GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00069686		
Field of study	Recycling and Energy Recovery		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Optional subject group
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Ewa Klugmann-Radziemska	
	Teachers	prof. dr hab. Ewa Klugmann-Radziemska dr inż. Anna Dettlaff dr inż. Anna Kuczyńska-Łażewska	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	20.0	0.0	0.0	10.0	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	5.0	15.0	50

Subject objectives

The aim of the course is to familiarize students with issues related to industrial waste management, which constitutes 90% of waste in Poland: the principles of its classification, segregation, and management, the basics of recycling technologies for specific waste groups, and environmental and economic aspects, with particular emphasis on photovoltaic waste.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W05] analyzes practical issues in the field of recovery of raw materials and energy, using knowledge and understanding of: materials, devices and tools, processes and technologies.	The student analyzes practical issues in the field of raw material and energy recovery.	[SW1] Assessment of factual knowledge
[K6_K03] is committed to independent lifelong learning and independently follows the development of science and technology, especially in the area of recycling raw materials and energy.	The student engages in independent lifelong learning and independently tracks developments in science and technology, especially in the area of raw materials and energy recovery.	[SK5] Assessment of ability to solve problems that arise in practice
[K6_U03] designs processes, technologies and systems related to the recovery of raw materials and energy, using appropriate concepts, standards and design methods.	The student designs processes, technologies and systems related to the recovery of raw materials and energy.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	1. Industrial waste - classification. 2. EU directives and national regulations on industrial waste management. 3. Life cycle assessment (LCA). 4. The 3/4R principle, the principle of sustainable development. 5. Handling hazardous waste. 6. Material, raw material, and energy recycling in specific waste groups: industrial waste, packaging waste, waste from automotive repair shops, construction waste, used electrical and electronic equipment, and medical waste. 7. Industrial water management. Electrochemical methods for its treatment. 8. Electrochemical recovery of precious metals. 9. The impact of pH, salinity, and temperature of industrial water on the environment and aquatic ecosystems. 10. Basics of crystalline silicon and thin-film photovoltaic module manufacturing technology. 11. Life cycle of photovoltaic modules. 12. Recycling and disposal of photovoltaic waste - regulations regarding waste electrical and electronic equipment (WEEE). 13. Possibilities for the recovery of clean materials in the recycling of crystalline silicon and thin-film photovoltaic waste. 14. Reuse of whole PV cells and materials recovered in the recycling process. 15. Recycling of energy storage batteries in renewable energy installations.
Prerequisites and co-requisites	n/a
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Test - lecture	60.0%	50.0%
Exercises and laboratory	60.0%	50.0%

Recommended reading	Basic literature	1. Ustawa o odpadach z dnia 14 grudnia 2012 (Dz.U.2022.699) https://sip.lex.pl/akty-prawne/dzu-dziennik-ustaw/odpady-17940659 2. DYREKTYWA RADY 1999/31/WE z dnia 26 kwietnia 1999 r. w sprawie składowania odpadów https://sip.lex.pl/akty-prawne/dzienniki-UE/dyrektywa-1999-31-we-w-sprawie-skladowania-odpadow-67427597 3. Dyrektywa 2000/53/WE Parlamentu Europejskiego i Rady z dnia 18 września 2000 r. w sprawie pojazdów wycofanych z eksploatacji https://sip.lex.pl/akty-prawne/dzienniki-UE/dyrektywa-2000-53-we-w-sprawiepojazdow-wycofanych-z-eksploatacji-67427581 4. Ustawa o recyklingu pojazdów wycofanych z eksploatacji (Dz.U.2020 poz. 2056) https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20200002056 5. KOMUNIKAT KOMISJI Europejski Zielony Ład https://eur-lex.europa.eu/legal-content/PL/TXT/HTML/?uri=CELEX:52019DC0640&from=EN 6. Ustawa z dnia 13 czerwca 2013 r. o gospodarce opakowaniami i odpadami opakowaniowym https://sip.lex.pl/akty-prawne/dzu-dziennikustaw/ gospodarka-opakowaniami-i-odpadamiopakowaniowymi-18015362 5. KOMUNIKAT KOMISJI Europejski Zielony Ład https://eur-lex.europa.eu/legal-content/PL/TXT/HTML/?uri=CELEX:52019DC0640&from=EN 6. Ustawa z dnia 13 czerwca 2013 r. o gospodarce opakowaniami i odpadami opakowaniowym https://sip.lex.pl/akty-prawne/dzu-dziennikustaw/ gospodarka-opakowaniami-i-odpadamiopakowaniowymi-18015362
	Supplementary literature	1) Błędzki A.K., Recykling materiałów polimerowych, Wyd. Naukowo-Techniczne, Warszawa 1997 2) Wilczyński K. Reologia w przetwórstwie tworzyw sztucznych, Wyd. Naukowo-Techniczne, Warszawa 2001 3) Oprzędkiewicz J., Technologie i systemy recyklingu samochodów, WNT Warszawa 2003 4) Czerwinski A., Akumulatory, baterie, ogniwa, Wydawnictwa Komunikacji i Łączności, Warszawa, 2005
	eResources addresses	
Example issues/ example questions/ tasks being completed	• Discuss the 3R and 4R principles. • What paper recycling methods do you know? • Product fee calculation principles. • Glass packaging recycling.	
Work placement	Not applicable	

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