GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00065744		
Field of study	Recycling and Energy Recovery		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	
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	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jacek Gębicki	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	20.0	10.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=45021

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	60	0.0	0.0	60

Subject objectives

The aim of the course is to familiarize students with various methods of waste-to-energy conversion. It will educate students on currently used waste processing technologies and provide theoretical and practical knowledge on waste-to-energy conversion. Methods such as incineration/cogeneration, fermentation, gasification, and pyrolysis will be presented.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] demonstrates knowledge and understanding of research methods (information acquisition, simulations, experimental methods) in the field of technologies related to the recovery of raw materials and energy.	The student is able to use appropriate research methods in the field of technologies related to the recovery of raw materials and energy.	[SW3] Assessment of knowledge contained in written work and projects
[K6_W03] identifies problems and phenomena related to the recovery of raw materials and energy as well as applicable concepts, standards and design methods and is aware of their limitations.	The student is able to identify problems and phenomena related to the recovery of raw materials and energy and is able to apply concepts, standards and design methods and is aware of their limitations.	[SW1] Assessment of factual knowledge
[K6_U04] formulates research problems and selects appropriate research methods (information acquisition, simulations, experimental methods) in the field of technologies related to the recovery of raw materials and energy in order to solve specific tasks and to report research results.	The student has knowledge of formulating a research problem and selecting appropriate research methods (information acquisition, simulations, experimental methods) in the field of technologies related to the recovery of raw materials and energy in order to solve specific tasks and report research results.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools

Subject contents	Course content – lecture • Classification and energy potential of waste in fermentation processes • Control of biomethane and biohydrogen production processes in fermentation processes. • Technical analysis of waste gases. • Conversion of biogas to electricity Introduction to combustion, gasification, and pyrolysis of waste. • Heat of combustion and calorific value of various gaseous, liquid, and solid fuels • Flue gas desulfurization and reduction of nitrogen oxide emissions (primary and secondary methods) • Flammability of plastics: characteristics, flammability testing methods. • Plastic combustion: benefits, risks, and technological challenges • Thermochemical waste treatment: pyrolysis and gasification • Thermochemical waste treatment: techniques coupled with pyrolysis and gasification • Using waste carbon dioxide to obtain synthetic fuels
Prerequisites and co-requisites	• Knowledge of basic chemical reactions, particularly those related to combustion and fermentation processes. • Ability to perform basic chemical calculations. • Understanding of the principles of thermodynamics and energy balance. • Knowledge of basic concepts related to heat and temperature. • Understanding of basic waste processing methods. • Knowledge of environmental protection technologies.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
tests and laboratory reports	60.0%	30.0%
written practical test	60.0%	30.0%
written practical test	60.0%	40.0%

Recommended reading

Basic literature	K. Biernat, Możliwości wykorzystania odpadów jako surowców energetycznych w Polsce, 9 (2011) 113132. E. Klugman-Radziemska, Energetyka i ochrona środowiska. Generowanie i magazynowanie energii. Odpady energetyczne. Analiza cyklu życia, PWN, 2023. Parker, C and Roberts, T. "Energy from waste: An evaluation of conversion technologies." , Jan. 1985. Thomas B. Reed, Agua Das "Handbook of Biomass Downdraft Gasifier Engine System, Biomass Energy Foundation, 1988.
Supplementary literature	GUT library resources, scientific and popular science articles in the field of waste-to-energy processing.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Introduction to thermochemical methods. Comparison of combustion, gasification, and pyrolysis of waste. 2. Using waste carbon dioxide to produce synthetic fuels. Introduction to CO2 conversion technology. Examples of practical applications. 3. Pyrolysis as a method for converting waste plastics and biomass. Characterization of raw materials and gaseous, solid, and liquid products.
Practical activites within the subject	Not applicable

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