GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	PHYSICOCHEMICAL TESTS OF SOLUTION, PG_00064403		
Field of study	Chemistry		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
Education level	first-cycle studies	Subject group	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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Maciej Śmiechowski	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	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	2.0	18.0	50

Subject objectives

The aim of the course is to familiarize students with the current state of knowledge in the field of experimental physicochemistry of solutions and modeling of solution properties and to provide in-depth knowledge about anhydrous systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] operates typical laboratory apparatus and carries out analyses to identify chemical compounds and materials, integrating computational methods and application software	personally performs experiments related to selected physicochemical properties of solutions using typical measuring equipment, including a digital ultrasonic density meter	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
[K6_U01] gathers information from literature, databases and other sources, interpreting, critically evaluating, summarising, formulating and justifying opinions, independently analyses and produces technical drawings with the use of computer assistance	uses physicochemical databases to predict the properties of liquid mixtures and select a solvent with the desired properties	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information
[K6_W03] demonstrates knowledge in the area of theoretical chemistry and related engineering disciplines, necessary to predict structures, design and conduct basic process operations using molecular mechanics tools	knows how to relate expected solvent properties to molecular descriptors and knows the principles of the theory of modeling solution properties	[SW1] Assessment of factual knowledge
[K6_W05] recognises methods, techniques and tools of computer aided design for solving engineering tasks in chemistry, chemical engineering and technology, mechanical engineering, in the design and analysis of technological processes	can prepare reports from individually performed experiments , including appropriate tables and graphs, analyzes the obtained data based on a physicochemical model and determines the accuracy and precision of the obtained results based on literature data	[SW3] Assessment of knowledge contained in written work and projects

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Resume of phenomenological thermodynamics: principles of thermodynamics, thermodynamic potentials, Gibbs-Duhem equation, partial quantities, apparent quantities, excess quantities; Basic information about solutions: definitions, classification of solvents and solutes; Water as solvent; Imperfect solutions: regular and athermal solutions; Advanced colligative properties: osmotic coefficients, osmotic virial equation; Gas solubility; Influence of high pressures and temperatures on solutions; Supercritical fluids; Advanced solution electrochemistry: activity coefficients of electrolytes; Spectroscopic studies of solutions.

Course content – laboratory
Three exercises in measuring the physicochemical properties of solutions.

1. Determination of partial molar volumes of solution components
2. Determination of the solubility isotherm in ternary liquid systems
3. Determination of the average molecular weight of a polymer using a viscometric method</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Completion of basic courses in mathematics, physics, and physical chemistry at the first level of studies.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Written test covering lecture material</td><td>50.0%</td><td>60.0%</td></tr>
<tr><td>Short test and reports from lab exercises</td><td>50.0%</td><td>40.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. K. Pigoń, Z. Ruziewicz, Chemia fizyczna. Tom 1. Podstawy fenomenologiczne, PWN, Warszawa 2005.
2. A. Olszowski, L. Komorowski, Chemia fizyczna. Tom 4. Laboratorium fizykochemiczne, PWN, Warszawa 2013.
3. Praca zbiorowa, Chemia fizyczna, PWN, Warszawa 1980.</td></tr>
<tr><td>Supplementary literature</td><td>Series "Lectures in physical chemistry":

1. H. Buchowski, W. Ufnalski, Roztwory, WNT, Warszawa 1995.
2. H. Buchowski, W. Ufnalski, Podstawy termodynamiki, WNT, Warszawa 1994.
3. J. Sadlej, Spektroskopia molekularna, WNT, Warszawa 2002.
4. A. Kisza, Elektrochemia I. Jonika, WNT, Warszawa 2000.
5. H. Buchowski, W. Ufnalski, Fizykochemia gazów i cieczy, WNT, Warszawa 1998.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Given two acids: hydrogen chloride and acetic acid, choose a solvent in which the difference in acid strength is: (a) smaller than in water, (b) greater than in water.
2. Write down the equation for the autoionization of ammonia. Which base is the strongest in this environment?
3. Define the donor number (Gutmann number). Which solvent has a higher value of this number, ammonia or chloroform?
4. Describe the relationship between Bjerrum's osmotic coefficient and the solute's activity coefficient.
5. Describe the most important modifications to the Debye-Hückel equation that allow its extension to high concentrations.
6. Define an ionic liquid and list the most important differences between ionic liquids and molecular solvents.
7. Describe the relationship between adiabatic compressibility and the measured physicochemical quantities of a solution.
8. Give an example of a physical quantity that is not strictly additive for an ideal solution.
9. List the applications of vibrational spectroscopy in the study of solutions.
10. Describe the effect of electrolyte concentration on the solubility of gases in solution.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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