GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basic thermodynamic analysis in energy conversion processes, PG_00060863		
Field of study	Podstawy analiz termodynamicznych w procesach przetwarzania energii		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Ewa Klugmann-Radziemska	
	Teachers		

Lesson types

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_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] Ocena realizacji zadania
[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] Ocena wiedzy faktograficznej
[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] Ocena umiejętności rozwiązywania problemów występujących w praktyce

Subject contents	Course content – lecture 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.
Prerequisites and co-requisites	Passed mathematics and physics courses as required by the study program

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Labs Passed, Written test	60.0%	100.0%

Recommended reading

Basic literature	A. Ziębik, M. Szega, W. Stanek; Efektywność 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
Supplementary literature	Klugmann-Radziemska E., Odnawialne źródła energii. Przykłady obliczeniowe, Wyd. IX, Wydawnictwo Politechniki Gdańskiej, 2021
eResources addresses	Basic https://chem.pg.edu.pl/kkime/studenci/materialy-do-zajec/instrukcje-laboratorium-zrodla-energii - laboratory instructions

Example issues/ example questions/ tasks being completed	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 of4. Calculate the required electrical power of the heat pump.
Practical activites within the subject	Not applicable