

Metrology in chemistry Educational subject description sheet

Basic information

Study programme Chemia (General Chemistry)		Didactic cycle 2023/24	
Speciality -		Subject code 02CENS.18KU.01833.23	
Organizational unit Faculty of Chemistry		Lecture languages English	
Study level First-cycle programme		Course type Elective	
Study form Full-time		Block Complementary major subjects	
Education profile General academic			
Subject coordinator	Anetta Hanć, Adam Sajnóg		
Lecturer	Adam Sajnóg		
Period Semester 4	Activities and hours Lecture: 15, Graded credit Laboratories: 15, Graded cr 	edit	Number of ECTS points 3

Goals

Code	Goal
C1	Knowledge of the basics of chemical metrology, principles of conducting measurements, explanation of the position of metrology in analytical chemistry.
C2	Introduction of the principles of metrology in chemistry in relation to the evaluation and quality control of analytical measurement results.
С3	Learning the principles of validation of measurement procedures.
C4	Assessment of the uncertainty of the results of chemical measurements.
C5	Preparation for proper interpretation of research results based on statistical analyses.

Entry requirements

Passed the course in basic analytical chemistry.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge	e - Student:		
W1	knows the basic definitions and terms used in chemical metrology.	CEN_K1_W01	Written colloquium, Oral colloquium
W2	knows the principles of validation of measurement procedures.	CEN_K1_W01, CEN_K1_W04, CEN_K1_W14	Written colloquium, Test
W3	knows how to determine the measurement uncertainty.	CEN_K1_W01, CEN_K1_W03, CEN_K1_W04, CEN_K1_W14	Written colloquium, Oral colloquium
W4	demonstrates knowledge of metrological traceability.	CEN_K1_W01, CEN_K1_W14	Written colloquium, Oral colloquium
W5	knows the elements of quality control of the results of chemical measurements.	CEN_K1_W01, CEN_K1_W14	Written colloquium, Test
W6	knows basic statistical tests and significance tests used to verify research hypotheses.	CEN_K1_W04, CEN_K1_W14	Written colloquium, Oral colloquium
Skills - Student:			
U1	is able to use the principles of metrology in order to obtain reliable results of chemical analyses.	CEN_K1_U01, CEN_K1_U09	Written colloquium, Test
U2	demonstrates the ability to validate measurement procedures.	CEN_K1_U01, CEN_K1_U09, CEN_K1_U25	Written colloquium, Oral colloquium, Test
U3	demonstrates the ability to assess the uncertainty of the results of chemical measurements.	CEN_K1_U01, CEN_K1_U09, CEN_K1_U25, CEN_K1_U27	Written colloquium, Oral colloquium
U4	correctly interprets the results of statistical calculations; prepares a report.	CEN_K1_U01, CEN_K1_U09, CEN_K1_U27	Written colloquium, Oral colloquium

Code	Outcomes in terms of	Learning outcomes	Examination methods
U5	can apply health and safety rules in a chemical laboratory.	CEN_K1_U25, CEN_K1_U27	Test
Social competences - Student:			
K1	has the knowledge and skills necessary to control and ensure the quality of measurement results in everyday laboratory practice.	CEN_K1_K04, CEN_K1_K05	Test

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Introduction to metrology in chemistry.	W1	Lecture
2.	Statistical tests in analytical chemistry.	W1, W6, U4	Lecture, Laboratories
3.	QA/QC quality assurance and control.	W1, W5, K1	Lecture, Laboratories
4.	The role of reference materials and inter-laboratory comparisons in chemical measurements.	W1, W5, U1, K1	Lecture, Laboratories
5.	Analytical procedure. Sampling as a component of the analytical procedure.	W1, W2, U5	Lecture, Laboratories
6.	Validation of the analytical procedure.	W1, W2, U2, U5	Lecture, Laboratories
7.	Estimation of measurement uncertainty according to different approaches.	W3, U3	Lecture, Laboratories
8.	Ensuring traceability in chemical measurements.	W4, U1	Lecture, Laboratories

