GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00069687		
Field of study	Analityka zanieczyszczeń środowiska		
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	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Faculty of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Justyna Płotka-Wasylka	
	Teachers	dr hab. inż. Justyna Płotka-Wasylka dr inż. Tomasz Dymerski dr inż. Bartłomiej Cieślik dr inż. Tomasz Majchrzak dr inż. Natalia Jatkowska dr inż. Paweł Kubica dr inż. Małgorzata Rutkowska dr hab. inż. Weronika Hewelt-Belka	

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 addresses:

Moodle ID: 2023 Analityka zanieczyszczeń środowiska
https://enauczanie.pg.edu.pl/2025/course/view.php?id=2023

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	5.0	35.0	100

Subject objectives

The aim of the course *Environmental Pollution Analytics* is to familiarize students with the fundamentals and modern methods of analyzing pollutants resulting from human activity, with particular emphasis on waste and its impact on the environment. Students will learn about the classification and characteristics of different types of waste, as well as the principles of sampling and preparing environmental samples for laboratory analysis. Both classical methods of pollution analysis and modern chromatographic and spectroscopic techniques will be discussed, including their use in the determination of heavy metals, microplastic particles, and gaseous pollutants. Special attention will be paid to air monitoring methods, the assessment of emissions from waste, as well as new trends in environmental analytics related to waste management and the possibilities of utilizing waste for energy recovery.

The course aims to develop the ability to practically apply analytical methods in environmental studies, interpret results, and assess the impact of pollutants on the environment and human health. It also builds awareness of modern, eco-friendly, and sustainable solutions in waste management.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[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 is able to independently formulate research problems related to environmental pollution and waste management, and to select appropriate research methods, including information gathering, simulations, and experimental techniques, in the field of raw material and energy recovery. The student is capable of practically applying selected methods to solve specific research tasks, conduct environmental analyses, and report and interpret research results in a reliable and scientifically justified manner.	[SU2] Ocena umiejętności analizy informacji [SU1] Ocena realizacji zadania
	[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 demonstrates knowledge and understanding of research methods, including information gathering, simulations, and experimental techniques, in the field of technologies related to raw material and energy recovery. The student is able to evaluate the practical application of these methods and their usefulness for analyzing and solving technological problems.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym [SW2] Ocena wiedzy zawartej w prezentacji [SW1] Ocena wiedzy faktograficznej
	[K6_W02] analyzes engineering and technological issues and problems in the area of raw materials and energy recovery using appropriate and appropriate analytical, numerical and experimental tools and methods	The student is able to analyze engineering and technological issues related to raw material and energy recovery, using appropriate analytical, numerical, and experimental tools and methods. The student is capable of practically applying these methods to solve specific technological problems, assess process efficiency, and interpret the obtained results.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym [SW1] Ocena wiedzy faktograficznej
	[K6_U02] solves engineering issues and problems in the area of raw materials and energy recovery through the use of appropriate analytical, numerical and experimental tools and methods.	The student is able to apply classical and modern analytical methods (chromatographic, spectroscopic, biological) to identify and quantify pollutants in waste and the environment, and subsequently use the obtained results to assess the potential for resource and energy recovery while minimizing the negative impact on the environment.	[SU4] Ocena umiejętności korzystania z metod i narzędzi [SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu [SU2] Ocena umiejętności analizy informacji

Subject contents	
Subject contents	**Lecture Topics** **1. Introduction to Environmental Analytics** • importance and scope of environmental analytics, • basic concepts and legal acts, • the role of analytics in environmental monitoring and waste management. **2. Types of Waste and Their Classification** • municipal, industrial, hazardous, and medical waste, • waste classification criteria and waste codes. **3. Sampling and Preparation of Environmental Samples** • techniques for sampling soil, water, air, and waste, • avoiding analytical errors, representativeness of samples, • sample preparation methods (drying, homogenization, extraction, mineralization). **4. Classical Methods of Pollution Analysis** • titration, gravimetry, UV-VIS spectrophotometry, • applications and limitations of classical methods, • examples of simple pollutant analysis. **5. Chromatographic Methods in Environmental Analytics** • gas chromatography (GC) and liquid chromatography (HPLC), • detectors used in the analysis of organic pollutants, • examples of pesticide and polycyclic aromatic hydrocarbon (PAH) analysis, • miniaturization and new trends in chromatography. **6. Heavy Metal Analysis Using Spectroscopic Techniques** • heavy metals as environmental and health hazards, • atomic absorption spectrometry (AAS), • ICP-OES, ICP-MS applications and method comparison,

- examples of soil, wastewater, and waste analysis.

7. Analysis of Microplastic Particles

- sources and characteristics of microplastics,
- separation and sample preparation techniques,
- FTIR and Raman spectroscopy in microplastic identification,
- environmental and health consequences of microplastic presence.

