

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Podstawy Chemii Nieorganicznej
 Name of subject in English: Fundamentals of Inorganic Chemistry
 Main field of study (if applicable): all specializations of Faculty of Chemistry
 Specialization (if applicable):
 Profile: academic
 Level and form of studies: 1st level, full-time
 Kind of subject: obligatory
 Subject code
 Group of courses NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30	30		
Number of hours of total student workload (CNPS)	90	60	60		
Form of crediting	Examination	crediting with grade	crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	3	2	2		
including number of ECTS points for practical (P) classes		2	2		
including number of ECTS points for direct teacher-student contact (BU) classes	1,3	1,4	1,4		

***PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of general chemistry
2. Skills in the field of balancing chemical equations, making stoichiometric calculations, applications of the law of masses action and rules of defiance

SUBJECT OBJECTIVES

- C1. Understanding the basic aspects of equilibria in electrolyte solutions and the theory of acids and bases (solvent, Brønsted - Löwry, Lewis, Pearson)
- C2. Understanding the elements of electrochemistry, properties of precious and non-precious metals, mastering the knowledge about cells and batteries, learning about electrolysis laws and issues related to electrochemical corrosion
- C3. Understanding the basic aspects of symmetry in chemistry and solid structure
- C4. Poznanie pojęć chemii koordynacyjnej, nomenklatury związków kompleksowych, teorii pola ligandów, właściwości spektroskopowych i magnetycznych kompleksów pierwiastków przejściowych, izomerii związków kompleksowych
- C5. Getting the knowledge of the elements of the technology of obtaining selected metals
- C6. The ability to situate elements in the Periodic Table and determine their most important chemical properties: electronegativity, oxidation states, the type of chemical bonds in selected compounds and prediction of the properties of these compounds
- C7. Mastering simple principles and / or advanced calculations in the field of equilibria in aqueous electrolyte solutions
- C8. Acquainting with the rules of health and safety and using laboratory equipment (measuring glass, analytical balance, ultracentrifuge, pH meter) and performing experiments in the field of inorganic chemistry

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEK_W01 - knows the rules governing equilibria in electrolyte solutions and modern theories of acids and bases

PEK_W02 - has basic knowledge in the field of electrochemistry, knows the laws of electrolysis and has knowledge about electrochemical corrosion

PEK_W03 - has knowledge about elements and operations of point symmetry and can indicate elements of symmetry of simple molecules or ions

PEK_W04 – has basic knowledge about the structure of a solid body, including the structure of crystals, types of crystal lattices and elementary cells, knows the notion of isomorphism and polymorphism and has knowledge about defects occurring in the crystal lattice

PEK_W05 - knows the basics of solid-state band theory and its application to explain the properties of conductors, semiconductors and insulators, can distinguish between intrinsic semiconductors and n-type doped semiconductors

PEK_W06 - has basic knowledge about the structure of a solid body, including the structure of crystals, types of crystal lattices and elementary cells, knows the notion of isomorphism and polymorphism and has knowledge about defects occurring in the crystal lattice

PEK_W07 - ma podstawową wiedzę o pirometalurgii, hydrometalurgii i biometalurgii stosowanych w technologiach najważniejszych metali użytecznych

PEK_W08 - has a basic knowledge of the properties of the compounds of elements s and p block depending on their electronegativity and position in the Periodic Table

PEK_W09 - has a basic knowledge of the properties of the compounds of elements d and f

relating to skills:

PEK_U01 - can practically use the Periodic Table of elements

PEK_U02 - can write metal dissolution reactions in acids, bases and solutions of complexing agents

PEK_U03 – is able to perform pH calculations in solutions of weak and strong electrolytes, buffer solutions, salt solutions derived from weak electrolytes and calculate the solubility of poorly water-soluble compounds and solutions of common ion electrolytes

PEK_U04 – knows the health and safety rules in force at the laboratory and mastered the basics of laboratory technology

PEK_U05 – knows how to perform simple chemical experiments (preparing solutions, precipitating sediments, performing various chemical reactions), interpreting obtained results and formulating conclusions

PEK_U06 - knows how to use elementary laboratory equipment (BALANCE, centrifuge, pH meter)

