GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00063686		
Field of study	Nanotechnology		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Specialty 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	1	Language of instruction	English
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Physics of Disordered Systems -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Maciej Bobrowski	
	Teachers	dr hab. Maciej Bobrowski dr inż. Marta Prześniak-Welenc Aiswarya Manohar	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	E-learning hours included: 0.0						
	Additional information:						

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	45	5.0	50.0	100

Subject objectives	The goal of this course is to teach general chemistry and connection of this knowledge with synthesis' methods and analysis of nanostructures. An emphasis is laid on an analysis of electronic structure of molecules and prediction of resulting properties and reasons of onsequent behaviour in chemical reactions. A substantial part is dedicated to nanostructures, their syntehis and proprieties, from monoatomic (carbon (graphen, nanotubes, fulerenes), metals(through diatomic (iron oxides) up to more complex.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U02] has enhanced abilities in laboratory work.	Student has knowledge on the OSH: Occupational Safety and Health in chemistry laboratory. Student knows on how to analyze mixture of dissolved cations and anions, qualitatively determining the chemical content of the analyte. Student can do the titration and to determine quantitatively the content of acid/ base samples. Student can predict the course of redox reaction under distinct environment and on this basis -- analyze qualitative and quantitative redox samples. Student can apply knowledge on electrochemical series and on this basis can do experiments with given samples containing redox compounds.	[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 [SU1] Assessment of task fulfilment
[K7_W04] has practical and theoretical knowledge of physical and chemical experimental methods of nanotechnology.	Student has deep knowledge on practical metods of calculations of chemical concentrations, can balance redox reactions, calculate redox potential, identify and explain the direction of redox reaction, determine the strength of acids and bases, can identify and name chemical compounds, orientates in chemical synthesis of nanoparticles and tiny layers as well as in their properties and applications.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_W07] has extended knowledge concerning potential negative biological and ecological effects resulting from using nanostructures and relevant safety rules.	student distinguishes different types of chemical substances, defines the relationship between the chemical composition and the harmfulness of the compound.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents

Introduction, chemical bonds (weak and strong), hybridization, electron configuration, atomic and molecular bonds, reactive oxygene species, concentrations, calculus in chemistry, redox reactions, balancing of redox reactions, electrochemical cells, electrochemical series, Nernst equation, batteries, electrolysis, corrosion, acids and bases, strength of acids and bases,
pH, pOH, titration, oxygenes. Introduction to organic chemistry and biochemistry.

Prerequisites and co-requisites

Fundamentals of chemistry, mathematics and physics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
final exam	51.0%	50.0%
positively reviewed all reports from all laboratories.	51.0%	50.0%

Recommended reading

Basic literature	1. Timberlake, Karen C. Chemistry: An Introduction to General, Organic, and Biological Chemistry, Global Edition, Boston : Pearson. 2015 2. Atkins, P. W. Chemistry: A Very Short Introduction, Oxford : OUP Oxford. 2014 3. General chemistry; principles, patterns, and applications. (http://www.saylor.org/books)
Supplementary literature	1. Robert J. Ouellette and J. David Rawn. Organic Chemistry.Structure, Mechanism, and Synthesis, Elsevier, 2014. 2. Chemistry Dictionary: http://www.chemistry-dictionary.com/definition/d-orbitals.php 3. Dahm, Donald J. Calculations in chemistry: an introduction, New York: Norton, 2013
eResources addresses	Adresy na platformie eNauczanie: Chemistry and Nanochemistry 2024 - Moodle ID: 40232 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=40232

Example issues/ example questions/ tasks being completed	• Covalent bonds: understanding, distinguishing, examples, types of covalent bonds, radical orbitals (singly occupied molecular orbitals (SOMOs)), spin of molecules, types of critical points on energy hypersurface: minimas, saddle points. Reactive oxygene species, energy levels of oxygene molecule's molecular orbitals. • Ionic bonds, differences between ionic bonds and covalent bonds, examples, zwitterions, ionic liquids, application of iuonic liquids. • Coordinate and metallic bonds, -interactions, hydrogen bonds, Van der Waals bonds. Examples os systems, differences, delocalization of electrons. • Concentrations: only problems: (given reactions, concentrations, calculate different concentration, also by using metric prefixes). • Redox reactions: half reactions, disproportionation, basic and acidic media, oxidation states, • Typical oxidizers, reductors, construction of voltaic and electrochemical cells redox reactions occuring there): zinc-copper, cadmium-silver • Redox potentials, galvanic series, standard conditions, directionality of a reaction, construction and chemical reactions of following electrodes: SHE, calomel, silver. • Equilibrium constants, description (charging and discharging redox reactions) of zinc-carbon dry-cell battery, lead-storage battery, lithium-ion batteries. • Acids and bases: Arrhenius definition, Bronsted-Lowry definition, Lewis theory. Ka, Kb, pKa, pKb, pH, pOH. Amphoterism. • Strength of acids and bases. Titration. • Metals: occurence, periodic trends in metallic properties. Metal oxides: acidic, basic, amphoteric, neutral, peroxides, trends in acid-base behaviour. In all cases - the reactions! • Metal oxides nanoparticles' synthesis: Hydrothermal/solvothermal, sol-gel, chemical precipitation, CVD, PVD. Ferrofluids. • Hydrocarbons: saturated, unsaturated. Functional organic groups: alkane, alkene, alkyne, phenyl, amine, alcohol, ether, alkyl halides, thiol, aldehyde, ketone, ester, carboxylic acid, amide. • Nutrients, macromolecules: carbohydrates, lipids, proteins, nucleic acids.
Work placement	Not applicable

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