8. Monitoring and Analysis of Air and Emissions from Waste

- emission sources from waste combustion and landfilling,
- monitoring of particulate matter (PM10, PM2.5),
- methods for determining volatile organic compounds (VOCs),
- air quality monitoring systems and their applications.

9. New Trends in Environmental Analytics and Waste Management

- biosensors and biological methods in pollution assessment,
- rapid field methods (portable devices),
- circular economy approaches.

10. Waste and Energy Recovery

- energy recovery from organic waste (biogas, fermentation),
- environmental and analytical aspects of energy processes,
- evaluation of efficiency and impact on emission reduction.

Topics of laboratory and field exercises:

1. **Air quality assessment in high-risk areas** practical methods for monitoring air pollutants in locations of elevated environmental and health risk.
2. **Odour nuisance evaluation using field olfactometry** application of sensory techniques to assess the intensity and nuisance of odours in the environment.
3. **Assessment of surface water quality using rapid colorimetric tests** application of simple colorimetric methods to determine selected physicochemical parameters of water.
4. **Analysis of pharmaceutical residues in water using LC-MS** identification and quantification of pharmaceuticals in environmental samples with liquid chromatography coupled with mass spectrometry.

	5. **Determination of compound lipophilicity** assessment of parameters relevant for evaluating the environmental fate of substances and their potential for bioaccumulation. 6. **Determination of polycyclic aromatic hydrocarbons (PAHs) in soil** sample extraction and analysis using gas chromatography coupled with mass spectrometry (GC-MS). 7. **Identification and analysis of petroleum-derived fractions in environmental samples** determination of characteristic contaminants in soil and water. 8. **Determination of heavy metals in by-products from thermal waste treatment** application of modern spectroscopic techniques to evaluate the composition of ashes and slags. 9. **Mercury content in ashes from thermal waste treatment and environmental risk assessment** examination of potential hazards associated with mercury presence in combustion by-products. 10. **Toxicity assessment of environmental samples** application of biological and bioanalytical methods to evaluate the degree of risk to living organisms and ecosystems. During the laboratory classes, students will analyze the results obtained in selected laboratory exercises and use them to prepare risk assessment sheets. The entire project will be evaluated based on a presentation.
Prerequisites and co-requisites	The student should: • have basic knowledge of **general and analytical chemistry**, • be familiar with fundamentals of **organic, inorganic and physical chemistry**, • understand the basic concepts of **environmental protection and waste management**, • be able to use **basic laboratory techniques** (weighing, pipetting, preparation of solutions, and laboratory safety rules).

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratories	60.0%	40.0%
Exercises	60.0%	10.0%
Lectures	60.0%	50.0%

Recommended reading

Recommended reading	Basic literature	**Fifield, F.W., Haines, P.J.** (2000). *Environmental Analytical Chemistry.* 2nd Edition. Blackwell Science. **Alloway, B.J.** (2013). *Heavy Metals in Soils: Trace Metals and Metalloids in Soils and their Bioavailability.* Springer. **Manahan, S.E.** (2017). *Environmental Chemistry.* 10th Edition. CRC Press **Holler, F.J., Skoog, D.A., Crouch, S.R.** (2014). *Principles of Instrumental Analysis.* 7th Edition. Cengage Learning. **Paustenbach, D.J.** (2015). *Human and Ecological Risk Assessment: Theory and Practice.* Wiley-Interscience
	Supplementary literature	**Van Leeuwen, C.J., Vermeire, T.G.** (2007). *Risk Assessment of Chemicals: An Introduction.* Springer.
	eResources addresses	

Example issues/ example questions/ tasks being completed	**Sample multiple-choice questions:** 1. Which of the following techniques is best suited for the determination of microplastics in environmental samples? a) Gas chromatography (GC) b) FTIR spectroscopy c) Complexometric titration d) Potentiometry 2. For the determination of heavy metals in wastewater samples, the most commonly used technique is: a) ICP-MS b) GC-MS c) HPLC with UV detector d) Colorimetry **Sample short-answer questions:** 1. Explain why sample representativeness is crucial in environmental analytics. 2. List three examples of classical methods for pollution analysis and describe their limitations. 3. What does the lipophilicity parameter (log P) represent and why is it important in environmental risk assessment? **Sample problem-based questions (case studies):** 1. You received samples of ashes from waste incineration. Which analytical methods would you use to determine heavy metals? Justify your choice. 2. Describe how you would conduct an air quality assessment in the vicinity of a landfill, including method selection, equipment, and potential sources of error. 3. Residues of pharmaceuticals were detected in surface water samples. What analytical steps (sampling, sample preparation, analysis) are necessary to reliably determine their concentrations? 4. Imagine that mercury contamination was found in soil near an industrial facility. What further analytical and environmental actions would you propose? 5. Based on the results of rapid colorimetric tests, physicochemical parameters of surface waters were assessed. What are the advantages and limitations of such tests compared to classical laboratory analyses?
Practical activites within the subject	Not applicable