COURSE DESCRIPTION CARD - SYLLABUS

Course name
General and inorganic chemistry [S1IFar1>COiN1]

Course

Field of study
Pharmaceutical Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

6,00

Coordinators

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Lecturers

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Prerequisites

Knowledge: Student: W1) Has theoretical knowledge at high school level in the field of general and inorganic chemistry, in particular: knows the basic laws, concepts and chemical quantities as well as the names and symbols of chemical elements W2) Has knowledge at high school level in the field of physics and, in particular, knows the basics of the structure of matter and identifies the components of the atomic nucleus and atom W3) Has knowledge at high school level in mathematics, especially regarding proportions and using them in simple calculations Skills: Student: U1) Writes summary formulas for simple inorganic compounds U2) Writes simple chemical reactions involving inorganic reagents U3) Performs basic chemical calculations and, in particular, can calculate and recalculate the percentage and molar concentrations of solutions; can make other calculations based on the skill of stacking proportions (percentage composition of chemical compound, purity and degree of reacting substrates, yield of reaction products) Social competences: Student: K1) Is determined to acquire knowledge in chemistry as an exact subject being the basis for thorough education in many engineering professions K2) Demonstrates interest in how to implement useful chemical processes on an industrial scale

Course objective

Showing chemistry as a science in constant, dynamic development. Reminding and organizing computational problems in the scope of solution concentration and stoichiometry as well as kinetics and thermodynamics of chemical reactions. Expanding the knowledge of general and inorganic chemistry and its systematization based on the types of reactions, transformations and chemical equilibria as well as the law of periodicity. Showing the relationship between the properties of compounds and the type of chemical bonds in their molecules. Acquisition of knowledge and practical skills related to work in a chemical laboratory. Acquainting with the principles of safe work in the laboratory. Acquainting with the organization of laboratory work and the basic techniques of work used in a chemical laboratory.

Course-related learning outcomes

Knowledge:
1. student has extended knowledge regarding the structure of matter; identifies the components of matter and characterizes the interactions between them; knows the structure of atoms and the genesis of their creation; defines and explains the laws governing the interaction of matter components at both the nuclear and atomic levels (k_w03, k_w04)
2. indicates the properties of elements resulting from the electronic configuration of their atoms and their position in the periodic table and, in particular, knows and explains the relationship between the electronic configuration of atoms and the reactivity of elements (k_w04)
3. knows the principles of health and safety at work in a chemical laboratory and, in particular, the principle of maintaining order in the workplace; knows the basic principles of first aid in the event of accidents and incidents (k_w27)
4. lists and characterizes the basic techniques of laboratory work (k_w04, k_w21)
5. knows how to plan and carry out a simple chemical experiment and how to analyze, develop and describe its results (k_w04)

Skills:
1. student analyzes and interprets the content of computational tasks and performs chemical calculations (mainly in the field of concentration conversion, stoichiometry and basics of thermodynamics of chemical reactions) (k_u02)
2. uses the periodic table of elements and is able to use it as a basic source of information about the physicochemical properties of elements and their compounds (k_u02)
3. uses the current nomenclature of inorganic compounds and is especially able to combine the correct name of the compound with its correct summary (stoichiometric) formula, which can correctly write, and on this basis prepare its structural formula (k_u03)
4. writes and correctly balances chemical reactions between inorganic reagents (also with the participation of simple organic compounds); predicts the direction of any type of chemical reactions (including oxidation and reduction reactions) and is able to quantify the steady state of the reaction (can calculate the equilibrium constant of a chemical reaction) (k_u02)
5. can organize his own work in a chemical laboratory; correctly applies laboratory work techniques; correctly uses laboratory equipment and correctly interprets the results obtained; practically implements the principles of safe work in a chemical laboratory (k_u12, k_u22, k_u24)

Social competences:
1. the student is aware of the continuous, rapid increase in knowledge in the field of inorganic chemistry and, as a result - the level of his knowledge in this field, which causes him to further study and assimilate new knowledge on his own initiative, with determination and an active attitude (k_k01)
2. is aware that knowledge regarding inorganic chemistry is widely used in industry and the economy; understands and reckons with the necessity of practical use of acquired knowledge and skills in the future; is aware of the responsibility associated with this (k_k01, k_k03)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture: the final verification of the learning outcomes is done in a form of a stationary or remote test (depending on the method of conducting classes). The test may contain approximately 40-50 questions, open and closed. The threshold of pass the exam: 50% of the total points. Based on the number of points obtained, the final grade is issued, according to the rating scale in force at Poznan University of

Technology.
Laboratory: the teacher regularly controls the theoretical preparation of students for the implementation of the laboratory exercise plan. The check is carried out by oral questioning and/or in the form of written tests. The teacher observes and assesses the behavior of students in the laboratory, including the ability to organize laboratory work and manual skills during the performance of the exercises planned. Written reports on performed exercises are subject to evaluation. The final grade from laboratory classes is the outcome of the above three components - it is evaluated according to the scale of grades in force at Poznan University of Technology. If the classes are conducted remotely, then as part of the report, the tutor gives students additional problems for solving, relating to the issues of laboratory practice, assessing the manner of their description and interpretation.

