



Subject card

Subject name and code	Analytical Chemistry, PG_00036289						
Field of study	Green Technologies						
Date of commencement of studies	October 2020	Academic year of realisation of subject				2022/2023	
Education level	first-cycle studies	Subject group				Optional subject group 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				9.0	
Learning profile	general academic profile	Assessment form				exam	
Conducting unit	Department of Analytical Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Żaneta Polkowska				
	Teachers		prof. dr hab. inż. Żaneta Polkowska dr hab. inż. Mariusz Marć prof. dr hab. inż. Piotr Konieczka dr inż. Bartłomiej Cieślik dr inż. Małgorzata Rutkowska				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	60.0	0.0	0.0	90
	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	90	25.0		110.0	225	
Subject objectives	Knowledge of methods to solve analytical problems, understanding theoretical basis for individual analytical techniques.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_U02] is able to operate equipment and perform typical analyzes of studies of environmental pollution, is able to carry out an analysis of typical environmental pollution and simple devices according to specification	Student knows the apparatus for the analysis of environmental pollution and other parameters			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		
	[K6_U05] can formulate and solve engineering tasks analytical methods, simulation as well as experimental, able to apply knowledge of basic physics and mathematics to analyze the results of experiments, is able to analyze and assess existing technical solutions	Student is able to use the acquired knowledge			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		
	[K6_W02] has a basic knowledge of chemistry including general chemistry, inorganic, organic, physical, analytical, including the knowledge necessary to describe and understand the phenomena and chemical processes occurring in the environment; measurement and the determination of the parameters of these processes.	Student has knowledge and understands the issues presented			[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		

Subject contents	<p>SUBJECT OF ANALYTICAL CHEMISTRY: types of analytical information, criteria of method selection. Handbooks and basic journals. Work safety and organisation in an analytical laboratory. Basic steps in a typical analysis. Representative sampling and sample preparation for analysis. Propagation of independent measurement errors. GRAVIMETRIC METHODS OF ANALYSIS: factors influencing on sediments solubility and purity, Most favourable conditions for precipitation. Sources of errors and methods of avoidance. Thermogravimetry. Precipitation titration: general equation of titration curves, types and principles of activity of indicators, Argentometric and Mercurometric Methods. ACIDIMETRY AND ALKALIMETRY: general equation of titration curves and its particular solution for weak and strong acids and bases, titration in nonaqueous medium, theoretical principles of polyfunctional acids alkalimetry and acidimetry of carbonates, visual indicators of titration end point. OXIDATION/REDUCTION: types of methods, analytical reactions and factors influencing on equilibrium constants, equation of redox titration curves, molecular multiplier based on redox reactions. Electrogravimetric analysis. COMPLEXOMETRY: equation of titration curves, indicators, complexometry and analytical characteristics of selected complexones, mercurimetry, types of complexometric methods, determination of water hardness. Spectroscopic methods of analysis. Types of methods and principles. Monochromators, detectors, methods of atomisation and excitation. Separation methods with particular regard to chromatographic techniques. Gas chromatography; principles, characteristic of columns, selected detectors, qualitative and quantitative analysis. Electroanalytical methods, basic physicochemical law. Potentiometry, conductometry, coulometry. EVALUATION OF DATA: statistical evaluation of the results reliability and comparison of analytical methods, detection limit and quantification limit, sensitivity, selectivity, criteria of methods preference considering precision. Application of computer science in analytical chemistry.</p>														
Prerequisites and co-requisites	<p>Student should have knowledge of the: stoichiometry, chemical reaction equilibrium, reaction and theory of acids and bases, precipitation reaction, solubility product, reaction mechanism and complex formation constant</p>														
Assessment methods and criteria	<table border="1" data-bbox="448 658 1487 797"> <thead> <tr> <th data-bbox="448 658 794 696">Subject passing criteria</th> <th data-bbox="794 658 1141 696">Passing threshold</th> <th data-bbox="1141 658 1487 696">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 696 794 725">Exam</td> <td data-bbox="794 696 1141 725">50.0%</td> <td data-bbox="1141 696 1487 725">45.0%</td> </tr> <tr> <td data-bbox="448 725 794 754">Laboratory</td> <td data-bbox="794 725 1141 754">50.0%</td> <td data-bbox="1141 725 1487 754">45.0%</td> </tr> <tr> <td data-bbox="448 754 794 797">Seminary</td> <td data-bbox="794 754 1141 797">50.0%</td> <td data-bbox="1141 754 1487 797">10.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Exam	50.0%	45.0%	Laboratory	50.0%	45.0%	Seminary	50.0%	10.0%
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Exam	50.0%	45.0%													
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Recommended reading	<p>Basic literature</p>	<p>1. J. Minczewski, Z. Marczenko, Chemia analityczna, tom 1, 2 i 3 wyd. 9 l 10, zm., PWN, Warszawa 2005 2. 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 i 2, PWN, W-wa 2006 3. A. Cygański, Chemiczne metody analizy ilościowej, WN-T, Warszawa 1992. 4. A. Cygański, B. Ptaszyński, J. Krystek, Obliczenia w chemii analitycznej, WN-T, Warszawa 2000. 5. Z. Galus, Ćwiczenia rachunkowe z chemii analitycznej, PWN, Warszawa 2005. 6. 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. 7. Fizykochemiczne metody kontroli zanieczyszczeń środowiska, [red.] J. Namieśnik i Z. Jamrógiewicz, WN-T, Warszawa 1998. 8. Z. Marczenko, Spektrofotometryczne oznaczanie pierwiastków, PWN, Warszawa 1979. 9. A. Cygański, Metody elektroanalityczne, WN-T, Warszawa 1995. 10. Z. Witkiewicz, Podstawy chromatografii, WN-T, Warszawa 2000. 11. A. Cygański, Metody spektroskopowe w chemii analitycznej, WN-T, Warszawa 1993. 12. Metody analitycznej spektrometrii atomowej, [red.] W. Żyrmicki, J. Borkowska-Burnecka, E. Bulska, E. Szmyd, Malmut, Warszawa 2010.</p>													
	<p>Supplementary literature</p>	<p>1. A. Hulanicki, Reakcje kwasów i zasad w chemii analitycznej, PWN, Warszawa 1992, wyd. 3 zm. 2. D. Kealey, P.J. Haines, Krótkie wykłady. Chemia Analityczna, PWN, W-wa 2005. 3. Podstawy analityki, [red.] J. Łukasiak, Akademia Medyczna w Gdańsku, Gdańsk 1990. 4. A. Hulanicki, Współczesna chemia analityczna. Wybrane zagadnienia, PWN, Warszawa 2001 5. K. Eckschlager, Błędy w analizie chemicznej, PWN, Warszawa 1974. 6. K. Danzer, E. Than, D. Moloch, Analityka. Przegląd systematyczny, WN-T, Warszawa 1993. 7. J. Czermiński i współautorzy, Metody statystyczne dla chemików, PWN, Warszawa 1986. 8. M. Jarosz, E. Malinowska, Pracownia chemiczna. Analiza instrumentalna, wyd. 2 uzup., WSiP, Warszawa 1999. 9. J. Szczepaniak, Metody instrumentalne w analizie chemicznej, PWN, Warszawa 1999.</p>													
	<p>eResources addresses</p>														
Example issues/ example questions/ tasks being completed	<p>Electrogravimetric determination of lead and copper</p>														
Work placement	<p>Not applicable</p>														