



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				
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	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		
	[K6_W04] understands processes 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		has knowledge of technical thermodynamics and chemical engineering necessary to analyze technological processes and properly design installations and systems in the chemical industry		[SW1] Assessment of factual knowledge		
	[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 a process line		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	<p>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 system, thermodynamically isolated system. 3. Principles of thermodynamics. Classification of 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. Determination of the thermal conductivity coefficient of building materials 2. Determination of the heat of combustion of fuels using a calorimeter 3. Determining the efficiency of a heat exchanger 4. Determining the efficiency of a heat pump 5. Determining the characteristics of a fuel cell 6. Determining the efficiency of a wind generator 7. Calculating the efficiency of a solar collector.</p>								
Prerequisites and co-requisites	Passed mathematics and physics courses as required by the study program								
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Labs Passed, Written test</td> <td>60.0%</td> <td>100.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Labs Passed, Written test	60.0%	100.0%
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Recommended reading	Basic literature	<p>A. Ziębik, M. Szega, W. Stanek; Efektywność Energetyczna i Ekologiczna. Poradnik Metodyczny w Zakresie Analiz Termodynamicznych i Termoeologicznych; Wydawnictwo Politechniki Śląskiej 2022, ISBN: 978-83-7880-791-9</p> <p>S. Postrzednik, Z. Żmudka; Termodynamiczne oraz ekologiczne uwarunkowania eksploatacji tłokowych silników spalinowych, ISBN: 978-83-7335-421-0, Wydawnictwo Politechniki Śląskiej 2007</p> <p>J. Szargut, Termodynamika, Wydawnictwo Naukowe PWN Warszawa 2022, Wydanie: 7</p> <p>Klugmann-Radziemska E., Termodynamika Techniczna, Wyd. Politechniki Gdańskiej 2016</p> <p>Wiśniewski S: Termodynamika techniczna, Warszawa WNT Wyd. 7., 2022</p> <p>Pudlik W.: Termodynamika, Wydawnictwo Wyd. Politechniki Gdańskiej 2022</p>							
	Supplementary literature	Klugmann-Radziemska E., Odnawialne źródła energii. Przykłady obliczeniowe, Wyd. IX, Wydawnictwo Politechniki Gdańskiej, 2021							
	eResources addresses	<p>Podstawowe https://chem.pg.edu.pl/kkime/studenci/materialy-do-zajec/instrukcje-laboratorium-zrodla-energii-laboratory-instructions Adresy na platformie eNauczanie: Podstawy analiz termodynamicznych w procesach przetwarzania energii - TCh 24/25 sem. 4 - Moodle ID: 39362 https://enauznanie.pg.edu.pl/moodle/course/view.php?id=39362</p>							
Example issues/ example questions/ tasks being completed	<p>A flat solar collector with an area of 2 m² heats 14 l of water in ½ h at 40°C under standard conditions (E=1000W/m²). Calculate its efficiency.</p> <p>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.</p>								
Work placement	Not applicable								

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