GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Physical chemistry, PG_00057673		
Field of study	Green Technologies		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	2	Language of instruction	Polish
Semester of study	3	ECTS credits	8.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Dorota Warmińska	
	Teachers	dr hab. inż. Dorota Warmińska	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	45.0	0.0	0.0	90

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	90	15.0	95.0	200

Subject objectives

The aim of the course is to familiarize students with the laws of physical chemistry in the field of properties of states of matter, chemical thermodynamics, phase equilibria and chemical equilibria.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] is able to use information and communication technologies relevant to the common tasks of engineering, is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes	Student understands mathematical formulae and can express verbally their meaning. Student can also formulate problems verbally with precision permitting to write a suitable equation. Student can analyse simple physicochemical problems and construct suitable algorithms to solve them.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
[K6_W02] has a basic knowledge of chemistry including general chemistry, inorganic, organic, physical, analytical, including the knowledge necessary to describe and understand the phenomena and chemical processes occurring in the environment; measurement and the determination of the parameters of these processes.	Student knows fundamental concepts in physical chemistry, is aware of their mutual relations and can explain these relations.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>LECTURE:
States of matter: Gases: Model and equation of state of an ideal gas, laws: Boyle, Gay-Lussac, Avogadro, Dalton, kinetic theory of gases. Reasons for deviations in the behavior of real gases from ideal ones, real gas isotherms, compressibility coefficient, van der Waals equation, critical parameters, reduced form of the gas equation of state. Internal energy and heat capacity of gases with monoatomic and polyatomic molecules. Liquids - characteristics of mutual forces. Liquid properties: thermal expansion, compressibility, dynamic and kinematic viscosity, surface tension. Phase equilibria in one-, two- and three-component systems. Thermodynamics Internal energy, heat, enthalpy, properties of state functions. Principles of thermodynamics: perpetual motion machines of the first and second kind. Thermochemistry: Hess's and Kirchoff's laws. Reversible and irreversible processes, entropy. Free enthalpy and free energy, thermodynamic potentials. Mathematical relationships between thermodynamic functions. Thermodynamics of open systems: partial molar values, excess functions and solution mixing functions. Chemical equilibrium: Thermodynamic reaction equilibrium constant, Van't Hoff isotherm and isobar equations, the influence of temperature and pressure on the equilibrium position of a chemical reaction.
TOTURIALS:
Calculation of basic thermodynamic functions of chemical reactions and physical transformations: H, U, G, S; application of Hess's law and Kirchhoff's law in thermodynamic calculations. Application of the laws of thermodynamics to describe equilibria in one-component systems (Clausius-Clapeyron equation) and two-component liquid-vapor systems. Chemical statics. Calculating the equilibrium composition of the reaction mixture, determining the reaction equilibrium constant based on experimental data, and relating the reaction equilibrium constant to thermodynamic functions (Van't Hoff isotherm and isobar).
LABORATORY
Performing 6 experiments from the list:
1. Measurement of physicochemical solids of liquids. 2. Determination of the saturated vapor pressure of a liquid.
3. Determination of the average molecular weight of the polymer using the viscometric method.
4. Determination of partial molar volumes of solution components.
5. Calorimetry: a) measurement of the specific heat of a liquid; b) measurement of the heat of the acid-base neutralization reaction.
6. Determination of the heat of dissolution using solubility measurements.
7. Determining the phase diagram in a three-component system.
8. Determination of the liquid-vapor phase diagram in a two-component system.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>completed courses in mathematics, physics, inorganic chemistry</td></tr>
<tr><td>Assessment methods and criteria</td><td>
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<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>2 written tests</td><td>50.0%</td><td>30.0%</td></tr>
<tr><td>Lab - written/oral tests</td><td>50.0%</td><td>20.0%</td></tr>
<tr><td>Lab - performance and reports</td><td>100.0%</td><td>10.0%</td></tr>
<tr><td>written/oral exam</td><td>50.0%</td><td>40.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. K. Pigoń i Z. Ruziewicz, Chemia fizyczna, PWN 2006.2. P. W. Atkins, Chemia fizyczna, PWN 2001.3. H. Strzelecki, W.Grzybkowski (red.), Chemia fizyczna, ćwiczenia laboratoryjne, PG, Gdańsk 2004.4. M. Pilarczyk, Zadania z chemii fizycznej, PG, Gdańsk 1996.</td></tr>
<tr><td>Supplementary literature</td><td>1. H. Buchowski i W. Ufnalski, Podstawy termodynamiki (poz. 1-6 z serii Wykłady z chemii fizycznej, WNT, Warszawa)2. W Libuś, Chemia Fizyczna, część I, PG, Gdańsk 1970.3. W. Grzybkowski, Chemia fizyczna w przykładach, PG, Gdańsk 2014</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Chemia Fizyczna dla studentów Zielonych Technologii_2024/2025 - Moodle ID: 39726
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39726</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Derive the equation linking the first and second laws of thermodynamics.

2. Draw the dependence of the heat capacity of an ideal diatomic gas under constant pressure on temperature.

3. Why is the melting curve of the water negative?

4. Define the pressure equilibrium constant for a specific chemical reaction, then discuss the influence of temperature and pressure on the reaction yield.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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