GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00048764		
Field of study	Green Technologies		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2021/2022
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	English
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. Maciej Śmiechowski	
	Teachers	dr hab. inż. Maciej Śmiechowski dr hab. inż. Adam Kloskowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	45.0	0.0	0.0	90

E-learning hours included: 0.0

Adresy na platformie eNauczanie:

Physical Chemistry for Green Technologies summer 2021/22 - Moodle ID: 20969
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=20969

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	90	5.0	55.0	150

Subject objectives

The aim of the subject is familiarizing the students with basic concepts in electrochemistry, chemical kinetics and surface science.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] is able to use information and communication technologies relevant to the common tasks of engineering, is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes	Preparation of reports from performed experiments. Estimation of accuracy and precision of experimental results. Knowledge of 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
[K6_W02] has a basic knowledge of chemistry including general chemistry, inorganic, organic, physical, analytical, including the knowledge necessary to describe and understand the phenomena and chemical processes occurring in the environment; measurement and the determination of the parameters of these processes.	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

Subject contents	Electrochemistry: Electrolyte solutions. Electrical conductivity. Conductometry. Theory of strong electrolytes. Ionic activity coefficients. Debye-Hückel Law. Ionic mobility. Transference numbers. Electrodes. Faradays Laws. Hittorf method. Coulometry. Selected electrolytic processes. Thermodynamics of galvanic cells. Half-cells and their classification. Standard reduction potentials. The electrochemical series. Potentiometry. Determination of pH. Electrodesolution interface. Interfacial potentials. Electrode polarization. Galvanic sources of energy. Introduction to corrosion. Chemical kinetics: Reaction rates. Rate law and rate constant. Reaction order. Rate constant and reaction order determination. Elementary reactions. Arrhenius Law. Reversible, parallel and consecutive reactions. Complex reaction mechanisms. Steady state approximation. Rate law theories: collision theory, transition state theory. Homogeneous and heterogeneous catalysis. Enzymatic catalysis. Lindemann-Hinshelwood mechanism. Michaelis-Menten mechanism. Chain reactions. Explosion. Polymerisation. Introduction to electrochemical kinetics. Surface science: Interfacial phenomena. Surface tension and its measurement. Cohesion and adhesion. Kelvin equation. Surface active agents. Adsorption on liquid-gas interface. Gibbs adsorption isotherm. Micelles and layers. Structure of colloidal particles. Electrokinetic phenomena. Coalescence and coagulation. Adsorption on solid-gas interface. Langmuir isotherm. BET isotherm. Thermodynamic description of adsorption.
Prerequisites and co-requisites	Knowledge of basic mathematics, physics and general chemistry as obtained during the first year of studies in chemical sciences.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
performing laboratory exercises and submitting lab reports	100.0%	10.0%
entry test in laboratory exercises	50.0%	20.0%
2 written tests in tutorials	50.0%	30.0%
final exam	50.0%	40.0%

Recommended reading

Basic literature	1. P. W. Atkins, General Chemistry, Scientific American Books, 1992. 2. P. Atkins, J. de Paula, J. Keeler, Atkins Physical Chemistry, Oxford University Press, 2018.
Supplementary literature	1. Chemistry LibreTexts, Physical & Theoretical Chemistry, https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps 2. H. DeVoe, Thermodynamics and Chemistry, http://www2.chem.umd.edu/thermobook/
eResources addresses	Physical Chemistry for Green Technologies summer 2021/22 - Moodle ID: 20969 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=20969

Example issues/ example questions/ tasks being completed	1. Write the half reaction (always as reduction) and the Nernst equation for given half-cells. 2. Write half-reactions occurring during electrolysis in the followings systems: Pt|NaCl(aq)|Pt, Cu|CuSO4(aq)|Pt, Ag|AgBr|HBr(aq)|Pt. 3. Draw a graph presenting the titration curve for a strong base titrated by a weak acid. Write an example of such titration and thoroughly explain the shape of the curve. 4. Given the cell Co(s)|$CoCl_2$(aq; 1.0 mol/dm^3)|AgCl(s)|Ag(s) answer the questions below. 5. Derive the equation permitting to calculate the time, after which the concentration of reactant X decreases to one-twelfth (1/12) of its initial value in a second order reaction. 6. On the diagram draw a linearized plot of transformed concentration of reactant X vs. time for reactions of 2nd order. Clearly mark the axes, label the intercept and write equation of the line. 7. Given the half-time of a first order reaction: R -> P (100 s), determine the time, after which the concentration of reactant R falls down to $^1/_8$ of its initial value. 8. Draw a graph showing a linearized adsorption isosthere, write down its equation, and demonstrate how to obtain a relevant thermodynamic parameter characterizing the adsorption process from this plot. 9. Draw a graph showing the Langmuir isotherm, write down its equation, and demonstrate the limiting behavior of the curve.
Work placement	Not applicable