COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-00EIKP-0294	Name of the course	Polish	**Nowoczesne techniki spektrometrii mas w analizie środowiskowej, biologicznej i przemysłowej**
			English	**Modern mass spectrometry for environmental, biological and industrial analysis**

tType of the course	Specialty course		
Course coordinator	Prof. Ryszard Łobiński, Ph.D., D.Sc., Eng	Course teacher	Prof. Ryszard Łobiński, Ph.D., D.Sc., Eng
Implementing unit	Faculty of Chemistry	Scientific discipline	chemical sciences; biotechnology; chemical engineering; environmental engineering, mining and energy

Level of education	Doctoral studies	Semester	winter		
Language of the course	English				
Type of assessment	Graded credit, ZAL	Number of hours in a semester	30	ECTS credits	2
Minimum number of participants	10	Maximum number of participants		Available for students (BSc, MSc)	Yes/~~No~~

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	2		2		
	in a semester	20		10		

1. Prerequisites

Fundamentals of chemistry

2. Course objectives

Introduce the subject, present mass spectrometry techniques and analytical characteristics of different instrumental configurations. Discuss typical applications in the field of environmental, biological and industrial analysis. Present challenges, limitations and perspectives.

3. Course content (separate for each type of classes)

Lecture

1. Introduction to Mass Spectrometry (MS):
* Definition and basic principles of mass spectrometry.
* Overview of the evolution and advancements in MS technology.
2. Advanced Techniques in Mass Spectrometry:
* Overview of tandem mass spectrometry (MS/MS) and its benefits.
* High-resolution mass spectrometry (HRMS) for enhanced accuracy and precision.
3. Applications in Environmental Analysis:
* Detection and quantification of pollutants and trace contaminants in air, water, and soil.
* Role of MS in environmental monitoring and regulatory compliance.
* Examples of environmental issues addressed by MS (e.g., pesticide residues, heavy metals).
4. Applications in Biological Analysis:
* Utilization of MS in proteomics, metabolomics, and genomics.
* Identification and quantification of biomolecules such as proteins, lipids, and metabolites.
* Contributions of MS to disease diagnosis, biomarker discovery, and understanding of biological pathways.
5. Applications in Industrial Analysis:
* Quality control and assurance in pharmaceutical and food industries.
* Process optimization and monitoring in chemical manufacturing.
* Detection and identification of impurities and contaminants.
6. Challenges and Limitations:

* Technical and practical limitations of mass spectrometry. * Challenges in sample preparation, data interpretation, and instrument maintenance. * Future directions and potential solutions to current limitations. 7. Conclusion: * Summary of the critical role of modern mass spectrometry in various fields. * The future outlook of MS technology and its potential to address emerging analytical challenges.
Seminar
Case Studies and Examples: * Specific examples of successful applications of MS in environmental, biological, and industrial contexts. * Analysis of case studies to highlight the versatility and effectiveness of MS.

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	Student is able to explain the principles of measurements by mass spectrometry	SD_W1	evaluation of activity during class, presentation evaluation
K02	Student is familiar with state-of-the-art MS analytical instrumental techniques	SD_W2	evaluation of activity during class, presentation evaluation
Skills			
S01	The student is able to identify main application areas of MS techniques in environmental, biological and industrial analysis	SD_U1 SD_U3 SD_U4 SD_U5 SD_U6	evaluation of activity during class, presentation evaluation
S02	Students is able to discuss advantages and problems related to the use of problems of MS techniques in environmental, biological and industrial analysis based specialized scientific English-language literature	SD_U3 SD_U4 SD_U5 SD_U6	evaluation of activity during class, presentation evaluation
Social competences			
SC01	The student understands the importance of on-going research in chemical analysis and staying updated with the latest scientific advancements and methodologies. He/she is able to share his/her knowledge discussing case studies to highlight the versatility and effectiveness of MS techniques.	SD_K2 SD_K3 SD_K4	evaluation of activity during class, presentation evaluation

*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
Active presence during lectures and seminars will produce the final grade.

6. Literature
Primary references:
[1] Jürgen H. Gross, Mass Spectrometry, A Textbook, 2017, Springer
[2] Yolanda Picó, Julian Campo (Eds), Mass Spectrometry in Food and Environmental Chemistry, 2023, Springer
[3] Beccaria M., Cabooter D., Current developments in LC-MS for pharmaceutical analysis, (2020) Analyst, 145 (4), 1129 – 1157 DOI: 10.1039/c9an02145k

55 h, w tym: 1. Godziny kontaktowe 15 h - obecność na wykładach; 2. przygotowanie do egzaminu i obecność na egzaminie 40 h;

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	20
2	Hours of consultations with the academic teacher, exams, tests, etc.	2
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	20
4	Amount of time devoted to the preparation for exams, test, assessments	18
	Total number of hours	**60**
	ECTS credits	**2**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	1
Number of ECTS credits earned by a student in a practical course	1