University of Gdańsk

Subject card

Subject name and code	Physical chemistry, PG_00033321		
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	0.0	0.0	30.0	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_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 [SW2] presentation/project/paper/ report
[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	[SU2] presentation/project/paper/ report [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.	[SK2] presentation/project/paper/ report [SK4] 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.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written
[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.	[SU2] presentation/project/paper/ report [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.	[SU2] presentation/project/paper/ report [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.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written

Subject contents

Determination of dissociation constants based on spectroscopic measurements; calculations based on the Lambert-Beer law; applications of spectroscopic measurements; principle of operation of UV-VIS spectrophotometer; methods of determining dipole moment; dipole moment and molecular structure; polarizability and chemical bonds; molar refraction; types of molecular polarization; behavior of molecules in an electric field; determination of refractive index; principle of operation of a dielectrometer. Principles of calorimetric measurements (including thermometer calibration, heat capacity, construction of a bomb calorimeter, and method limitations); liquid-vapor equilibrium diagrams for binary systems with unlimited mixing (isotherms and isobars); lever rule; fractional distillation of zeotropic and azeotropic systems; refractive index and its measurement. Basic types of physical adsorption isotherms (Langmuir, Freundlich, BET); specific surface area and its calculation; application of adsorption phenomenon. Coulometry, methods of determining ion transfer number; construction of a conductometer, calibration of a conductometric probe, determination of dissociation constant based on conductivity measurements; electrolysis process, electrolysis of acids, bases, and salts; SEM measurement methods and determination of activity coefficient; pH coefficient and its potentiometric measurement, pH meters, glass electrode, calomel electrode, quinhydrone electrode, antimony electrode, electrode characteristics. Determination of activation energy, catalyst influence on reaction progress, precise control of reaction temperature.

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
test	51.0%	60.0%
report	51.0%	40.0%

Recommended reading

Basic literature	Laboratorium chemii fizycznej, red.. Krzymiński, Wydawnictwo UG, Gdańsk 2014.

	Supplementary literature	Praca zbiorowa, red J. Woźnicka , H. Piekarski, Ćwiczenia laboratoryjne z chemii fizycznej, Wydawnictwo Uniwersytety Łódzkiego. Łódź 2019.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Define heat of formation and combustion. What is the relationship between the heat of reaction and the heats of combustion and formation of the reactants? 2. Derive the Clausius-Clapeyron equation and show how the vapor pressure in equilibrium with a liquid should depend on temperature. 3. Azeotropic solutions. Compare distillation in a system forming a positive azeotrope with distillation occurring in a system forming a negative azeotrope. 4. Using the theory of active collisions, explain the origins of steric, pre-exponential, and exponential factors. 5. Describe the principle of measuring SEM (Scanning Electron Microscope) cells using the Poggendorff method. Why is the currentless method used in SEM measurements?	
Work placement	Not applicable	

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