



Subject card

Subject name and code	Kinetics and electrochemistry, PG_00060861						
Field of study	Chemical Technology						
Date of commencement of studies	October 2025	Academic year of realisation of subject				2026/2027	
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				6.0	
Learning profile	general academic profile	Assessment form				exam	
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Joanna Krakowiak				
	Teachers						
Lesson types	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		10.0		95.0	180
Subject objectives	The aim of the course is to provide students with a fundamental understanding of chemical kinetics, including formal kinetics, reaction mechanisms, and theories of reaction rates, as well as the core concepts of electrochemistry, such as ionics, electrode processes, and electrochemical kinetics. The course also aims to develop students ability to perform basic calculations in both chemical kinetics and electrochemistry, thereby preparing them for more advanced studies and practical applications in these fields.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W02] Possesses the chemical knowledge necessary to synthesize, analyze and evaluate the properties of compounds and processes used in chemical technology.	The student has knowledge of chemical kinetics and electrochemistry, including an understanding of the influence of physicochemical parameters on reaction rates and the fundamental principles governing electrochemical processes.			[SW1] Assessment of factual knowledge		
	[K6_U03] Uses chemical knowledge to design compounds, perform physicochemical and analytical measurements, and obtain appropriate sources of information.	The student is able to apply knowledge of chemical kinetics and electrochemistry to solve basic measurement problems and interpret experimental data.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools		
	[K6_U02] Performs design calculations of technological processes, selects industrial equipment, operates laboratory equipment and conducts material analyses	The student is able to perform basic calculations related to chemical kinetics and electrochemical processes and to use laboratory equipment to carry out simple measurements and analyse the results.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		

