



Subject card

Subject name and code	Physical chemistry , PG_00048532						
Field of study	Chemical Technology						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
Education level	first-cycle studies	Subject group			Obligatory subject group in the field of study 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	2	Language of instruction			Polish		
Semester of study	4	ECTS credits			7.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Wojciech Chrzanowski					
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	30.0	0.0	0.0	75
	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	75	5.0	95.0	175		
Subject objectives	Familiarizing the students with basic concepts of electrochemistry (ionic, electrochemical and electrochemical kinetics), as well as with fundamental ideas in chemical kinetics (formal kinetics, reaction mechanisms, theories of reaction rates). Enabling the students to perform basic calculations involved and training them in correct and safe ways of carrying out basic physico-chemical experiments/measurements, including proper data treatment and drawing the conclusions.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_U02						
	K6_U11						
	K6_W02	Knowledge of basic laws of physical chemistry and their applications in solving simple technological problems.			[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		
	K6_U03	Preparation and analysis of tables and graphs. Evaluation of accuracy and precision of experimental results. Understanding databases in physical chemistry.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		

Subject contents	<p>LECTURES: Electrochemistry: 1. Ionics. Solutions of electrolytes. Mean ionic activity coefficients. Model of ionic interactions and ionic solutions structure according to Debye'a-Hückel theory. Discussion of equations for activity coefficients derived on the basis of their model. Electric conductivity of solutions of electrolytes (basic relations, ways of measurements, conductometric titrations, specific and molar conductivities). Solvation of ions. Transference numbers. 2. Electrodeics. Elektrolysis. Galvanic cells: electromotive force, classes of cells and half-cells, fuel cells, thermodynamic characteristics, practical applications, secondary cells. Potential jumps in galvanic cells. Electrode potentials, hydrogen scale. Electrochemical series. Applications of potentiometry. Chemical kinetics: Basic concepts of formal kinetics: reaction order and molecularity. definition of the reaction rate, deriving basic kinetic equations (rate laws and integrated rate laws). Kinetics of complex reactions and their mechanisms: (parallel, serial, reversible, chain, oscillating reactions). Steady-state approximation, Lindemann-Hinshelwood mechanism, Michaelisa-Menten mechanism, Lotka-Volterra mechanism. Dependence of reation rates on temperature. Theory of active collisions, thory of active complex. Basic concepts in catalysis. Electrochemical kinetics: electrical double layer. Processes of transport of depolarizers to the electrode surface. Polarization pof electrodes and overpotential. Overpotential in the hydrogen evolution reaction. Polarography. Butler-Volmer equation, Tafel equation. Characteristics of a working galvanic cell. Basic concepts in corrosion and anti-corrosion protection.</p> <p>TUTORIALS (TEXT PROBLEM SOLVING): Transference number calculations, conductometric calculations. Calculating EMFs of different types of galvanic cells. Calculating ΔH, ΔS, and ΔG of reactions occurring in galvanic cells. Relation between ΔG and the cell or half-cell potential. Calculating mean ionic activity coefficients of electrolytes. Calculations in formal kinetics. Determination of a reaction order.</p> <p>LABORATORY: Performing six selected experiments out of the list below: 1. Kinetics of the saccharose inversion (polarimetric measurements). 2. Kinetics of aniline iodination (volumetric analysis, potentiometric titrations). 3. Determination of transference numbers of ions. 4. Conductometry. 5. Determination of activity coefficients on the basis of EMF measurements. 6. Determination of ΔG^0, ΔH^0 i ΔS^0 of reaction in a galvanic cell on the basis of measurements of dependence of its EMF on temperature. 7. Determination of decomposition voltage in solutions and HER overpotential. 8. Adsorption on solids from gas phase. 9. Determination of dipole moments of liquid dielectrics by Guggenheim-Smith method. 10. Adsorption from liquid phase.</p>																	
Prerequisites and co-requisites	Completed courses in mathematics, physics, general and inorganic chemistry., physical chemsistry (semester 3). Knowledge of organic chemistry at the high school level (extended).																	
Assessment methods and criteria	<table border="1" data-bbox="448 1001 1487 1196"> <thead> <tr> <th data-bbox="448 1001 794 1037">Subject passing criteria</th> <th data-bbox="794 1001 1141 1037">Passing threshold</th> <th data-bbox="1141 1001 1487 1037">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 1037 794 1095">carrying out the measurements and delivery of reports</td> <td data-bbox="794 1037 1141 1095">100.0%</td> <td data-bbox="1141 1037 1487 1095">12.5%</td> </tr> <tr> <td data-bbox="448 1095 794 1131">2 written tests in problem solving</td> <td data-bbox="794 1095 1141 1131">50.0%</td> <td data-bbox="1141 1095 1487 1131">25.0%</td> </tr> <tr> <td data-bbox="448 1131 794 1167">final exam (written/oral)</td> <td data-bbox="794 1131 1141 1167">50.0%</td> <td data-bbox="1141 1131 1487 1167">50.0%</td> </tr> <tr> <td data-bbox="448 1167 794 1196">preparatory tests for the lab</td> <td data-bbox="794 1167 1141 1196">50.0%</td> <td data-bbox="1141 1167 1487 1196">12.5%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	carrying out the measurements and delivery of reports	100.0%	12.5%	2 written tests in problem solving	50.0%	25.0%	final exam (written/oral)	50.0%	50.0%	preparatory tests for the lab	50.0%	12.5%
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Example issues/ example questions/ tasks being completed	Published in the net on the pages of the Department of Physical Chemistry																	
Work placement	Not applicable																	