GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basics of Chemical Metrology, PG_00060882						
Field of study	Podstawy metrologii chemicznej						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2026/2027			
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	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		prof. dr hab. inż. Piotr Konieczka				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/user/index.php?id=2434						
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	40.0	75	
Subject objectives	Learning about useful mathematical statistics, methods of processing measurement results, familiarisation with the problem of estimating measurement uncertainty including creating an uncertainty budget, characteristics of the analytical method, determining validation parameters.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_K02] understands the non-technical aspects and implications of the activities of a chemical engineer, including the impact on the environment, is aware of professional behaviour, observance of professional ethics and respect for diversity of views and cultures	The student understands the importance of adhering to professional ethics in the work of a chemical engineer, including responsibility for the safety of people and the environment. They are aware of the need to behave professionally, including reliable communication of research and analysis results, an honest approach to work and respect for legal regulations. They understand that the actions of a chemical engineer have social and economic consequences, and are therefore able to consider them in the context of sustainable development.	[SK5] Ocena umiejętności rozwiązywania problemów występujących w praktyce [SK3] Ocena umiejętności organizacji pracy
[K6_U05] recognises and identifies the relationship between technological issues, implemented in industrial practice, and their impact on various elements of the environment, in the context of mechanisms and conditions of sustainable development, recognizes their systemic and non-technical aspects	The student is able to analyse and assess the environmental impact of selected industrial processes, taking into account technical and non-technical (economic, social, cultural) factors. The student is able to identify systemic links between technology, the environment and sustainable development policy, and propose solutions that minimise negative impacts.	[SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu [SU1] Ocena realizacji zadania
[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 knows the basic laws and concepts of inorganic, organic, physical and analytical chemistry and their applications in chemical technology. The student has knowledge of methods for obtaining selected groups of chemical compounds and their physical and chemical properties. The student understands the mechanisms of chemical reactions and is able to determine the kinetic and thermodynamic parameters of processes.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym

Subject contents

Course content – lecture
Fundamentals of mathematical statistics; statistical parameters and basic statistical tests; creating an uncertainty budget and estimating measurement uncertainty; validation parameters methods of determination, calculation and verification. The course will be completed with a final examination.

Course content – laboratory
Calculations using Excel spreadsheets related to the practical implementation of the lecture topics.

Prerequisites and co-requisites

Students should have basic knowledge of general and analytical chemistry (concepts of solution concentration, chemical reactions, basic techniques of quantitative and qualitative analysis).
Know the basics of mathematics and statistics (operations on real and exponential numbers, basic statistical concepts).
Be able to read and interpret numerical data and graphs.

In addition, they should have completed courses in physical chemistry or instrumental analysis, which will help them understand concepts related to accuracy, sensitivity and calibration of measuring equipment. They should be able to use data analysis software, such as Excel or Origin, or have a basic knowledge of programming (e.g. Python, R) especially for statistical analysis of measurement data.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lecture	60.0%	50.0%
laboratory	60.0%	50.0%

Recommended reading	Basic literature	1. Konieczka P., The role of and place of method validation in the quality assurance and quality control (QA/QC) System, *Crit. Rev. Anal. Chem*., 37, 173-190, 2007. 2. Konieczka P., and Namieśnik J. eds., Kontrola i zapewnienie jakości wyników pomiarów analitycznych, WNT, Warsaw, 2017. 3. *I*nternational vocabulary of metrology Basic and general concepts and associated terms (VIM), Joint Committee for Guides in Metrology, JCGM 200:2012 4. Wenclawiak, B.W., Koch, M., and Hadjicostas E., (Eds.), Quality Assurance in Analytical Chemistry, Training and teaching, Second edition, Springer, 2014. 5. ISO/IEC Guide 98-3:2008. Uncertainty of Measurement Part 3: Guide to the Expression of Uncertainty in Measurement (GUM: 1995). • ISO/IEC Guide 98-1:2024. Guide to the Expression of Uncertainty in Measurement (GUM) Part 1: Introduction
	Supplementary literature	Literature related to the subject matter.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Accuracy vs precision of measurement differences and significance. 2. Systematic and random errors definitions and examples. 3. Measurement traceability how to ensure it in a chemical laboratory. 4. Primary and working standards role and examples. 5. SI units in chemical analysis. 6. Definition and significance of measurement uncertainty (according to GUM). 7. Type A and type B evaluation of uncertainty components. 8. Calculation of combined and expanded uncertainty; k factor. 9. Main sources of uncertainty in chemical analysis. 10. Stages of analytical method validation. 11. Validation parameters (accuracy, precision, selectivity, LOD, LOQ, linearity). 12. CRM (Certified Reference Material) role in ensuring measurement quality. 13. Requirements of the PN-EN ISO/IEC 17025 standard in the field of chemical metrology. 14. QC and QA differences and significance for accredited laboratories. 15. The importance of measurement traceability for the comparability of results.	
Practical activites within the subject	Not applicable	

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