University of Gdańsk

Subject card

Subject name and code	Physico-chemical analytical methods, PG_00082037		
Field of study	Chemistry		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Optional subject group Subject group related to scientific research in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	academic	Assessment form	exam
Conducting unit	Laboratory of Luminescence Research -> Department of Physical Chemistry -> Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Karol Krzymiński	
	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	40.0	75

Subject objectives	Familiarizing students with the issues included in the course content; Deepening and enriching physicochemical knowledge with practical aspects; Acquiring the ability to independently perform physicochemical measurements, processing and evaluating the obtained results. Familiarization with the methodology of modern physicochemical measurements. Understanding the phenomena of physicochemical processes and their relation to the environment; Selecting and assessing the acquired information; Developing self-education skills by acquiring and analyzing information from various sources.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[CHEML3_W04] Characterises the basic methods of chemical compound analysis.	- The student selects/proposes optimal methods for analyzing selected physicochemical parameters of the system.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
[CHEML3_U05] Uses basic statistical methods and IT techniques to describe chemical processes and analyse experimental data.	- The student draws conclusions about the properties and behavior of the tested system based on physicochemical data; - can use experimental data to perform calculations related to the thermodynamics and kinetics of a chemical system.	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
[CHEML3_W02] Describes the properties of elements and the most important chemical compounds, enumerates the methods of their preparation and methods of analysis.	The student answers the test and problem questions; - Applies theoretical laws and relationships in the context of performed tasks.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
[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.	- The student selects a method for the given laboratory task during a discussion in the laboratory - Participates in the discussion when planning the experiment; - Recognizes the elements of modern equipment for physicochemical tests and provides their functions.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion

Subject contents

Enthalpy of changes in the environment; Crystal lattice energy and solubility; Born-Haber cycle; Entropy, enthalpy and the surroundings; Thermodynamic analysis in practice; Kinetics in natural/industrial processes; Gibbs phase rule analysis for mixtures; Phase diagram analysis; Fractional distillation in industry; Refractometry; Applications of colligative properties of solutions.Applications of UV-Vis spectroscopy; Chromophores and auxochromes; batho- and hypsochromic shift. NMR spectroscopy: structure of the spectrometer, formation of spectra; Emission techniques: fluorescence (FL); Jabłoński's diagram; Kasha and Vavilov's law; Stokes shift; Determination of the equilibrium constant in the excited state; FL in quantitative analysis; Requirements and properties for FL probes; FRET processes; Chemiluminescence (CL) and bioluminescence (BL); Advantages of luminometric methods; CL measurements; FL and CL Quantum Efficiency, CL Markers and Indicators; Determination of parameters used in HPLC validation; Calibration charts in HPLC. MS spectrometry and mixed techniques; MS-MS type analyses; LC-MS and other combined techniques; Examples of applications of MS and LC-MS methods.

Prerequisites and co-requisites

- Passing courses in the following subjects at the first-cycle (bachelor's) level: mathematics, physics, general chemistry, physical chemistry.- The student is able to use source texts, obtains, analyzes, evaluates and processes information from various sources. Acquires knowledge through research - observes, verifies, independently draws conclusions and generalizes.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test exam with varying degrees of difficulty	51.0%	100.0%

Recommended reading

Basic literature

1. P.W. Atkins, Physical Chemistry, PWN Scientific Publishing House, Warsaw 2003.2. L. Sobczyk, A. Kisza, K. Gatner, A. Koll, Experimental physical chemistry, PWN Warszawa 1982.3. Electronic materials provided by the lecturer.

	Supplementary literature	1. E. Więckowska-Bryłka, Experimental physical chemistry, SGGW Publishing House, Warsaw 2007.2. J. Demichowicz-Pigoniowa, Physicochemical calculations, PWN Warszawa, 1984.3. P. Suppan, Chemistry and light, PWN Warszawa 1998.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Indicate the optimal answer regarding the partition coefficient (P): 2. Under standard conditions, aqueous solutions of sulfuric acid are stable, while sulfuric acid (IV) decomposes slowly with the release of gaseous sulfur oxide (IV). Calculate the free energy change for the above processes using the given thermochemical data.3. Match the answers to the statements about the spontaneity of chemical processes Ho > 0, So < 0; Ho < 0, So < 0; Ho < 0, So > 0; Ho > 0, So > 0.4. For a certain reaction, 50% of the substrate reacted after 10 seconds and 75% - after 20 seconds. The rate constant of this reaction due to the disappearance of the substrate takes value ...	
Work placement	Not applicable	

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