Subject contents	Course content – lecture																
	<p><b>Chemical kinetics:</b> Basic concepts of formal kinetics: order and molecularity of reactions, definition of reaction rate, derivation of basic kinetic equations (differential and integrated forms). Kinetics and mechanisms of complex reactions (parallel, consecutive, reversible, and chain reactions). Steady-state approximation. Temperature dependence of reaction rates. Collision theory and transition state theory. Basic concepts of chemical catalysis in homogeneous and heterogeneous systems. Kinetics of electrode reactions.</p>																
	<p><b>Electrochemistry:</b></p> <p>1. <b>Ionics.</b> Electrolyte solutions, strength of electrolytes. Mean ionic activity coefficients. Electrical conductivity of electrolyte solutions (fundamental relations, measurement methods, conductometric titrations, molar conductivities). Transport numbers definition and methods of determination.</p> <p>2. <b>Electrode processes.</b> Classification of half-cells and electrochemical cells, electrode reactions. Electrode potential and electromotive force of a cell the Nernst equation. Electrochemical series. Applications of potentiometry. Thermodynamic characterization. Electrode polarization and overpotential. Electrolysis electrode reactions. Electrochemical energy storage systems.</p>																
	Course content – exercises																
Prerequisites and co-requisites	<p><b>Chemical kinetics:</b> Calculation of the reaction rate and the extent of reaction. Determination of reaction order. Kinetics of reversible reactions composed of elementary first-order steps.</p>																
	<p><b>Electrochemistry:</b> Application of Faradays first law in electrochemical calculations. Determination of transport numbers and conductivity using conductometric methods. Application of the Nernst equation to calculate electrode potentials and the electromotive force (EMF) of different types of cells. Determination of thermodynamic functions (<math>\Delta H</math>, <math>\Delta S</math>, <math>\Delta G</math>) for cell reactions. Estimation of activity coefficients of electrolytes.</p>																
	Course content – laboratory																
Assessment methods and criteria	Execution of five of the following experiments and analysis of the experimental results:																
	<p>1. <b>Kinetics of the iodination of aniline (titrimetric analysis)</b> determination of the reaction rate constant using potentiometric titration to monitor changes in reagent concentration.</p> <p>2. <b>Determination of ion transport numbers</b> application of Hittorfs method and the moving boundary method.</p> <p>3. <b>Conductometry</b> performance of several conductometric titrations followed by data analysis.</p> <p>4. <b>Determination of activity coefficients</b> based on EMF measurements.</p> <p>5. <b>Determination of <math>\Delta G</math>, <math>\Delta H</math> and <math>\Delta S</math> for a cell reaction</b> using the dependence of EMF on temperature.</p> <p>6. <b>Solidliquid adsorption determination of the equations of two adsorption isotherms</b></p>																
	Completed courses in mathematics, physics, general and inorganic chemistry. Knowledge of organic chemistry at the high school level (extended).																
	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>2 written tests in problem solving</td> <td>50.0%</td> <td>25.0%</td> </tr> <tr> <td>final exam (written/oral)</td> <td>60.0%</td> <td>50.0%</td> </tr> <tr> <td>carrying out the measurements and delivery of reports</td> <td>100.0%</td> <td>12.5%</td> </tr> <tr> <td>preparatory tests for the lab</td> <td>50.0%</td> <td>12.5%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	2 written tests in problem solving	50.0%	25.0%	final exam (written/oral)	60.0%	50.0%	carrying out the measurements and delivery of reports	100.0%	12.5%	preparatory tests for the lab	50.0%
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Recommended reading	Basic literature	<p>1. P. W. Atkins, Chemia fizyczna, PWN 2001. 2. W. Libuś i Z. Libuś, Elektrochemia, PWN 1987. 3. I Uruska (red.), Zbiór zadań z chemii fizycznej, PG, Gdańsk 1997. 4. H. Strzelecki, W.Grzybkowski (red.), Chemia fizyczna, ćwiczenia laboratoryjne, PG, Gdańsk 2004.</p>															
	Supplementary literature	<p>1. A. Molski, Wprowadzenie do kinetyki chemicznej (poz. 1-3. z serii Wykłady z chemii fizycznej, WNT, Warszawa) 2. A. Kisza, Elektrochemia. Jonika 3. A. Kisza, Elektrochemia. Elektrodyka 5. M. Pilarczyk, Zadania z chemii fizycznej, PG, Gdańsk 1996. 6. I Uruska, Zbiór zadań testowych z chemii fizycznej, PG, Gdańsk 1997. 7. P. W. Atkins, Podstawy chemii fizycznej, PWN 1999. 8. P. W. Atkins, Przewodnik po chemii fizycznej, PWN 1997. 9. K. Pigoń i Z. Ruziewicz, Chemia fizyczna, PWN 2006.</p>															
	eResources addresses																

<p>Example issues/ example questions/ tasks being completed</p>	<p>Kinetics</p> <p>In a first-order elementary reaction carried out at <b>27 °C</b>, the reactant concentration decreases to one half after <b>5000 s</b>. At <b>37 °C</b>, the concentration halves after <b>1000 s</b>. Compute: a) the rate constant at <b>27 °C</b>, b) the activation energy of the reaction.</p> <p>Electrochemistry</p> <p>1. Calculate the EMF at 20 °C for the cell: <math>\text{Cu} \text{Cd} \text{CdCl}_2(\text{aq}, 0.1\text{M}) \text{AgCl}(\text{s}) \text{Ag}(\text{s})</math></p> <p>Given standard reduction potentials: <math>E(\text{Cd}^{2+}/\text{Cd})=0.40\text{ V}</math>, <math>E(\text{AgCl}(\text{s})/\text{Ag}, \text{Cl})=+0.22\text{ V.E.}</math></p> <p>2. Draw the conductometric titration curve for an aqueous solution of <b>KOH</b> titrated with aqueous <b>HCl</b>. Clearly explain the changes in conductivity during the titration and write the relevant chemical reactions.</p>
<p>Practical activities within the subject</p>	<p>Not applicable</p>

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