PROGRAMME CONTENT

Lectures		Number of hours
Lec 1	Balance in aqueous and non-aqueous electrolyte solutions. Acids and principles. Electrolytes, polar solvents. Ionic strength, activity, activity coefficient. Effect of strong electrolytes on dissociation of weak electrolytes, dissociation of multi-proton acids: e.g. sulfuric acid (VI), phosphoric acid (V), hydrogen sulfonic acid. Properties of aqueous solutions: diffusion, osmosis and osmotic pressure, cryoscopic and ebullioscopic effects. Acids and principles in terms of the theory: Brönsted and Lowry, Lewis, soft and hard acids and bases. Superacids. Molten salts. Gibbs phase rule, phase diagram of water, supercritical fluids (e.g. carbon dioxide).	4
Lec 2	Electrochemistry Definition of half-cells (electrodes), Nernst equation. A series of voltage red-ox circuits. Definition of a cell, SEM cells, useful cells (including fuel cells). Corrosion (on the example of iron) and ways to prevent it. Electrolysis, electrolysis products, electrolysis law.	3

Lec 3	Symmetry in chemistry The concept of symmetry, elements and operations of symmetry. Symmetry of simple molecules such as: BF_3 , CCl_4 , H_2O , NH_3 , and SF_6 .	2
Lec 4	The structure of a solid body Isotropic and anisotropic bodies. Liquid crystals. Spatial network and elementary cell of a crystal. Metallic networks type A1, A2 and A3. Ionic networks (NaCl , CsCl , CaF_2 , $\alpha\text{-ZnS}$). Covalent networks (diamond). Molecular networks (CO_2). List of network types. Isomorphism and polymorphism. Crystal lattice defects - Schottky and Frenkel defects, colored centers, dislocations. Crystal structure research, X-ray analysis, Bragg equation, rotating crystal method and powder method.	5
Lec 5	Band theory of a solid The formation of energy bands in solid bodies. Conductors, semiconductors, insulators. Intrinsic and dopant semiconductors type n and p.	2
Lec 6	Complex compounds Basic concepts. Nomenclature of complex compounds. Isomerism of complex compounds. Equilibrium in aqueous solutions of complex compounds. Theory of the crystalline field in coordination chemistry.	4
Lec 7	Metals Methods of obtaining metals: pyro-, hydro- and biometallurgy. Metal dissolution in acids, bases and salts. Alloys and composite materials.	2
Lec 8	Overview of basic classes of compounds of the elements of blocks s and p depending on their electronegativity and position in the periodic table. Hydrides. Oxides. Hydroxides and acids. Acid-base properties, amphotericity. Salts: nitrates, sulphates, chlorides, phosphates, sulphides. Complexing abilities of elements of block s and p.	3
Lec 9	Overview of the basic classes of metal compounds of blocks d and f of periodic table Ionic forms in aqueous solutions: aquacomplex cations, oxocations and oxo-anions, anions of iso- and heteropolyacids. Oxides, nitrides, carbides, borides, phosphides. Carbonyls. Chloride, cyanide and nitrosyl complexes. Lower halides, clusters with a direct metal-to-metal bond. Complexes with hydrocarbons.	3
Lec 10	Calculation problems and tasks Stoichiometry in systems with a simple and oxidation-reduction reaction. Electrochemistry. Equilibrium in aqueous solutions of electrolytes. Equilibrium in solutions of complex compounds.	2
	Total hours	30
Classes		Number of hours
Cl 1	Rules for conducting and passing exercises. Calculation of pH and pOH in solutions of strong acids and bases. The ionic product of water. Ionic strength, activity and activity coefficient. Constant and degree of electrolytic dissociation.	2
Cl 2	Dissociation of weak electrolytes in solutions with constant ionic strength. Ostwald's dilution law. Mixing solutions of weak acids or weak bases. Calculation of pH and degree of dissociation.	4
Cl 3	Dissociation of weak acids in the presence of strong acids and weak bases in the presence of strong bases. Limit dilution of strong acids and bases.	2
Cl 4	Dissociation of polybasic acids	2
Cl 5	Dissociation of weak acids and bases in the presence of their salts. Reactions of	4

