



Subject card

Subject name and code	General chemistry, PG_00061677						
Field of study	Recycling and Energy Recovery						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
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	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			6.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Ewa Wagner-Wysięcka					
	Teachers	dr hab. inż. Ewa Wagner-Wysięcka dr hab. inż. Andrzej Nowak dr inż. Mariusz Szkoda					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	20.0	20.0	30.0	0.0	0.0	70
	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	70	5.0		75.0		150
Subject objectives	The purpose of the course is to provide knowledge of the basic concepts and definitions of general chemistry including elements of chemical analysis. Exercises are aimed at - teaching independent solutions of problems and calculation tasks in the field of basic chemistry. Laboratory exercises are designed to familiarize with the specifics of working in a chemical laboratory and to acquire skills useful in further education and in professional work.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W01] demonstrates knowledge and understanding of mathematics and other exact sciences and engineering disciplines at the level necessary to solve theoretical, engineering and technological problems and issues.	The student is able to independently solve theoretical and calculus problems in general chemistry. Uses basic equipment in a chemical laboratory. Draws and formulates conclusions from own measurements and observations.			[SW1] Assessment of factual knowledge		
	[K6_U01] applies knowledge of mathematics and other exact sciences and engineering disciplines to solve theoretical, engineering and technological problems and issues.	The student knows the structure of the atom, knows the properties of the elements resulting from their position in the periodic table, knows the relationship between the structure and properties of substances. The student knows the principles of nomenclature of chemical compounds. The student knows the types of chemical reactions, including redox reactions. Knows the properties of solutions, including electrolyte solutions. Has the knowledge of the basics of thermodynamics and kinetics, as well as electrochemistry. Student is able to apply the above issues in solving calculus and practical problems.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information		

Atom. The electron structure of the atom. Heisenberg's indeterminacy principle. Quantum numbers, orbitals, Pauli's prohibition, Hund's rule. Valence electrons. Electron configurations of atoms and ions.

Periodic table of elements. Electron configurations of atoms. Periodicity of changes in physical and chemical properties of elements. Concepts: ionization energy of elements, electron affinity, electronegativity of elements. Atomic and ionic radii. Allotropy. Isomorphism.

Basic chemical laws, chemical formulas and equations.

The molecule. Chemical bonds: main types of bonds. Dependence of chemical and physical properties of substances on their chemical structure. Intermolecular interactions.

Inorganic chemical compounds. Hydrides, oxides, acids, bases, salts. Basic reactions of acids, bases and salts. Amphotericity.

Elements of organic chemistry: main classes of organic compounds.

Types of chemical reactions. Oxidation and reduction reactions. Degree of oxidation.

Solutions, types of solutions. Properties of water. Physical properties of solutions.

Chemical equilibrium.

Equilibria in aqueous solutions. Solutions of electrolytes. Ionic and proton theory of acids and bases. The concept of pH. Weak electrolytes. Hydrolysis. Ostwald's dilution law. Buffer solutions. Electron theory of acids and bases. Strong electrolytes, the concept of activity and ionic strength.

Chemical thermodynamics - basic concepts, first principle. Enthalpy of physical transformations and chemical reactions. Second principle of thermodynamics: entropy, free enthalpy, free enthalpy of reaction, spontaneous processes, reactions at equilibrium.

Kinetics of chemical reactions

Fundamentals of electrochemistry: the Nernst equation - electrodes of the first, second and third kind. Electrolysis, Faraday's laws. Electrochemical series. Galvanic cells: primary and secondary.

