UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU

Atomic spectrometry

Educational subject description sheet

Basic information

Study programme Chemia (General Chemistry)	**Didactic cycle** 2023/24
Speciality -	**Subject code** 02CENS.18KU.01831.23
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	Izabela Komorowicz
Lecturer	Izabela Komorowicz, Anetta Hanć, Adam Sajnóg

Period	**Activities and hours**	**Number of ECTS points**
Semester 4	• Lecture: 15, Graded credit • Laboratories: 30, Graded credit	4

Goals

Code	Goal
C1	Transfer of knowledge on spectroscopy and spectrometry, basic processes and physicochemical phenomena used in atomic spectrometry techniques.
C2	Transfer of knowledge in the field of atomic spectrometry, including the principles and construction of atomic absorption spectrometers (F-AAS, ET-AAS, HG-AAS and CV-AAS) as well as emission spectrometers and mass spectrometers in plasma techniques (AES, ICP-OES and ICP -MS), the possibilities and limitations of the analytical techniques used and the current applications of selected techniques.
C3	Developing the ability to choose the right analytical technique for solving issues related to analytical determinations, creating new analytical procedures and correctly solving analytical problems using atomic spectrometry methods (calibration, optimization, interferences).
C4	Transfer of knowledge on the development of analytical procedures and quality control of analytical measurement results.
C5	Developing the skills of proper interpretation of research results and writing reports.
C6	Developing the ability to correctly apply the rules of occupational health and safety in the laboratory.
C7	Developing communication and teamwork skills.

Entry requirements

No prerequisites required.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge – Student:			
W1	knows and can explain the basic definitions of spectroscopy and spectrometry as well as the basic issues of atomic spectrometry.	CEN_K1_W01	Written colloquium, Oral colloquium, Test
W2	knows and understands the basic physicochemical processes/phenomena of emission, atomic absorption and ionization in low and high plasma temperature.	CEN_K1_W01, CEN_K1_W14, CEN_K1_W15	Written colloquium, Oral colloquium, Test
W3	knows the construction of modern analytical equipment (F-AAS, ET-AAS, HG-AAS, CV-AAS, F-AES, ICP-OES and ICP-MS), analytical capabilities and limitations of individual types of techniques: AAS and ICP and their current applications.	CEN_K1_W14, CEN_K1_W15	Written colloquium, Oral colloquium, Test, Report
W4	knows and understands the principles of analytical procedures development and methods of quality control of analytical measurement results.	CEN_K1_W14	Written colloquium, Oral colloquium, Test, Report
Skills – Student:			
U1	can explain the definition of spectroscopy, spectrometry, divide spectroscopic methods and explain their basics.	CEN_K1_U01	Written colloquium, Oral colloquium, Test
U2	can explain the construction of modern analytical equipment (F-AAS, ET-AAS, HG-AAS, CV-AAS, F-AES, ICP-OES and ICP-MS) and indicate the possibilities of its use.	CEN_K1_U01, CEN_K1_U02, CEN_K1_U16, CEN_K1_U17	Written colloquium, Oral colloquium, Test

Code	Outcomes in terms of	Learning outcomes	Examination methods
U3	can identify possible causes of incorrect analysis results (spectral, chemical, ionization, spectral and non-spectral interferences) and eliminate them.	CEN_K1_U16	Written colloquium, Oral colloquium, Test, Report
U4	can properly prepare the instrument for work (calibration and optimization).	CEN_K1_U16, CEN_K1_U17	Written colloquium, Oral colloquium, Test, Report
U5	is able to develop analytical procedures, correctly interpret the obtained results and assess their suitability for the intended purpose.	CEN_K1_U19, CEN_K1_U27	Written colloquium, Oral colloquium, Test, Report
U6	can prepare a report on the performed exercise.	CEN_K1_U19	Report
U7	can objectively assess the contribution of their own and others' work in jointly conducted research and can work independently or in a group.	CEN_K1_U15, CEN_K1_U21	Report
U8	can apply the rules of occupational health and safety in the laboratory.	CEN_K1_U14	Report
Social competences – Student:			
K1	is prepared to use atomic spectrometry techniques and to select the appropriate analytical technique for a specific purpose.	CEN_K1_K06	Written colloquium, Oral colloquium, Test, Report
K2	is ready for the practical application of atomic spectrometry techniques in laboratory work in accordance with health and safety rules and for the correct interpretation and evaluation of analytical measurement results.	CEN_K1_K03, CEN_K1_K06	Written colloquium, Oral colloquium, Test, Report

