University of Gdańsk

Subject card

Subject name and code	Physical chemistry, PG_00081923		
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	credit
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Janusz Rak	
	Teachers	dr Lidia Chomicz-Mańka Natasza Masłowska dr Magdalena Zdrowowicz-Żamojć Magdalena Mańkowska dr Samanta Romanowska	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	45.0	0.0	0.0	45
	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	45	8.0	22.0	75

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
[CHEML3_K05] Observes established procedures in laboratory work and is responsible for the safety of her/his and others' work.	Carries out planned experiments. Adheres to the established procedures regarding conducted experiments. Ensures safety during experiment execution. Is capable of cooperating and working within a group, assuming different roles within it.	[SK2] presentation/project/paper/ report [SK4] test/exam - oral or written
[CHEML3_U06] Uses basic application software packages to solve problems from the field of science.	Can plan and conduct simple experimental studies or observations and analyze the results using available computer tools.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written
[CHEML3_W01] Enumerates basic laws and theories in chemistry, physics, mathematics and biology.	Has a general knowledge of basic concepts, principles, and theories in the field of physical chemistry.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[CHEML3_W06] Chooses higher mathematics techniques to the extent necessary to understand and describe the physical processes important for understanding chemistry.	Understands and explains 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
[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 scientific research equipment encountered during studies and explains the principles of its operation.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[CHEML3_W03] Explains the relationship between the structure of matter and its observed properties.	Analyzes problems and finds solutions based on known principles and methods.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[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.	[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	

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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