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 2026	Academic year of realisation of subject	2027/2028
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.	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.	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	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

Chemical kinetics:
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.

Electrochemistry:

1. **Ionics.** 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.

2. **Electrode processes.** 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.

Course content – exercises
Chemical kinetics: Calculation of the reaction rate and the extent of reaction. Determination of reaction order. Kinetics of reversible reactions composed of elementary first-order steps.

Electrochemistry: 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 (ΔH, ΔS, ΔG) for cell reactions. Estimation of activity coefficients of electrolytes.

Course content – laboratory

Execution of five of the following experiments and analysis of the experimental results:

1. **Kinetics of the iodination of aniline (titrimetric analysis)** determination of the reaction rate constant using potentiometric titration to monitor changes in reagent concentration.
2. **Determination of ion transport numbers** application of Hittorfs method and the moving boundary method.
3. **Conductometry** performance of several conductometric titrations followed by data analysis.
4. **Determination of activity coefficients** based on EMF measurements.
5. **Determination of ΔG, ΔH and ΔS for a cell reaction** using the dependence of EMF on temperature.
6. **Solidliquid adsorption determination of the equations of two adsorption isotherms**

Prerequisites and co-requisites

Completed courses in mathematics, physics, general and inorganic chemistry. Knowledge of organic chemistry at the high school level (extended).

Assessment methods and criteria

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%	12.5%

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	

Example issues/ example questions/ tasks being completed	Kinetics In a first-order elementary reaction carried out at **27 °C**, the reactant concentration decreases to one half after **5000 s**. At **37 °C**, the concentration halves after **1000 s**. Compute: a) the rate constant at **27 °C**, b) the activation energy of the reaction. Electrochemistry **1.**Calculate the EMF at 20 °C for the cell: CuCdCdCl2(aq,0.1M)AgCl(s)Ag(s) Given standard reduction potentials: $E(Cd^{2+}/Cd)=0.40$ V,E(AgCl(s)/Ag,Cl)=+0.22 V.E. **2.** Draw the conductometric titration curve for an aqueous solution of **KOH** titrated with aqueous **HCl**. Clearly explain the changes in conductivity during the titration and write the relevant chemical reactions.
Practical activites within the subject	Not applicable

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