University of Gdańsk

Subject card

Subject name and code	Physical chemistry, PG_00080720		
Field of study	Chemical Business		
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	2.0
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 hab. Piotr Storoniak	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	30.0	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
[BCHINŻ_U03] Plans, selects the appropriate research and measuring equipment and performs simple chemical experiments; analyses the results and draws conclusions based on them.	Can plan and conduct simple experimental studies or observations and analyze the results.	[SU4] test/exam - oral or written
[BCHINŻ_U08] Uses the chemical nomenclature and engineering terminology properly.	Can properly use chemical nomenclature and engineering terminology in speech and writing.	[SU4] test/exam - oral or written
[BCHINŻ_K01] Identifies the level of her/his own knowledge and skills as well as the need to update engineering knowledge, continuous professional training and personal development.	Is aware of knowledge and skills, understands the need for continuous professional development and personal growth, self-assesses own competencies and improves skills, sets directions for own development and education.	[SK4] test/exam - oral or written
[BCHINŻ_W07] Describes the construction and operating principles of basic scientific, technological and control-measuring apparatus.	Identifies scientific research equipment encountered during studies and explains the principles of its operation.	[SW4] test/exam - oral or written
[BCHINŻ_W03] Describes the techniques of higher mathematics and IT tools necessary to describe and model chemical phenomena and technological processes.	Understands and can explain patterns, phenomena, and processes using the language of mathematics, particularly able to independently reproduce basic laws and theorems.	[SW4] test/exam - oral or written
[BCHINŻ_U02] Uses basic methods, techniques and tools in formulating and solving engineering tasks in the field of chemistry.	Is capable of applying techniques, methods, and tools to conduct research in the field of physical chemistry.	[SU4] test/exam - oral or written
[BCHINŻ_W02] Enumerates basic laws and theories in chemistry, physics and mathematics necessary to formulate and solve simple engineering tasks.	Has general knowledge of the basic concepts, principles, and theories of physical chemistry."	[SW4] test/exam - oral or written

Subject contents

Calculations of changes in internal energy, heat, and work for physical processes and chemical reactions. Calculations of changes in entropy, free energy, and free enthalpy of physical transformations and chemical reactions. Determination of the chemical equilibrium constant, calculation of free enthalpy based on the chemical equilibrium constant, van't Hoff isotherm. Calculation of critical temperature, melting temperature, activity, and activity coefficients. Phase equilibria, Gibbs phase rule. Identifying the order of reactions, deriving kinetic equations based on reaction mechanisms, determining the kinetics of complex reactions, deriving and using integrated forms of kinetic equations, calculations using the Arrhenius equation, collision theory, and transition state theory. Calculation of specific and equivalent conductivity, mobility, and speed of ion movement in solution, determination of ion transference numbers using the Hittorf method and the moving boundary method, determination of the hydrodynamic radius of ions. Using standard potentials to determine chemical equilibrium constants, calculations using the Nernst equation, determination of the EMF of a working cell and ion activity coefficients, calculation of thermodynamic functions of reactions occurring in cells, calculations of the temperature coefficients of cells.

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%	100.0%

Recommended reading

Basic literature	P.W. Atkins, C.A. Trapp, M.P. Cady, C. Giunta, Chemia fizyczna. Zbiór zadań z rozwiązaniami, PWN Warszawa 2001.
Supplementary literature	A. W. Adamson, Zadania z chemii fizycznej, PWN, Warszawa 1978.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Before it was discovered that Freon-12 (CF_2Cl_2) is harmful to the Earth's ozone layer, it was often used as a dispersing agent in deodorants and hair sprays. Its enthalpy of vaporization at the normal boiling point of -29.9°C is 20.25 kJ mol-1. Calculate the pressure that a container holding Freon-12 must withstand at a temperature of 40°C (the temperature of the container exposed to sunlight), assuming that H_{vap} is constant for this temperature range and equal to the value at -29.9°C. 2. The ion mobilities of K^+, Cu^{2+}, and Br^- in a field strength of 1.0 V cm^{-1} are respectively: 0.00076276, 0.0005699, and 0.0008093 cm s^{-1}. Calculate the equivalent conductivities of KBr and $CuBr_2$. Also, calculate the transference number of the Cu^{2+} ion in a solution that is simultaneously 0.1 M with respect to KBr and 0.01 M with respect to $CuBr_2$. 3. For the cell: Pt | H_2 (10^5 N/m^2) | H_2SO_4 (0.01 M) | $PbSO_4$(s) | Pb, $E°_{298}$ = -0.355 V. a) Calculate E_{298} assuming that the limiting Debye-Hückel law is satisfied (A = 0.5), b) Calculate the solubility product of $PbSO_4$, knowing that $E°_{298}$ (Pb/Pb^{2+}) = -0.126 V.
Work placement	Not applicable

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