GDAŃSK UNIVERSITY OF TECHNOLOGY

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. 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	5.0	95.0	175

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.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U11	The subject is conducted through three types of classes: lectures, exercises, and laboratory sessions, allowing for the acquisition of diverse information and skills. The course is prepared on the eLearning platform, encompassing general information about conducted classes, grading criteria, as well as materials used during the sessions. Additionally, instructional materials are provided to supplement and broaden knowledge in the subject area.	[SU4] Assessment of ability to use methods and tools
K6_U03	Preparation and analysis of tables and graphs. Evaluation of accuracy and precision of experimental results.Understanding databases in physical chemistry.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
K6_W02	Knowledge of basic laws of physical chemistry and their applications in solving simple technological problems.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
K6_U02	The student is capable of performing conductometric and potentiometric measurements, which are useful in both quantitative and qualitative analysis.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents

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. 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.

Prerequisites and co-requisites

Completed courses in mathematics, physics, general and inorganic chemistry., physical chemsitry (semester 3). Knowledge of organic chemistry at the high school level (extended).

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%
2 written tests in problem solving	50.0%	25.0%
carrying out the measurements and delivery of reports	100.0%	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	Adresy na platformie eNauczanie: Chemia Fizyczna dla kierunku Technologia Chemiczna 2023/24 sem. letni - Moodle ID: 33799 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33799
Example issues/ example questions/ tasks being completed	Published in the net on the pages of the Department of Physical Chemistry	
Work placement	Not applicable	