GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Instrumental Analysis , PG_00060866		
Field of study	Chemical Technology		
Date of commencement of studies	October 2023	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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Analytical Chemistry -> Faculty of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Mariusz Marć	
	Teachers	dr hab. inż. Mariusz Marć	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	0.0	45

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 1005 Analiza instrumentalna_zima_2025
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1005

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	45	5.0	25.0	75

Subject objectives

The aim of the course is to familiarize students with the basic analytical techniques used in chemical technology, including instrumental methods for qualitative and quantitative analysis of chemical substances. Students will acquire skills in performing chemical analyses using modern analytical tools such as spectroscopy, chromatography, and mass spectrometry. In addition, the course aims to develop skills in processing analysis results, interpreting data, and formulating conclusions in the context of technological processes, thus providing a solid foundation for the practical application of these techniques in the chemical industry and scientific research.

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	The student understands the social role of an engineer in the application of analytical techniques in chemical analysis. They are able to formulate and communicate information concerning the results of instrumental analyses, their significance for environmental protection, public health, and industry, as well as in an ethical context, in an accessible and responsible manner, taking into account the needs and expectations of society and sustainable development.	[SK5] Assessment of ability to solve problems that arise in practice [SK4] Assessment of communication skills, including language correctness
[K6_W02] has knowledge of inorganic, organic, physical and analytical chemistry useful for obtaining selected groups of compounds, determining their physical and chemical properties allowing for their quantitative and qualitative analysis, making measurements and determining the parameters of chemical reactions, phenomena and processes occurring in chemical technology	The student has knowledge of the use of analytical techniques in the quantitative and qualitative analysis of chemical compounds. They are able to select appropriate instrumental methods for the identification, determination, and characterization of the physical and chemical properties of selected groups of chemical compounds, including the determination of the parameters of chemical reactions and processes, taking into account the requirements of chemical technology.	[SW1] Assessment of factual knowledge
[K6_U01] is able to acquire information from literature, databases and other appropriately selected sources, also in English; is able to integrate information obtained, interpret it and make conclusions, formulate and justify opinions	can make accurate and precise measurements in an analytical laboratory	[SU2] Assessment of ability to analyse information
[K6_U03] is able to apply knowledge of inorganic, organic, physical and analytical chemistry and identify appropriate sources of information to design and synthesize simple chemical compounds, carry out basic physicochemical and analytical measurements	Has knowledge of the operation of analytical equipment and can determine the basic validation parameters of the analytical procedure	[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task

Subject contents

Specificity of analytical methods based on relative measurement. Characteristics of analytical measurement systems. Types of signals, their location and magnitude, the problem of noise in comparative methods. Comparison of the precision and accuracy of analytical methods. Elemental analysis of organic compounds, usefulness and role in analytical chemistry. Methods for determining carbon, hydrogen, and nitrogen. Mineralization methods, ignition mineralization. Spectroscopic methods of analysis, theoretical foundations. Qualitative and quantitative analysis using spectroscopic methods. Classification of methods and principles of operation. Monochromators, detectors, atomization and excitation methods, and the influence of the matrix on the analytical effect. Sources of errors and methods of their elimination. Flame photometry, steeloscopy, atomic and molecular absorption spectroscopy - principles of operation, apparatus and methods of measurement and selection of optimal operating conditions. Gas chromatography: theoretical basis, column characteristics, selected detectors, qualitative and quantitative analysis. High-performance liquid chromatography (HPLC) column and thin-layer. Mechanisms of chromatographic processes, selectivity and efficiency of chromatographic systems; types of phases; chromatographic apparatus. Electroanalytical methods, basic physicochemical laws. Potentiometry, conductometry, coulometry, ion-selective electrodes, chronoamperometry: theoretical foundations, measurement methods, and apparatus.

