



Subject card

Subject name and code	Instrumental Analysis , PG_00060866						
Field of study	Analiza instrumentalna						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2026/2027		
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 -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Mariusz Marć				
	Teachers						
Lesson types	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						
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 the skills to compile analysis results, interpret data, and formulate 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] Ocena umiejętności rozwiązywania problemów występujących w praktyce [SK4] Ocena umiejętności komunikacji, w tym poprawności językowej
	[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 quantitative and qualitative analysis of chemical compounds. He/she is 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] Ocena wiedzy faktograficznej
	[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	The student is able to take accurate and precise measurements in an analytical laboratory	[SU2] Ocena umiejętności analizy informacji
	[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	The student has knowledge of the functioning of analytical equipment and is able to determine the basic validation parameters of analytical procedures	[SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania [SU4] Ocena umiejętności korzystania z metod i narzędzi

Subject contents	Course content – lecture Comprehensive information directly related to the topic of Instrumental Analysis. The following topics and issues will be discussed in the lectures: • Specific characteristics of analytical methods based on relative measurement. • Characteristics of analytical measurement systems. • Types of signals, their position and magnitude, noise issues in comparative methods. • Comparison of precision and accuracy of analytical methods. • Elemental analysis of organic compounds, its usefulness and role in analytical chemistry. • Spectroscopic methods of analysis, theoretical foundations. • Qualitative and quantitative analysis using spectroscopic methods. • Classification of methods and their principles of operation. • Monochromators, detectors, atomization and excitation methods, and the influence of the matrix on the analytical result. • Sources of errors and methods of their elimination. • Flame photometry, stolloscopy, atomic and molecular absorption spectroscopy principles of operation, instrumentation, and methods of measurement and selection of optimal working conditions. • Gas chromatography: theoretical foundations, column characteristics, selected detectors, qualitative and quantitative analysis. • High-performance liquid chromatography (HPLC), column and thin-layer chromatography. • Mechanisms of chromatographic processes, selectivity, and efficiency of chromatographic systems; types of phases; chromatographic instrumentation. • Electroanalytical methods, basic physicochemical laws. • Potentiometry, conductometry, coulometry, ion-selective electrodes, chronovoltammetry: theoretical foundations, measurement methods, and instrumentation Course content – laboratory Topics of laboratory exercises: 1. Fundamentals of gas chromatography theory and practice, i.e., what influences retention time. 2. Calibration methods for gas chromatography systems how to relate the obtained signal to the analyte content in the sample. 3. Fundamentals of liquid chromatography what influences qualitative and quantitative analysis. 4. Determination of water content in MTBE sample using the Karl Fischer technique.
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	5. Atomic Emission and Absorption Spectrometry determination of sodium and potassium ion content in tap water. 6. Molecular spectrophotometry determination of chromium and cobalt simultaneously. 7. Application of electrochemical techniques in analytical practice comparison of two methods.		
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
	Laboratory	50.0%	50.0%
	Lecture	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 elektroanalizy, 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, Analytika. 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. Żywnicki, J. Borkowska-Burnecka, E. Bułska, 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?	
Practical activities within the subject	Not applicable	

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