LABORATORY: Introduction, principles of health and safety in the chemical laboratory, discussion of basic glassware and laboratory equipment, disposal of reagents, data sheets, preparation of results, estimation of uncertainties. Qualitative analysis of cations. Qualitative analysis of anions. Properties of solutions - concentrations, acidity. Precipitation reactions of precipitates. Quantitative analysis of inorganic substances -1. Spectroscopic methods: UV-Vis spectroscopy. Quantitative analysis of inorganic substances -2. Electrochemical methods - potentiometry. Kinetics of chemical reactions. Water - water treatment processes: softening and demineralization, membrane processes. Colloids. Redox reactions. Electrochemical series of metals. Cells. Conductivity of solutions and electrolysis. Corrosion

EXERCISES Estimation of uncertainty in results, statistical analysis Chemical notation: sum formulas, structural formulas, nomenclature Basic chemical laws and concepts. Amount of matter (mole). Solutions: ways to express concentrations of solutions. Arranging and balancing chemical equations, including oxidation and reduction reaction equations. Stoichiometry of chemical formulas and transformations: mass balance, yield of a chemical reaction. Aqueous solutions: pH. Buffer solutions Ionic equilibria in electrolyte solutions (ionic dissociation, weak and strong electrolytes, degree of dissociation, dissociation constant.

	Elements of electrochemistry - Faraday's Law. Equilibria in solutions of electrolytes containing a hard-soluble electrolyte. Solubility product. Energy effects of physical processes and chemical reactions. Thermochemical calculations.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Exercise - two colloquia	51.0%	30.0%
	Laboratory -Practical completion of all exercises	51.0%	35.0%
	Oral exam	51.0%	35.0%
Recommended reading	Basic literature	<p>L. Jones, P. Atkins, L. Leroy, Chemia ogólna, Wydawnictwo Naukowe PWN, W-wa, 2020</p> <p>A. Bielański, Podstawy chemii nieorganicznej, Wydawnictwo Naukowe PWN, W-wa, 2022</p> <p>G. I. Sackheim, Wprowadzenie do chemii w zadaniach, Wydawnictwo Naukowe PWN, W-wa, 2021</p> <p>M. Almond, E. Page, M. Spillman, Chemia nieorganiczna, Wydawnictwo Naukowe PWN, W-wa, 2021</p> <p>P. Mastalerz, Elementarna chemia nieorganiczna, Wydawnictwo Chemiczne, Wrocław, 2017</p> <p>Krzysztof M. Pazdro, A. Rola-Noworyta "Akademicki zbiór zadań z chemii ogólnej" Oficyna Edukacyjna K. Pazdro, 2013 r.</p> <p>Chemia ogólna. Ćwiczenia laboratoryjne" red. E. Luboch, M. Bocheńska, J.F. Biernat, Wydawnictwo PG, 2003.</p>	
	Supplementary literature	<p>Z. Hubicki, Ćwiczenia laboratoryjne z chemii nieorganicznej Podręcznik dla studentów ochrony środowiska. Wyd. UMCS, 2010.</p> <p>P.A. Cox, Krótkie wykłady Chemia nieorganiczna, Wydawnictwo Naukowe PWN, W-wa, 2022.</p> <p>J. McMurry, Chemia organiczna, Wydawnictwo Naukowe PWN, W-wa, 2022.</p> <p>A.L. Kowal, M. Świdorska-Bróz, M. Wolska, Oczyszczanie wody, Wydawnictwo Naukowe PWN</p> <p>L. Reczek, T. Siwiec, M. M. Michel, Procesy technologiczne oczyszczania wody i ścieków. Laboratorium. Szkoła Główna Gospodarstwa Wiejskiego SGGW w Warszawie, 2022</p>	
	eResources addresses	Adresy na platformie eNauczanie:	

Example issues/ example questions/ tasks being completed	Calculate the pH of an aqueous solution of acetic acid with a concentration of 0.1 mol/dm ³ . On the basis of the thermochemical equation of the reaction, provide the value of the enthalpy of formation of the product. Indicate which chemical transformations are redox type reactions. Balance the redox equation. Identify the type of chemical bond in the given chemical compounds, explain the relationship between the type of bond and chemical properties. Explain what the rate of chemical reactions depends on.
Work placement	Not applicable