



Subject card

Subject name and code	, PG_00057772						
Field of study	Green Technologies						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2023/2024		
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		English		
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. Maciej Śmiechowski				
	Teachers						
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 subject is to familiarize the student with fundamental physico-chemical laws in chemical thermodynamics, phase equilibria and chemical equilibria together with ability of solving relevant text problems involving calculations, as well as teachnig him/her effective and safe carrying out simple experiments/measurements of physico-chemical quantities and proper presentation and interpretation of their results.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[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 has basic knowledge of physical chemistry, including the knowledge necessary to describe and understand the phenomena and chemical processes occurring in the environment; measurements and determination of the parameters of these processes		[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		
	[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 is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes		[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment		

Subject contents	<p>LECTURES</p> <p>Chemical thermodynamics: Thermochemistry, Hess law and kirchoff's equation. State functions. First principle of thermodynamics. Thermodynamic cycles, Second principle, Gibbs free anergy and Helmholtz free energy. Third principle. Criteria of spontaneity and equilibrium of reactions. Open systems, partial molar quantities, chemical potential. Chemical equilibrium. Standard molar Gibbs free energy and reaction quotient. Equilibrium constants. Le Chatelier principle and Van't Hoff isobar. Gibbs-Helmholtz equation. General conditions of phase equilibria. Clausius-Clapeyron equation. Gibbs rule of phases. Gibbs-Duhem equation. Selected equilibria in one-, two, and three-component systems (Gibbs triangle) interpretation of phase diagrams. Simple and fractional distillation. Nernst law of partition. Solutions: Colligative properties. Thermodynamic characteristics of the perfect and perfectly diluted solutions. Thermodynamic definition of activity and activity coefficients. Excess functions.</p> <p>TUTORIALS:</p> <p>Calculations of heats of reaction at constant V or P. Calculations of S and G of reaction. Relation of G^0 with equilibrium constantsi. Calculations of chemical equilibria in gaseous phase, equilibrium compositions and sissociation (reaction) degree. Calculations in phase equilibria in one-component systems. Calculation of composition of phases in gas-liquid systems, compositions of distillates and residuals. Calculations related to colligative properties..</p> <p>LABORATORY</p> <p>Performing 6 experiments from the list:</p> <ol style="list-style-type: none">1. Vapor-liquid equilibrium of pure liquids.2. Vapor-liquid equilibrium for a two component systems.3. Cryometry - Measurements of freezing point depression.4. Calorimetry: a) measuring specific heat of liquids; b) measuring heat of acid-base neutralization..5. Heat of dissolution6. Determination of physicochemical constants of liquids.		
Prerequisites and co-requisites	completed courses in mathematics, physics, inorganic chemistry and computer science		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lab - written/oral tests	50.0%	20.0%
	Lab - performance and reports	100.0%	10.0%
	2 written tests	50.0%	30.0%
	written/oral exam	50.0%	40.0%
Recommended reading	Basic literature	1. P. W. Atkins, J.A.Beran, General Chemistry, Oxford University Press, any edition above 2nd.	
		2. P. W. Atkins, Physical Chemistry, Oxford University Press, any edition above 5th.	
		3. W.Chrzanowski, lecture notes, lab manuals and text problems published in the web pages of the Department of Physical Chemistry	
	Supplementary literature	1. P. W. Atkins, Przewodnik po chemii fizycznej, PWN 1997.	
		2. K. Pigoń i Z. Ruziewicz, Chemia fizyczna, PWN 2006.	
		3. H. Buchowski i W. Ufnalski, Podstawy termodynamiki (poz. 1-6 z serii Wykłady z chemii fizycznej, WNT, Warszawa)	
		4. H. Buchowski i W. Ufnalski, Fizykochemia gazów i cieczy	
		5. H. Buchowski i W. Ufnalski, Gazy, ciecze i płyny	
		6. H. Buchowski i W. Ufnalski, Roztwory	
		7. W. Ufnalski, Równowagi chemiczne	
		8. H. Buchowski, Elementy termodynamiki statystycznej	
		9. W. Libuś, Chemia Fizyczna, część I, PG, Gdańsk 1970.	
		10. M. Pilarczyk, Zadania z chemii fizycznej, PG, Gdańsk 1996.	
		11. I. Uruska, Zbiór zadań testowych z chemii fizycznej, PG, Gdańsk 1997	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	Published in web pages of the Department of Physical Chemistry at afore given link		
Work placement	Not applicable		