heat exchange 4. Determining the efficiency of a heat pump 5. Determining the efficiency of a solar collector.							
Prerequisites and co-requisites	Passed mathematics and physic:	ourses as required by the study program						
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade					
	Labs Passed, Written test	60.0%	100.0%					
Recommended reading	Supplementary literature eResources addresses	 K. Ziębik, W. 32ega, W. Stalek, Energetyczna iEkologiczna. Pora Termodynamicznych i Termoekci Śląskiej 2022, ISBN: 978-83-788 S. Postrzednik, Z. Żmudka; Term uwarunkowania eksploatacji tłok 978-83-7335-421-0, Wydawnictw J. Szargut, Termodynamika, Wyd 2022, Wydanie: 7 Klugmann-Radziemska E., Term Wyd. Politechniki Gdańskiej 201 Wiśniewski S: Termodynamika te WNT Wyd. 7.,2022 Pudlik W.: Termodynamika, Wyd Gdańskiej 2022 Klugmann-Radziemska E., Odna obliczeniowe, Wyd. IX, Wydawni Podstawowe https://chem.pg.edu.pl/kkime/stu 	 A. Ziębik, W. Szega, W. Staliek, Elektywiosc Energetyczna iEkologiczna. Poradnik Metodyczny w Zakresie Analiz Termodynamicznych i Termoekologicznych; Wydawnictwo Politechniki Śląskiej 2022, ISBN: 978-83-7880-791-9 S. Postrzednik, Z. Żmudka; Termodynamiczne oraz ekologiczne uwarunkowania eksploatacji tłokowych silników spalinowych, ISBN: 978-83-7335-421-0, Wydawnictwo Politechniki Śląskiej 2007 J. Szargut, Termodynamika, Wydawnictwo Naukowe PWN Warszawa 2022, Wydanie: 7 Klugmann-Radziemska E., Termodynamika Techniczna, Wyd. Politechniki Gdańskiej 2016 Wiśniewski S: Termodynamika techniczna, Warszawa WNT Wyd. 7.,2022 Pudlik W.: Termodynamika, Wydawnictwo Wyd. Politechniki Gdańskiej 2022 Klugmann-Radziemska E., Odnawialne źródła energii. Przykłady obliczeniowe, Wyd. IX, Wydawnictwo Politechniki Gdańskiej, 2021 Podstawowe 					
		laboratorium-zrodla-energii - laboratory instructions Adresy na platformie eNauczanie:						
Example issues/ example questions/ tasks being completed	 A flat solar collector with an area (E=1000W/m2). Calculate its efficiency 2. A detached house with a usab is heated by a ground heat pump the heat pump 	 A flat solar collector with an area of 2 m2 heats 14 l of water in ½ h at 40oC under standard conditions (E=1000W/m2). Calculate its efficiency. 2. A detached house with a usable area of 140 m2 and an energy consumption index of 150 kWh/(m2.year) is heated by a ground heat pump with an efficiency coefficient of 4. Calculate the required electrical power of the heat pump. 						
Work placement	Not applicable							