GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00057786					
Field of study	Green Technologies					
Date of commencement of studies	October 2024		Academic year of realisation of subject		2025/2026	
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		7.0	
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. Maciej Śmiechowski			
	Teachers		dr hab. inż. Maciej Śmiechowski			

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	15.0	85.0	175

Subject objectives	The aim of the subject is familiarizing the students with basic concepts in electrochemistry, chemical kinetics and surface phenomena

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[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.	The student has knowledge of basic physicochemical laws and their applications in solving simple technological problems.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
	[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	The student is able to prepare and analyze tables and graphs. They can assess the accuracy and precision of experimental results and are able to use databases in the field of physical chemistry.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents	Course content – lecture
	Electrolyte solution. Theory of strong electrolytes. Activity coefficients. Electrical conductivity. Electrode-solution interface. Interfacial potentials. Electrodes and galvanic cells. Thermodynamics of galvanic cells. Electromotive force measurements. Practical aspects of potentiometry. The determination of pH. Standard reduction potentials. The electrochemical series. Electrode polarization. Electrolysis. Galvanic sources of energy. Corrosion.
	Chemical kinetics. Reaction rates. Rate laws and rate constants. Elementary reactions. Reaction mechanisms. Homogeneous and heterogeneous catalysis. Enzymatic processes. Chain reactions. Explosion.
	Interfacial phenomena. Surface tension. Surfactants. Adsorption on liquid-gas interface. Gibbs adsorption isotherm. Characterization of colloidal particles. Structure of colloidal particle. Electrokinetic phenomena. Coalescence and coagulationAdsorption on solid-gas interface. Langmuir isotherm. BET isotherm. Thermodynamic description.
	Course content – exercises
	Conductivity of electrolyte solutions. Electrolysis: electrode reactions, Faraday's laws. Galvanic cells: electrode reactions, electromotive force, Nernst equation, activity coefficients of electrolytes in cells. Transference numbers: Hittorf's method.
	Chemical reaction kinetics: reaction order, kinetic equation, reaction rate constant. Reaction activation energy: Arrhenius' law. Kinetics of reversible reactions.
	Surface tension: measurement methods. Kelvin's equation. Work of surface formation. Work of cohesion and adhesion, wettability. Szyszkowski's equation, surface tension of surfactant solutions.
	Course content – laboratory 1. Conductometry 2. Potentiometry: Kinetics of the Aniline Iodination Reaction 3. Adsorption in a Solid-Liquid System 4. Measurement of Physicochemical Constants in Liquids.
Prerequisites and co-requisites	Knowledge of mathematics, physics and inorganic chemistry at BSc level.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
carrying out 4 experiments, submitting lab reports, passing tests	100.0%	30.0%
written exam	50.0%	40.0%
2 written tests	50.0%	30.0%

Recommended reading

Basic literature	1. P. W. Atkins, J.A.Beran, General Chemistry, Oxford University Press, any edition above 2nd. 2. P. W. Atkins, Physical Chemistry, Oxford University Press, any edition above 5th. 3. W.Chrzanowski et coll., lecture notes, lab manuals and text problems published in the web pages of the Department of Physical Chemistry
Supplementary literature	see e-links below: - http://www.freebookcentre.net/Chemistry/Physical-Chemistry-Books.html - Wide selection of textbooks, lecture notes and lab manuals in English
eResources addresses	

Example issues/ example questions/ tasks being completed	The standard EMF of the $Ag|Ag_2SO_4\ (s)|H_2SO_4\ (0.1\ m)|H_2\ (P°)|Pt$ cell is 0.627 V. Calculate the E_{298} value assuming $\gamma_{\pm}(H_2SO_4) = 0.7$.
	It takes about 3 minutes to cook a hard-boiled egg in Los Angeles, but at the higher altitude of Denver, where water boils at 92 °C, the cooking time is 4.5 minutes. Use this information to estimate the activation energy for the coagulation of the egg albumin protein, assuming its a first order process.
	The surface tension of the 0.02 $mol·dm^3$ KCl solution is 71.994 $mN·m^1$ ($\sigma_0 = 71.96\ mN·m^1$). Assuming the simplified version of the Szyszkowski equation calculate the surface excess and estimate the depth of the so-called empty surface layer of the solution.
	Derive the equation permitting to calculate the time (denote it as $\tau_{1/9}$), after which concentration of reactant X decreases to one-ninth (1/9) of its initial value in a zero order reaction.
	Explain as precisely as possible the construction and mechanism of the glass electrode, making an appropriate sketch, and describe its applications.
Practical activites within the subject	Not applicable

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