

GDAŃSK UNIVERSITY OF TECHNOLOGY GY GY SU SU

Subject card

Subject name and code	, PG_00058861								
Field of study	Nanotechnology								
Date of commencement of studies	October 2023		Academic year of realisation of subject			2023/2024			
Education level	second-cycle studies		Subject group			Optional 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 English.			
Semester of study	1		ECTS credits			3.0			
Learning profile	general academic profile		Assessment form		exam				
Conducting unit	Zakład fizyki układów nieuporządkowanych -> Instytut Nanotechnologii i Inżynierii Materiałowej -> 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							
Lesson types and methods	Lesson type	Lecture	Tutorial	Laboratory	Project	t	Seminar	SUM	
of instruction	Number of study hours	30.0	0.0	15.0	0.0		0.0	45	
	E-learning hours included: 0.0								
	Additional information: In-person teaching. When necessary online teaching.								
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		25.0		75	
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	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.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task				
	K7_W04	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.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects				
	K7_W07	student distinguishes different types of chemical substances, defines the relationship between the chemical composition and the harmfulness of the compound.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects				
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, mathem	atics and physics.					
Assessment methods	Subject pageing criteria	Dessing threshold	Dereentage of the final grade				
and criteria	final exam	51.0%	50.0%				
	positively reviewed all reports from all laboratories.	51.0%	50.0%				
Recommended reading	Basic literature	 Timberlake, Karen C. Chemistry: An Introduction to General, Organic, and Biological Chemistry, Global Edition, Boston : Pearson. 2015 Atkins, P. W. Chemistry: A Very Short Introduction, Oxford : OUP Oxford. 2014 General chemistry; principles, patterns, and applications. (http:// www.saylor.org/books) 					
	Supplementary literature	 Robert J. Ouellette and J. David Rawn. Organic Chemistry.Structure, Mechanism, and Synthesis, Elsevier, 2014. Chemistry Dictionary: http://www.chemistry-dictionary.com/ definition/d-orbitals.php Dahm, Donald J. Calculations in chemistry: an introduction, New York: Norton, 2013 					
	eResources addresses	Adresy na platformie eNauczanie: Chemistry and Nanochemistry 2023 - Moodle ID: 32799 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32799					

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,
	 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