Additional information

Activities	Teaching and learning methods and activities	
Lecture	Lecture with a multimedia presentation of selected issues, Discussion, Game/simulation	
Laboratories	Case study, Solving tasks (e.g. computational, artistic, practical), Activating method - "brainstorming"	

Activities	Credit conditions
Lecture	 The colloquium will be conducted in written form and will include: open questions and test questions. Oral colloquium is also allowed. The condition for taking the exam is the prior completion of laboratory classes and computer exercises. Grading scale with the applied percentage distribution: very good (bdb; 5.0): achieving the assumed learning outcomes by the student at the minimum level of 94.0%; good plus (db+; 4.5): achieving the assumed learning outcomes by the student in the range of 87.0% - 93.9%; good (db; 4.0): achieving the assumed learning outcomes by the student in the range of 80.0% - 86.9%; sufficient plus (dst+; 3.5): achieving the assumed learning outcomes by the student in the range of 75.0% - 79.9%; satisfactory (dst; 3.0): achieving the assumed learning outcomes by the student within the range of 60.0% - 74.9%; unsatisfactory (ndst; 2.0): failure to achieve the assumed learning outcomes by the student, score below 60.0%.
Laboratories	At each exercise, the student takes a written test on the issues given in the script for the given exercise. All exercises must be completed. In case of absence, the exercise must be done according to the schedule. The final grade consists of: grades obtained from colloquiums and reports. Grading scale with the applied percentage distribution: • very good (bdb; 5.0): achieving the assumed learning outcomes by the student at the minimum level of 94.0%; • good plus (db+; 4.5): achieving the assumed learning outcomes by the student in the range of 87.0% - 93.9%; • good (db; 4.0): achieving the assumed learning outcomes by the student in the range of 80.0% - 86.9%; • sufficient plus (dst+; 3.5): achieving the assumed learning outcomes by the student in the range of 75.0% - 79.9%; • satisfactory (dst; 3.0): achieving the assumed learning outcomes by the student within the range of 60.0% - 74.9%; • unsatisfactory (ndst; 2.0): failure to achieve the assumed learning outcomes by the student within the score below 60.0%.

Literature

Obligatory

1. Bulska E., Metrology in Chemistry, Springer (2018) ISBN 978-3-319-99204-4.

Optional

- 1. Konieczka P., Namieśnik J., Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach Second Edition, CRC Press (2018) ISBN 978-1-138-19672-8.
- 2. International Vocabulary of Metrology Basic and General Concepts and Associated Terms (VIM). 2. International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories.

Calculation of ECTS points

Activities	Activity hours*
Lecture	15
Laboratories	15
Preparation for classes	20

Preparation for the exam	20
Report preparation	10
Reading the indicated literature	5
Student workload	Hours
	85
Number of FOTC neight	ECTS
Number of ECIS points	3

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
CEN_K1_K04	The graduate is ready to understand the importance and consequences of the professional activity of a chemist and its impact on the environment and the associated responsibility for decisions taken
CEN_K1_K05	The graduate is ready to understand and appreciate the importance of professional ethics in his/her own actions and those of others
CEN_K1_U01	The graduate can use basic chemical terminology according to IUPAC and PTChem recommendations
CEN_K1_U09	The graduate can select and apply statistical methods to describe chemical and physicochemical processes and analyse data
CEN_K1_U25	The graduate can create a presentation of a specific chemical or physicochemical problem and propose a solution to it
CEN_K1_U27	The graduate can demonstrate the ability to make correct inferences on the basis of data from chemical or physico-chemical experiments and literature sources
CEN_K1_W01	The graduate knows and understands basic chemical laws and issues
CEN_K1_W03	The graduate knows and understands techniques of higher mathematics for the formal description of basic physical and chemical processes
CEN_K1_W04	The graduate knows and understands fundamental knowledge of natural sciences
CEN_K1_W14	The graduate knows and understands the basic laboratory and analytical techniques