University of Gdańsk

Subject card

Subject name and code	Physical chemistry, PG_00081921		
Field of study	Chemistry		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	Bachelor's 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	3.0
Learning profile	academic	Assessment form	exam
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Janusz Rak	
	Teachers	prof. dr hab. Janusz Rak	

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	40.0	75

Subject objectives	Acquainting students with the description of irreversible processes and the functioning of nature from the standpoint of thermodynamics, with the phenomenological description of chemical changes over time based on chemical kinetics, with the description and applications of catalysis phenomena, and with the description and utilization of electrochemical processes. Acquiring the ability to understand and quantitatively describe physical transformations, chemical reactions, and to use physicochemical data in order to prepare for the study of other subjects.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[CHEML3_K05] Observes established procedures in laboratory work and is responsible for the safety of her/his and others' work.	Conducts planned experiments. Adheres to established guidelines regarding the experiments conducted. Ensures safety during the execution of experiments. Can collaborate and work in a group, assuming various roles within it.	[SK4] test/exam - oral or written
[CHEML3_W10] Enumerates and describes the basic aspects of the construction, operation and use of measuring apparatus and equipment used in experimental works in the field of chemistry and related sciences.	Identifies the scientific research equipment encountered during studies and explains the principles of its operation.	[SW4] test/exam - oral or written
[CHEML3_W01] Enumerates basic laws and theories in chemistry, physics, mathematics and biology.	Has general knowledge of the basic concepts, principles, and theories in the field of physical chemistry.	[SW4] test/exam - oral or written
[CHEML3_W06] Chooses higher mathematics techniques to the extent necessary to understand and describe the physical processes important for understanding chemistry.	Understands and can explain the descriptions of regularities, phenomena, and processes using the language of mathematics, and in particular, can independently reconstruct fundamental laws and theorems.	[SW4] test/exam - oral or written
[CHEML3_U06] Uses basic application software packages to solve problems from the field of science.	To be able to plan and conduct simple experimental studies or observations, and to analyze results using available computer tools.	[SU4] test/exam - oral or written
[CHEML3_W03] Explains the relationship between the structure of matter and its observed properties.	Can analyze problems and find solutions based on the laws and methods learned.	[SW4] test/exam - oral or written
[CHEML3_U04] Plans and performs simple chemical experiments and analyses the results obtained.	Can plan and conduct simple experimental studies or observations and analyze the results.	[SU4] test/exam - oral or written

Subject contents

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

Prerequisites and co-requisites

Completion of courses in general chemistry, basic higher mathematics, and fundamentals of physics. Proficiency in general chemistry at the undergraduate level, familiarity with basic concepts and principles in 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	

Example issues/ example questions/ tasks being completed	1. Work, heat, and changes in internal energy and enthalpy in the processes of ideal gases: isothermal, isochoric, isobaric, and adiabatic transformations. 2. Derive the Clausius-Clapeyron equation and show how the pressure of saturated vapor in equilibrium with a liquid should depend on temperature. 3. Using the theory of active collisions, explain the origins of the steric, pre-exponential, and exponential factors. 4. How does Lindemann's theory explain the second-order reactions observed at low substrate pressures in unimolecular reactions? 5. Compare Hittorf's method with the moving boundary method. Describe the advantages and disadvantages of each method. 6. Derive the relationships between the electromotive force and its temperature coefficient and the thermodynamic functions of the reaction occurring in the cell.
Work placement	Not applicable

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