University of Gdańsk

Subject card

Subject name and code	Physical chemistry, PG_00033322						
Field of study	Environmental Protection						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	undergraduate studies		Subject group	Obligatory subject group 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	2.0			
Learning profile	academic		Assessment form				
Conducting unit	Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Janusz Rak				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	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	30		5.0		15.0	50
Subject objectives	Acquainting students with the description of irreversible processes and the functioning of nature based on thermodynamics, with the phenomenological description of chemical changes over time based on chemical kinetics, with the description and applications of catalytic phenomena, and with the description and utilization of electrochemical processes. Acquiring the skills to understand and quantitatively describe physical transformations, chemical reactions, and to use physicochemical data in preparation for studying other subjects.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[OŚL3_U04] Uses specialist language in the discussion and properly uses the nomenclature in the field of environmental protection and individual disciplines related to it.	Is proficient in using the correct scientific nomenclature.	[SU4] test/exam - oral or written
[OŚL3_K02] Works individually demonstrating initiative and independence in actions, and effectively cooperates in a team, performing various roles in it.	Is capable of working individually as well as collaborating and working in a group, assuming various roles within it."	[SK4] test/exam - oral or written
[OŚL3_W01] Discusses the basic concepts of mathematics, physics, chemistry and biology. Describes physical, chemical and biological phenomena occurring in nature as well as geological, geomorphological and climatic conditions of the functioning of nature.	Understands and can explain descriptions of regularities, phenomena, and processes using the language of mathematics; in particular, can independently reproduce basic laws and theorems.	[SW4] test/exam - oral or written
[OŚL3_U09] Prepares in Polish/ English a short description of research, observation or problem task carried out during classes using appropriate scientific terminology.	Writes in an accessible scientific language, using the appropriate terminology for reports on conducted experiments.	[SU4] test/exam - oral or written
[OŚL3_U07] Uses basic laboratory techniques, conducts field research and performs qualitative and quantitative analyses and draws conclusions on this basis for practical purposes.	Can plan and conduct simple experimental studies or observations and analyze the results.	[SU4] test/exam - oral or written
[OŚL3_U01] Performs tasks under supervision and independently in the field of analysis of the natural environment and the functioning of natural and man-made natural systems.	Can analyze problems and find solutions based on the learned principles and methods.	[SU4] test/exam - oral or written
[OŚL3_U11] Uses statistical methods as well as algorithms and IT techniques, including application software packages to describe environmental experiments and analysis of typical data in socio-economic activities based on science and natural sciences.	Use statistical methods and computer software to prepare reports of conducted experiments.	[SU4] test/exam - oral or written

Subject contents

Fundamentals of chemical thermodynamics of reversible processes: basic quantities and relationships between them, principles of thermodynamics. Phenomenological and molecular interpretation of energy and entropy. Thermodynamics: basic relationships, calculations. Thermodynamic criteria for equilibrium, equilibrium constant. Thermodynamics of the formation of ideal and real solutions. Physicochemical properties of gases, liquids, and solids. Phase equilibria: phase diagrams, physicochemical foundations of distillation, rectification, crystallization, and extraction processes. Chemical kinetics: elementary and complex processes, absolute reaction rate theory. Homogeneous and heterogeneous catalysis: mechanisms, technological and natural significance. Conductivity of electrolyte solutions. Dependence of conductivity on temperature, pressure, and type of solvent. Theory of strong electrolytes. Relaxation and electrophoretic effects - Debye-Hückel-Onsager theory. Conductivity of electrolytes in solvents with low dielectric constants. Electrochemical spontaneous and forced processes: cells, electrolysis.

Prerequisites and co-requisites

The necessity to complete courses in: general chemistry, basics of advanced mathematics, and fundamentals of physics.

Knowledge of general chemistry at the undergraduate level, familiarity with basic concepts and principles of mathematics and physics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
egzam	51.0%	100.0%

Recommended reading

Basic literature

1. P. Atkins, J. De Paula, J. Keeler, Atkin's Physical Chemistry, Oxford University Press, 2022.
2. P. Atkins, Julio De Paula, Elements of Physical Chemistry, Oxford University Press, 2016.
3. P. Atkins, Physical Chemistry: A Very Short Introduction, Oxford University Press, 2014.

	Supplementary literature	1. P. Atkins, The Laws of Thermodynamics: A Very Short Introduction, Oxford University Press, USA, 2010. 2. A. M. Steane,Thermodynamics: A Complete Undergraduate Course, Oxford University Press, 2016. 3. R. M. Rosenberg, I. M. Klotz,Chemical Thermodynamics: Basic Concepts and Methods, Wiley-Intrerscience, 2008. 4. C. H. Hamann, A. Hamnett, W. Vielstich, Electrochemistry, Wiley-VCH GmbH, 2007.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Work, heat and changes in internal energy and enthalpy in the isothermal, isochoric, isobaric and adiabatic transformations of ideal gases. 2. Derive the Claussius-Clapeyron law and show how the pressure of saturated vapor in equilibrium with the liquid should depend on temperature. 3. Using the theory of active collisions, explain the origin of steric, pre-exponential and exponential factors. 4. How does Lindemann's theory explain the second order of unimolecular reactions observed at low substrate pressures? 5. Compare Hittorf's method with the moving boundary method. Describe the advantages and disadvantages of each method. 6. Derive relationships between the electromotive force and its temperature coefficient and the thermodynamic functions of the reaction taking place in the cell.	
Work placement	Not applicable	

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