Prerequisites and co-requisites

Knowledge of the fundamentals of analytical, organic, and inorganic chemistry, as well as physics and mathematics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture	50.0%	50.0%
Laboratory	50.0%	50.0%

Recommended reading	Basic literature	1. A. Melnyk, K. Kuklińska, L. Wolska, ABC Chromatografii Gazowej, Wydawnictwo PG, Gdańsk, 2014 2. M. Janicka, G. Bajger-Nowak, A. Kot-Wasik, Rozwiązywanie problemów w chromatografii cieczowej, Wydawnictwo PG, Gdańsk, 2012 3. Z. Witkiewicz, E. Śliwka, Chromatografia i techniki elektromigracyjne, Wydawnictwo Naukowe PWN, 2017 4. A. Jakimska, W. Hewelt-Belka, K. Wilczewska, A. Kot-Wasik, Nowoczesna chromatografia cieczowa, Wydawnictwo PG, Gdańsk, 2014 5. Ocena i kontrola jakości wyników pomiarów analitycznych : praca zbiorowa / pod red. Piotra Konieczki i Jacka Namieśnika, Wydawnictwa Naukowo-Techniczne, 2008 6. J. Minczewski, Z. Marczenko, Chemia analityczna, tom 3, wyd. 9 i 10, zm., PWN, Warszawa 2005. 7. D.A. Skoog, D.M. West, J.F. Holler, S.R.Crouch, Fundamentals of Analytical Chemistry, (VII ed.), Saunders College Publishing, Philadelphia 1996, Podstawy Chemii Analitycznej, t. 1-2, PWN, Warszawa 2006. 8. P. Konieczka P., Namieśnik J., Zygmunt B., Bulska E., Świtaj-Zawadka A., Naganowska A., Kremer E., Rompa M., Ocena i kontrola jakości wyników pomiarów analitycznych, WN-T, Warszawa 2007. 9. Fizykochemiczne metody kontroli zanieczyszczeń środowiska, [red.] J. Namieśnik i Z. Jamrógiewicz, WN-T, Warszawa 1998. 10. A. Cygański, Metody spektroskopowe w chemii analitycznej, WNT, Warszawa 1993. 11. M. Pinta, Absorpcyjna spektrometria atomowa. Zastosowania w chemii analitycznej, PWN, Warszawa 1977. 12. Z. Marczenko, Spektrofotometryczne oznaczanie pierwiastków, PWN, Warszawa 1979. 13. A. Cygański, Metody elektroanalityczne, WN-T, Warszawa 1995. 14. Z. Witkiewicz, Podstawy chromatografii, WN-T, Warszawa 2000. 15. Z Witkiewicz, J. Hetper, Chromatografia gazowa, WN-T, Warszawa 2001. 16. B. Bobrański, Analiza ilościowa związków organicznych, PWN, Warszawa 1979. 17. Chromatografia cieczowa, [red.] M. Kamiński, CEEAM, Gdańsk 2004. 18. Spektrometria atomowa, [red.] E. Bulska, K. Pyrzyńska, Malmut, Warszawa 2007.
	Supplementary literature	1. M. Jarosz, E. Malinowska, Pracownia chemiczna. Analiza instrumentalna, wyd. 2 uzup., WSiP, Warszawa 1999. 2. W. Szczepaniak, Metody instrumentalne w analizie chemicznej, PWN, Warszawa 1999. 3. K. Danzer, E. Than, D. Moloch, Analityka. Przegląd systematyczny, WN-T, Warszawa 1993. 4. J. Czermiński i współautorzy, Metody statystyczne dla chemików, PWN, Warszawa 1986. 5. G.W. Ewing, Metody instrumentalne w analizie chemicznej, PWN, Warszawa 1980. 6. T.H. Gouw, Nowoczesne metody instrumentalne analizy, WN-T, Warszawa 1976. 7. H.W. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis, Wadsworth, Belmont 1981. 8. Z. Marczenko, Spektrofotometryczne oznaczanie pierwiastków, PWN, Warszawa 1979. 9. A. Cygański, Metody elektroanalityczne, WN-T, Warszawa 1995. 10. Z. Galus, Teoretyczne podstawy elektroanalizy chemicznej, PWN,Warszawa 1977. 11. Metody analitycznej spektrometrii atomowej, [red.] W. Żyrnicki, J.Borkowska-Burnecka, E. Bulska, E. Szmyd, Malmut, Warszawa 2010.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Describe what potentiometric titration is. What is the purpose of the potentiometric measurement system in such titration and what are the advantages of its use? 2. What are the characteristics of conductometric methods and what are their applications? 3. What is mineralization and what is its basic classification? 4. List 5 mineralization methods and describe one of them. 5. Explain the principle of operation of a splitless dispenser (dispensing without flow division). 6. What is the solvent effect and in which type of dispensing is it used?	
Work placement	Not applicable	

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