COURSE DESCRIPTION CARD - SYLLABUS

Course name
General and inorganic chemistry [S1IChiP1>COiN2]

Course

Field of study
Chemical and Process Engineering

Year/Semester
1/2

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
15

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr hab. inż. Grzegorz Milczarek prof. PP
grzegorz.milczarek@put.poznan.pl

Lecturers

dr hab. inż. Magdalena Frańska
magdalena.franska@put.poznan.pl

dr hab. inż. Grzegorz Milczarek prof. PP
grzegorz.milczarek@put.poznan.pl

Olga Stężycka
olga.stezycka@doctorate.put.poznan.pl

Prerequisites

Knowledge: The student has the knowledge resulting from passing the course of General and Inorganic Chemistry in the first semester, in particular: 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 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 3. Lists reactions involving inorganic compounds of great practical industrial importance. Describes, explains and characterizes their chemistry (course and associated effects) 4. Lists and generally characterizes the basic types of inorganic construction materials and indicates their general applications Skills: The student has the skills resulting from passing the course of General and Inorganic Chemistry in the first semester, in particular: 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) 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 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 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) Social competences: The student has the social competences resulting from passing the course of General and Inorganic Chemistry in the first semester, in particular: 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 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

Course objective

The arrangement of knowledge in the field of general and inorganic chemistry and expanding it with knowledge about the production, properties and applications of inorganic construction materials, and with knowledge and practical skills related to work in a chemical laboratory. Acquaintaning with the principles of safe work in the laboratory. Acquaintaning with the organization of laboratory work and the basic techniques of work used in the chemical laboratory. Teaching the correct interpretation of the experimental results

Course-related learning outcomes

Knowledge:
1. has solid theoretical knowledge in the field of inorganic and general chemistry and, in particular, describes the structure of matter at the nuclear, atomic and molecular level; identifies the properties of elements and their compounds, explaining them in connection with the place of the element in the periodic table (k_w03)
2. lists and characterizes inorganic construction materials from the point of view of their applications, physicochemical properties and production technology (k_w05)
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_w18)
4. lists and characterizes the basic techniques of laboratory work (k_w11)
5. knows how to plan and carry out a simple chemical experiment and how to analyze, develop and describe its results (k_w15)

Skills:
1. has well-established skills in the field of chemical calculations, using the periodic table of elements, notation of summary and structural formulas of chemical compounds as well as writing and balancing of any type of chemical reactions involving inorganic compounds (k_u01)
2. is able to analyze and solve typical chemical problems based on knowledge from various sources, including knowledge sought independently; knows how to compare knowledge from different sources (k_u01)
3. can organize his own work in a chemical laboratory; correctly applies laboratory work techniques; correctly uses laboratory equipment and correctly interprets the results obtained (k_u18, k_u19)
4. is able to select the appropriate construction material based on his own knowledge, knowing the physicochemical conditions in which the element or device made of it will be used (k_u01, k_u07)
5. practically implements the principles of safe work in a chemical laboratory (k_u12)

Social competences:
1. perceives the relationship between own safety as well as the safety of others working in a chemical laboratory and the compliance with the regulations which apply in a chemical laboratory; develops a habit of maintaining order in the workplace (k_k03)
2. is aware of the threat to the natural environment from some commonly used, inorganic chemical

compounds; understands the need for action to minimize these harmful effects (k_k02, k_k06)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture: the final exam is carried out in the form of a stationary or remote test (depending on the method of conducting classes). The test may contain approximately 20-30 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

