GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Kinetics and electrochemistry, PG_00060861		
Field of study	Chemical Technology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
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		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Joanna Krakowiak	
	Teachers	dr hab. inż. Joanna Krakowiak	

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	10.0	95.0	180

Subject objectives	Familarizing the students with basic concepts of electrochemistry (ionics, electrodics 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.

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<tr><td>Learning outcomes</td><td>
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<tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr>
<tr><td>[K6_W02] has knowledge of inorganic, organic, physical and analytical chemistry useful for obtaining selected groups of compounds, determining their physical and chemical properties allowing for their quantitative and qualitative analysis, making measurements and determining the parameters of chemical reactions, phenomena and processes occurring in chemical technology</td><td>The student learns about the application of conductometric and potentiometric measurements in both laboratory and industrial settings. They are aware of the impact of key parameters on the rate of chemical reactions, including those of industrial significance.</td><td>[SW1] Assessment of factual knowledge</td></tr>
<tr><td>[K6_U03] is able to apply knowledge of inorganic, organic, physical and analytical chemistry and identify appropriate sources of information to design and synthesize simple chemical compounds, carry out basic physicochemical and analytical measurements</td><td>The student is able to perform quantitative analysis using conductometric and potentiometric measurements. They select the appropriate measurement technique to track the kinetics of a chemical reaction in selected systems</td><td>[SU1] Assessment of task fulfilment
[SU2] Assessment of ability to analyse information
[SU4] Assessment of ability to use methods and tools</td></tr>
<tr><td>[K6_U02] is able to operate typical laboratory apparatus and conduct analyses related to materials testing</td><td>The student is able to perform conductometric and potentiometric measurements and use them to determine selected physicochemical quantities. They become familiar with various methods of tracking the kinetics of a chemical reaction and apply one of them during laboratory classes.</td><td>[SU1] Assessment of task fulfilment
[SU2] Assessment of ability to analyse information
[SU4] Assessment of ability to use methods and tools
[SU5] Assessment of ability to present the results of task</td></tr>
<tr><td>[K6_U11] individually plans and implements his/her own learning</td><td>As part of the course, lectures, calculation exercises, and laboratory classes are conducted according to a set schedule. The student plans and achieves defined educational goals, with the greatest amount of independent work dedicated to laboratory classes, where theoretical and practical knowledge, as well as the ability to analyze experimental data, are required</td><td>[SU1] Assessment of task fulfilment</td></tr>
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<tr><td>Subject contents</td><td>LECTURES:
Electrochemistry: 1. Ionics. Solutions of electrolytes. Mean ionic activity coefficients. Model of ionic interactions and ionic solutions structure according to Debyea-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. Electrodics. 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.
TUTORIALS (TEXT PROBLEM SOLVING):
Transference number calculations, conductometric calculations. Calculating EMFs of different types of galvanic cells. Calculating H, S, and G of reactions occurring in galvanic cells. Relation between G and the cell or half-cell potential. Calculating mean ionic activity coefficients of electrolytes. Calculations in formal kinetics. Determination of a reaction order.
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 G0 , H0 i S0 of reaction in a galvanic cell on the basis of measurements of dependence of its EMF on temperature.
7. . Adsorption from liquid phase.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Completed courses in mathematics, physics, general and inorganic chemistry. Knowledge of organic chemistry at the high school level (extended).</td></tr>
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Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	preparatory tests for the lab	50.0%	12.5%
	final exam (written/oral)	50.0%	50.0%
	carrying out the measurements and delivery of reports	100.0%	12.5%
	2 written tests in problem solving	50.0%	25.0%
Recommended reading	Basic literature	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.	
	Supplementary literature	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.	
	eResources addresses	Adresy na platformie eNauczanie: Kinetyka i elektrochemia, dla kierunku Technologia Chemiczna 2024/25 sem. letni - Moodle ID: 42776 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=42776	
Example issues/ example questions/ tasks being completed	Published in the net on the pages of the Department of Physical Chemistry		
Work placement	Not applicable		

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