



Subject card

Subject name and code	Physics in chemical systems, PG_00069013						
Field of study	Cosmetic technologies						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	first-cycle 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	3		ECTS credits		3.0		
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		dr hab. inż. Maciej Śmiechowski				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 6978 Fizyka w układach chemicznych 2026 https://enauczanie.pg.edu.pl/2025/course/view.php?id=6978						
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	The aim of the course is to familiarize students with the basics of thermodynamics, thermochemistry, chemical kinetics and surface physicochemistry to the extent necessary to understand the course of elementary processes in cosmetic technology.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_W01] defines the phenomena, processes and physicochemical laws used to produce utility goods and provide services		knows the laws of thermodynamics and thermochemistry to the extent necessary to characterize chemical reactions used in the cosmetics industry.		[SW1] Assessment of factual knowledge		
	[K6_W02] explains the structure and functions of cosmetic raw materials and methods and instruments for determining their quantity, quality and activity		knows kinetic measurements techniques and methods for determining surface tension and characterizing the adsorption process.		[SW1] Assessment of factual knowledge		
	[K6_W07] has knowledge of designing experiments while maintaining intellectual property protection and the principles of bioethics and applicable legal regulations		has the knowledge necessary to predict the thermodynamic effects of chemical reactions based on thermochemical data available in tables, correctly citing the source of that data.		[SW1] Assessment of factual knowledge		

Subject contents	Course content – lecture		
	First law of thermodynamics. Thermodynamic cycles. The concept of entropy. Second law of thermodynamics. Third law of thermodynamics. Thermochemistry: enthalpy of formation, enthalpy of combustion, Hess' law. Free energy and free enthalpy. Criteria of thermodynamic equilibrium. Criteria of irreversibility and spontaneity of processes. Law of mass action. Reaction quotient. Thermodynamic equilibrium constant. Le Chatelier's principle. Van't hoff's law.		
	Basic concepts of formal kinetics. Reaction rate and rate constant. Reaction order. Kinetic equations of various orders (0, 1, 2). Half-time. Kinetic plots. Experimental kinetics. Arrhenius equation.		
	Surface tension: definition and methods of determination. Gibbs isotherm. Surface-active compounds and the Szyszkowski equation. Absorption and adsorption: thermodynamic description. Adsorption isostere. Langmuir, Freundlich, and BET isotherms.		
	Course content – exercises		
	Solving practical problems in the following areas: chemical thermodynamics (three laws of thermodynamics, thermodynamic cycles, thermochemistry), chemical equilibrium, basics of chemical kinetics (reaction order determination, half-time, activation energy), basics of surface science (Szyszkowski equation, Gibbs isotherm, adsorption isotherms, adsorption isostere and process heat).		
Prerequisites and co-requisites	Completed subjects: mathematics and physics.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Final test (lecture)	50.0%	50.0%
	Two tests during the semester (tutorials)	50.0%	50.0%
Recommended reading	Basic literature	P. W. Atkins, Chemia fizyczna, Wydawnictwo Naukowe PWN, Warszawa 2001 P. W. Atkins, Podstawy chemii fizycznej, Wydawnictwo Naukowe PWN, Warszawa 1999 K. Pigoń, Z. Ruziewicz, Chemia fizyczna Tom 1. Podstawy fenomenologiczne, Wydawnictwo Naukowe PWN, Warszawa 2009 W. Grzybowski, Chemia fizyczna w przykładach, Wydawnictwo PG, Gdańsk 2014 I. Uruska (red.), Zbiór zadań z chemii fizycznej, Wydawnictwo PG, Gdańsk 1997	
	Supplementary literature	H. Buchowski, W. Ufnalski, Podstawy termodynamiki, WNT 1994 A. Molski, Wprowadzenie do kinetyki chemicznej, WNT 2001 E. T. Dutkiewicz, Fizykochemia powierzchni, WNT 1998	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Classify the given physical quantities as intensive or extensive. Describe the Joule-Thomson experiment and show which state function is conserved in it. Write a formula expressing the main conclusion from this experiment. From the following thermochemical data, determine the heat of formation of solid DyCl3 and the change in internal energy for this reaction. A heat engine operates between a heat source at 400 K and a cooler at 200 K. The manufacturer guarantees its efficiency to be 65%. Explain why this is misleading to customers. A certain ideal gas transformation is isothermal. Determine how entropy behaves (increases or decreases) if: (a) the gas pressure increases, and (b) the gas volume increases. Using Le Chatelier's principle, predict how the system in which the given chemical reaction occurs will behave when the listed process parameters change. Plot linearized graphs of the concentration of substrate A versus time for the zeroth- and second-order reactions. Label the axes. Write the equations for both lines. Determine the order of the chemical reaction based on kinetic data provided in the table. Using the Szyszkowski equation, calculate the limiting surface excess of SDS in an aqueous solution given the parameters a and b of the equation. Compare the processes of physical and chemical adsorption. Use the adsorption isostere equation to calculate the heat of this process. Determine the nature of adsorption.		
Practical activities within the subject	Not applicable		

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