Lecture:
1. Iron-based construction materials. Iron and his alloys. Classification of iron alloys. Iron alloys and their composition, structure and properties. A major steel and cast iron grades. Production of pig iron - blast furnace raw materials, blast furnace process and its operating parameters, chemism and products. Steel production - basic processes and reactions taking place. Production of cast iron and ferroalloys
2. Aluminum-based construction materials. Aluminum and its alloys. The role of aluminum in technics. Aluminum ores - bauxites and alumina as raw materials for the electrolytic production of aluminum. Methods for obtaining aluminum - wet Bayer alkaline method, dry alkaline method, electrolysis of molten alumina. Aluminum refining. Electrothermal issues of silicon-aluminum alloys
3. Other non-ferrous metals and their metallurgy. Zinc ores. Obtaining metallic zinc - pyrometallurgical, electrochemical and hydroelectrometallurgical methods. Cadmium metallurgy. Lead ores. Obtaining metallic lead - roasting and reduction method, roasting and reaction method. Raw lead refining. Copper metallurgy. Copper ores - hydrometallurgical processes. Silver and nickel metallurgy. Magnesium metallurgy. The role of magnesium in technics. Raw materials and magnesium ore. Electrolysis of molten magnesium chloride. Carbothermic and silicothermic magnesium production. Obtaining rare earths metals. Powder metallurgy
4. Ceramic materials. Raw materials for brick, faience, stoneware, porcelain and refractory products (chamotteous and magnesiteous). Basics of drying and firing ceramic materials
5. Glass. Physicochemical properties of glass. Glassmaking raw materials. Fundamentals of glass production technology. Technical applications of glass
A set of laboratory exercises performed:
1. pH scale
2. Acid-base reactions
3. The pH of aqueous solutions of salts
4. Buffer solutions
5. Complexing reactions I (gradual of coordination complexes formation, buffer solution of the coordination complex)
6. Complexing reactions II (properties of coordination complexes: coordination complexes and acidity, stability of coordination complexes)
7. Oxidation and reduction reactions I (reduction with metals, hydrogen ion as an oxidant, power of oxidants and reducers, the effect of temperature on the redox reaction)
8. Oxidation and reduction reactions II (effect of pH on redox reactions, disproportionation reactions)
9. Separation by precipitation
10. Separation by extraction
11. Verification of the accuracy of laboratory pipettes
12. Qualitative analysis of cations (division of cations according to Fresenius into five analytical groups; practically students perform characteristic reactions and then analysis of selected cations: Cu2+, Al3+, Ni2+, Zn2+, Mn2+, Fe3+, Cr3+, Ca2+, Sr2+, Ba2+, Mg2+, K+, NH4+)

13. Qualitative analysis of anions (division of anions according to Alexeyev into three analytical groups; practically students perform characteristic reactions and then analysis of selected anions: SO42-, PO43-, CO32-, C2O42-, S2O32-, F-, Cl-, I-, SCN-, NO2-, NO3-, CH3COO-)

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, they consist in the students themselves doing exercises included in the course plan. Exercises are performed in accordance with the attached instructions. 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
1. M. Saternus, A. Fornalczyk, J. Dankmeyer-Łączny, Chemia ogólna dla metalurgów, Wydawnictwo Politechniki Śląskiej, Gliwice 2011
2. Praca zbiorowa (red. W. Bobrownicki), Technologia chemiczna nieorganiczna, WNT, W-wa 1965
3. B. Jeżowska-Trzebiatowska, S. Kopacz, T. Mikulski, Pierwiastki rzadkie. Część 1, Występowanie i technologia, PWN, Warszawa-Wrocław 1976
4. A. Bielański, Podstawy chemii nieorganicznej, t.1-3, PWN, Warszawa 2005
5. F. Domka, J. Jasiczak, Analiza jakościowa, Wydawnictwo AE, Poznań 2004
6. L. Jones, P. Atkins, Chemia ogólna. Cząsteczki, materia, reakcje, tom 1 i 2, PWN, Warszawa 2009
7. L. Kolditz, Chemia nieorganiczna, PWN, Warszawa 1994
8. J.D. Lee, Zwięzła chemia nieorganiczna, PWN, Warszawa 1999
9. K. M. Pazdro, Zbiór zadań z chemii, Oficyna Edukacyjna 2007
Additional
1. J. Drzymała, Podstawy mineralurgii, Oficyna Wydawnicza Politechniki Wrocławskiej 2001
2. A. Ciszewski, M. Baraniak, Aktywność chemiczna i elektrochemiczna pierwiastków w środowisku wody, Wydawnictwo PP, Poznań 2006
3. F.A. Cotton, G. Wilkinson, C. Murillo, M. Bochmann, Chemia nieorganiczna. Podstawy, PWN, Warszawa 1995
4. G. Charlot, Analiza nieorganiczna jakościowa, PWN, Warszawa 1976
5. M.J. Sienko, R.A. Plane, Chemia. Podstawy i zastosowania, WNT, Warszawa 2002
6. W. Ufnalski, Podstawy obliczeń chemicznych z programami komputerowymi, WNT, W-wa 1999

Breakdown of average student's workload

	Hours	ECTS
Total workload	87	3,00
Classes requiring direct contact with the teacher	51	1,80
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	36	1,20