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Occupational health and safety in the laboratory.	U8, K2	Laboratories
2.	The history of atomic spectroscopy, the basics of the method, terminology, spectral transitions, energy levels, Bohr's rule.	W1, U1	Lecture
3.	Atomic emission, absorption and fluorescence processes, Boltzmann distribution, absorption laws.	W2, U1	Lecture
4.	Apparatus used in AAS, sources of radiation in AAS: HCL and EDL lamps, high-pressure xenon lamp.	W3, U2	Lecture, Laboratories
5.	Atomization process, flame and electrothermal atomizers, flame structure, determination of elements using flame and electrothermal atomization.	W3, U2, U6	Lecture, Laboratories
6.	AAS sample introduction techniques, microsampling and slurry insertion techniques, cold vapor (CV-AAS) and hydride generation (HG-AAS) techniques.	W3, U2, U6, U7, K1	Lecture, Laboratories
7.	Interferences in atomic absorption measurements and ways to eliminate interferences.	W3, U3, U6, U7, K1	Lecture, Laboratories

No.	Course content	Subject learning outcomes	Activities
8.	Atomic fluorescence spectrometry, inductively coupled plasma optical emission spectrometry (ICP-OES) - generation and physicochemical characterization of plasma, atomization, excitation, sample introduction and radiation registration systems.	W3, U2	Lecture
9.	Inductively coupled plasma mass spectrometry (ICP-MS).	W3, U2	Lecture
10.	ICP-MS spectrometers - ion sources, mass analyzers, detectors, sample introduction system, interferences.	W3, U2, U3	Lecture
11.	Calibration in spectral measurements, calibration methods.	W3, U4, U6, U7, K2	Lecture, Laboratories
12.	Development of the analytical procedures, control of the results of analytical measurements.	W4, U5, K2	Lecture, Laboratories
13.	Application of atomic spectrometry in trace inorganic analysis.	W3, U2, U3, K1, K2	Lecture, Laboratories

Additional information

Activities	Teaching and learning methods and activities
Lecture	Lecture with a multimedia presentation of selected issues, Audio and/or video demonstrations
Laboratories	Solving tasks (e.g. computational, artistic, practical), Laboratory method, Demonstration and observation, Activating method - "brainstorming", Work in groups

Activities	Credit conditions
Lecture	Written colloquium: • 4 open questions • 5 test questions Oral colloquium: • 3 open questions Grading scale: • 94% – 100% – excellent (A) • 87% – 93,9% - very good (B) • 78% – 86,9% - good (C) • 70% – 77,9% - satisfactory (D) • 60% – 69,9% – sufficient (E) • 0 – 59% – fail (F) Students who do not pass the laboratories cannot take the colloquium.

Activities	Credit conditions
Laboratories	Laboratory exercises consist of 6 exercises. Student must complete all exercises to pass. In the case of the student's absence, the given exercise should be made up according to the schedule. At each exercise, the teacher passes the exercise according to the following rules: • test (75%) • report (15%) • involvement in the exercise (10%) A student who does not obtain a positive grade from the colloquium will not be allowed to perform a given exercise. The exercise should be made up according to the schedule provided by the teacher. Grading scale: • 94% – 100% – excellent (A) • 87% – 93,9% - very good (B) • 78% – 86,9% - good (C) • 70% – 77,9% - satisfactory (D) • 60% – 69,9% – sufficient (E) • 0 – 59% – fail (F) The final grade from laboratory exercises can be increased by writing a test of the entire material.

Literature

Obligatory

1. Materials provided by the lecturer.
2. B. Welz, M. Sperling, Atomic Absorption Spectrometry, Third. Completely revised Edition, J. Wiley - VCH Vrlag, GmbH, Germany, 1999.

Calculation of ECTS points

Activities	Activity hours*
Lecture	15
Laboratories	30
Preparation for classes	25
Report preparation	20
Reading the indicated literature	10
Preparation for the exam	20

Student workload	**Hours** 120
Number of ECTS points	**ECTS** 4

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
CEN_K1_K03	The graduate is ready to correctly assessy the risks involved in conducting chemical experiments
CEN_K1_K06	The graduate is ready to formulate precise questions to deepen his/her own understanding of a topic or to find missing pieces of reasoning
CEN_K1_U01	The graduate can use basic chemical terminology according to IUPAC and PTChem recommendations
CEN_K1_U02	The graduate can present the knowledge acquired in an accessible manner
CEN_K1_U14	The graduate can work in a chemical laboratory according to health and safety rules
CEN_K1_U15	The graduate can work in a group in a variety of roles including group leader
CEN_K1_U16	The graduate can apply analytical techniques to explain basic chemical and physicochemical phenomena
CEN_K1_U17	The graduate can select instrumental analysis methods to investigate specific chemical and physicochemical phenomena
CEN_K1_U19	The graduate can analyse and develop test results and prepare a final report on the chemical and physico-chemical experiments carried out
CEN_K1_U21	The graduate can independently obtain information from both Polish and foreign literature, physicochemical tables and other available sources
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_W14	The graduate knows and understands the basic laboratory and analytical techniques
CEN_K1_W15	The graduate knows and understands the basic methods of instrumental analysis