	formation and properties of buffer solutions.	
Cl6	Adding strong acids or bases to buffer solutions	2
Cl 7	Ion equilibrium in salt solutions derived from weak acids and weak bases. Hydrolysis of NH_4Cl , CH_3COONa , Na_2CO_3 salts.	4
Cl 8	Mixing of solutions: a weak acid and a strong base or a strong acid and a weak base. Addition of a strong acid to a salt derived from a weak acid or strong bases to salts derived from weak bases. Stoichiometry, determination of the solution composition after the reaction, pH calculation.	2
Cl 9	Solubility product. Precipitation and dissolution of sediments of sparingly soluble substances. Solubility of sparingly soluble substances in solutions containing common ions with sediment.	4
Cl 10	Ion equilibria in aqueous solutions of complex compounds	2
	Total hours	30
Laboratory		Number of hours
Lab 1	Organizational exercises Laboratory regulations, health and safety regulations, pass rules, laboratory glass show.	2
Lab 2	Chemical reactions and their classification	2
Lab 3	Chemical reactions of oxidation and reduction	2
Lab 4	Chemical and electrochemical activity of metals	2
Lab 5	The rate of chemical reactions	2
Lab 6	Determination of the reaction rate constant	2
Lab 7	Chemical equilibrium	2
Lab 8	The equilibrium in aqueous solutions of electrolytes	2
Lab 9	Determination of the dissociation constant of weak electrolyte	2
Lab 10	Buffer solutions	2
Lab 11	Complex compounds	2
Lab 12	Insoluble substances	2
Lab 13	Basic laboratory activities in analytical chemistry	2
Lab 14	Fundamentals of qualitative analysis in inorganic chemistry	2
Lab 15	Colloq	2
	Total hours	30
TEACHING TOOLS USED		
N1. Lecture with multimedia presentation. N2. Solving tasks N3. Instructions with theoretical introduction and description of performed experiments N4. Execution of experiments N5. Preparation of the report		
EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
P1 (lecture)	PEK_W01– PEK_W010	Exam

F1 (clases)	PEK_U01 – PEK_U04	Partial colloq I (max. 16 points)
F2 (clases)	PEK_U05 – PEK_U09	Partial colloq II (max. 24 points)
F3 (laboratory)	PEK_U01 – PEK_U06	10 short quizzes (max. 10 × 10 points; min. 50 points)
F4 (laboratory)	PEK_U01 – PEK_U06	5 reports (max. 5 × 5 points, min. 15 points)
P2 (clases) = 3,0 if (F1 + F2) = 20,0 – 24,0 3,5 if (F1 + F2) = 24,5 – 28,5 4,0 if (F1 + F2) = 29,0 – 32,5 4,5 if (F1 + F2) = 33,0 – 36,5 5,0 if (F1 + F2) = 37,0 – 39,5 5,5 if (F1 + F2) = 40,0		
P3 (laboratory) = 3,0 if (F3 + F4) = 65 - 77 = 3,5 if (F3 + F4) = 78 - 89 = 4,0 if (F3 + F4) = 90 - 100 = 4,5 if (F3 + F4) = 101 - 110 = 5,0 if (F3 + F4) = 111 - 124 = 5,5 if (F3 + F4) = 125		
PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE:</u>		
[1] [1] A. Bielański, Podstawy Chemii Nieorganicznej, Wyd. VI, PWN Warszawa, 2010 lub wyd. V, PWN Warszawa, 2006. [2] P.A. Cox, Chemia Nieorganiczna, Krótkie Wykłady, PWN Warszawa, 2006. [3] S.F.A. Kettle, Fizyczna Chemia Nieorganiczna, PWN Warszawa, 1999. [4] A.F. Cotton, G. Wilkinson, P.L. Gaus, Chemia Nieorganiczna. Podstawy, PWN Warszawa, 2002. [5] Praca zbiorowa, Obliczenia w chemii nieorganicznej, Wyd. PWr., 2002 [6] Instrukcje do ćwiczeń laboratoryjnych - www.alchemik.pwr.wroc.pl		
<u>SECONDARY LITERATURE:</u>		
[1] [1] Chemia Nieorganiczna, cz. I i II praca zbiorowa pod redakcją Lothara Kolditza, PWN Warszawa, 1994. [2] S. Siekierski, J. Burgess, Concise Chemistry of the Elements, Horwood Publ. Ltd., Chichester, 2002. [3] A. Bartecki, Chemia pierwiastków przejściowych, Oficyna Wyd. PWr, 1996.		
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