GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basics of Chemical Metrology, PG_00060882		
Field of study	Chemical Technology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
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

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] is aware of the responsibility for his/her work and is ready to work in a team and share responsibility for common tasks.	The student carries out their tasks in the field of chemical metrology with due care, ensuring the reliability and accuracy of measurements; they actively collaborate within the team, sharing responsibility for joint experiments and projects and supporting other group members in achieving common goals.	[SK2] Assessment of progress of work [SK5] Assessment of ability to solve problems that arise in practice
[K6_U06] Recognizes the relationships between technological issues and their impact on the environment, taking into account the principles of sustainable development, systemic and non-technical aspects, and occupational health and safety principles	The student analyses the impact of technological processes on the natural environment, taking into account the principles of sustainable development, systemic and social aspects, and identifies potential risks, applying appropriate health and safety procedures in engineering practice.	[SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task
[K6_W02] Possesses the chemical knowledge necessary to synthesize, analyze and evaluate the properties of compounds and processes used in chemical technology.	The student possesses a sound knowledge of chemistry, enabling them to independently carry out syntheses, analyse and evaluate the properties of compounds and processes used in chemical engineering, and interpret the results obtained in the context of engineering practice.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects

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