Programme content

1. Chemical calculations. Different types of concentrations. Percent concentration. The mole concept and molar concentration. Equivalent weight and normal concentration. Conversion of concentrations. Stoichiometric calculations
2. Structure of matter. Big bang. Nucleons and primary nucleosynthesis. Isotopes. Chemical processes in stars. Artificial nuclear reactions. Distribution of elements in the Universe. Atom. Quantum numbers. Electron configurations of elements. Periodic table and periodicity of physicochemical properties of elements
3.Chemical bonds. Electronegativity. Ionic bond - the Haber-Born cycle. Atomic bond - Lewis structures. The dipole moment - the polarization of the atomic bond. Coordination-covalent bond. Metallic bond. Van der Waals forces. Hydrogen bond. Chemical bonds and properties of compounds
4. Thermodynamics and kinetics of reactions. Thermal effect of reaction. Entropy and enthalpy. Gibbs energy. The influence of temperature and pressure on the reaction equilibrium. Properties of gases and their mixtures. Thermodynamics of liquids, chemical potential, solutions of nonelectrolytes, gas-liquid and liquid-solid equilibria (phase diagrams). Thermodynamics of a solid. Kinetics of chemical reactions. 1st and 2nd order reactions, single- and two-molecule reactions. Activated complex theory, equations of Arrhenius and Eyring. Reversible, parallel and consecutive reactions. Chain reactions. Combustion and explosive reactions. Photochemical reactions. Hetero- and homogeneous catalysis - catalysts
5. Acids and bases. Electrolytic dissociation. Strong and weak electrolytes. Concentration and activity - activity coefficients. Theories of acids and bases. The power of acids and bases. The ionic product of water and the pH scale. Buffer solutions. Ampholytes. Acid-base titration. The pH of aqueous solutions of acids, bases and salts. Hydrolysis. pH measurement
6. Sediments. Compounds structure and their solubility. The solubility product constant. Solubility. Factors affecting solubulity - the effect of a common ion; the salt effect and complexation. Influence of pH on dissolution and selective precipitation of substances. Water hardness - hardness removal
7. The complexes (coordination compounds). Structure. Gradual complex formation - charge inversion. Equilibria in solutions of complexes. Influence of pH on complexation reactions. Sediment solubility and complex formation. Aquacomplexes - metal cations as acids. Hydroxocomplexes - amphotericity of hydroxides
8. Oxidation and reduction reactions. Basic concepts. Half-reactions, redox reaction equilibrium constant, Nernst equation, redox system normal potential, redox reaction balancing. Influence of pH on redox reactions. Potential-pH graphs (Pourbaix diagrams). Determining the reaction direction based on the potential-pH graphs. Range of thermodynamic water stability. Strong oxidizers and reducing agents in aqueous solutions. Chemical properties of iron (potential-pH graph). Iron corrosion
A set of laboratory exercises performed:
1. Verification of the accuracy of laboratory pipettes
2. pH scale
3. Acid-base reactions
4. The pH of aqueous solutions of salts
5. Buffer solutions
6. Complexing reactions (gradual of coordination complexes formation, buffer solution of the coordination complex; properties of coordination complexes: coordination complexes and acidity, stability of coordination complexes)
7. Oxidation and reduction reactions (reduction with metals, hydrogen ion as an oxidant, power of oxidants and reducers, the effect of temperature on the redox reaction; effect of pH on redox reactions, disproportionation reactions)
8. Separation by precipitation
9. Separation by extraction

Teaching methods

Lecture: based on multimedia presentations containing relevant examples; as a complement, additional examples with explanations, resulting from the current interest of the students.
Laboratory: Classes are practical - in accordance with the attached instructions, the students themselves doing exercises included in the course plan. The teacher personally shows and explains how to perform the activities and operations that students meet for the first time. The teacher constantly controls the student"s behavior in the laboratory and the way of performing his work themselves. He immediately notices and corrects irregularities. Students are required to keep notes on the basis of which they prepare reports on laboratory exercises. In the case of conducting laboratory classes remotely, it is of particular importance to present students" videos on the issues of laboratory practice and discuss them in detail.

Bibliography

Basic
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Additional
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2. F.A. Cotton, G. Wilkinson, C. Murillo, M. Bochmann, Chemia nieorganiczna. Podstawy, PWN, Warszawa 1995
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Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	75	3,00