

**Subject card**

<b>Subject name and code</b>	Monographic lecture - Advanced electrochemical methods, PG_00082431						
<b>Field of study</b>	Chemistry						
<b>Date of commencement of studies</b>	October 2024	<b>Academic year of realisation of subject</b>			2025/2026		
<b>Education level</b>	Master's studies	<b>Subject group</b>			Obligatory subject group in the field of study Optional subject group		
<b>Mode of study</b>	full-time studies	<b>Mode of delivery</b>			at the university		
<b>Year of study</b>	2	<b>Language of instruction</b>			Polish		
<b>Semester of study</b>	4	<b>ECTS credits</b>			3.0		
<b>Learning profile</b>	academic	<b>Assessment form</b>			credit		
<b>Conducting unit</b>	Department of Analytical Chemistry -> Faculty of Chemistry -> Rector						
<b>Name and surname of lecturer (lecturers)</b>	<b>Subject supervisor</b>		dr hab. Paweł Niedziałkowski				
	<b>Teachers</b>		dr hab. Paweł Niedziałkowski prof. dr hab. inż. Tadeusz Ossowski dr Anna Wcisło				
<b>Lesson types</b>	<b>Lesson type</b>	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	<b>Number of study hours</b>	30.0	0.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						
<b>Learning activity and number of study hours</b>	<b>Learning activity</b>	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	<b>Number of study hours</b>	30		5.0		40.0	75
<b>Subject objectives</b>	familiarization with the development and application of electrochemical methods, familiarization with the theoretical foundations and measurement principles of electroanalytical methods, introduction to the methodology of modification and imaging of various surfaces using electrochemical and optical methods and combined methods, presentation of the application of electroanalytical methods to solve complex analytical problems, developing the ability to search for applications of electroanalytical methods in the scientific literature						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[CHEMMU2_W05] Has extended knowledge in the field of the specialisation studied.	- lists and describes modern measurement methods - combines economic conditions with individual research methods	[SW4] test/exam - oral or written
	[CHEMMU2_W11] Demonstrates general knowledge about the current trends in the development of chemistry as a science and the latest discoveries in this field.	- explains complex physicochemical processes for a given research method - combines the possibilities of applying analytical chemistry in other fields of science	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[CHEMMU2_W01] Uses knowledge of spectroscopic methods of chemical compound analysis.	- can, based on acquired knowledge, propose solutions to chemistry problems, taking into account the economic aspect, using advanced measurement and analytical techniques	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[CHEMMU2_K01] Knows the limitations of her/his own knowledge; understands the need for further education and can inspire other people to do so.	- self-assesses their current knowledge - determines the challenges facing chemical sciences	[SK1] oral statement/conversation/ discussion [SK4] test/exam - oral or written
Subject contents	Theoretical concepts of electroanalytical methods: phenomena at the phase boundary, description of the diffusion of substances to the electrode surface, reversibility of the electrode process, Fick's law, Cottrell's law, modeling of the electrode process, double layer capacitance, kinetics of the electrode reaction, mechanisms of electrode processes. Electrochemical measurements in aqueous, mixed and non-aqueous environments. Voltammetric methods: chronoamperometry, cyclic and normal pulse voltammetry. Electrochemical impedance spectroscopy. Voltametric stripping. Surface modification: Langmuir-Blodgett layers, self-organizing layers on metallic surfaces (SAM). Techniques used to characterize monolayers: Raman, confocal and SERS spectroscopy. Spectroelectrochemical measurements. Application of the atomic force microscope (AFM). Principles of flow analysis. Automation and computerization of analytical methods.		
Prerequisites and co-requisites	completed "instrumental analysis" course		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	test/exam	51.0%	100.0%
Recommended reading	Basic literature	1. A. J. Bard, L. R. Faulkner - Electrochemical methods, Wiley 2. F. Scholz Electroanalytical methods, Guide to Experiments and Applications, Springer 3. C. Z. Zoski - Handbook of electrochemistry Elsevier 4. Z. Galus Elektrochemiczne metody wyznaczania stałych fizykochemicznych, PWN, Warszawa 5. A. Kiszka Elektrochemia cz. I i II, WNT, Warszawa	
	Supplementary literature	1. W. Szczepaniak Metody instrumentalne w analizie chemicznej, PWN, Warszawa	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Electrochemical measurements in aqueous, mixed and non-aqueous environments. Voltammetric methods: chronoamperometry, cyclic and normal pulse voltammetry. Electrochemical impedance spectroscopy. Voltametric stripping.		
Work placement	Not applicable		

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