COURSE DESCRIPTION CARD - SYLLABUS

Course name
Inorganic chemistry with basics of the technology of rare elements

Course

Field of study
Environmental Protection Technologies
Year/Semester
III/6
Area of study (specialization)
-
Profile of study
general academic
Level of study
First-cycle studies
Course offered in
polish
Form of study
full-time
Requirements
elective

Number of hours

Lecture
30
Laboratory classes
0
Other (e.g. online)
0
Tutorials
0
Projects/seminars
0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr eng. Andrzej Szymański

e-mail: Andrzej.Szymanski@put.poznan.pl

Faculty of Chemical Technology

street: Berdychowo 4, 60-965 Poznań

phone: (61) 665 2806

Responsible for the course/lecturer:

Prerequisites

The student has the knowledge, skills and social competences resulting from passing previous semesters of the field of study Environmental Protection Technologies, in particular the subjects: General and Inorganic Chemistry (1st and 2nd sem.), Geochemistry (3rd sem.), Fundamentals of Chemical and Process Engineering (4 sem.), Chemical technology (5 sem.) and Fundamentals of electrochemical technology (5 sem.), among others:

Knowledge:

W1) Has extended knowledge of the structure of matter; identifies the components of matter and characterizes the interactions between them; knows that the physicochemical properties of elements (including reactivity) result of the electron configuration of their atoms and their position in the periodic table

W2) Knows the basics of geochemistry, especially issues related to rock formation processes

W3) Has general knowledge about basic unit operations and the possibilities of their use on both laboratory and industrial scale

W4) Knows the rules and principles of sustainable development in relation to industrial production in the chemical and related industries

Skills:

U1) Is able to use the periodic table of elements as the basic source of information about the physicochemical properties of elements and their compounds; predicts the direction of any type of chemical reactions, writes them and balances correctly

U2) Calculates correctly the energy effect of a chemical reaction based on the functions of the state of substrates and reaction products

U3) Can indicate examples of specific industrial applications of basic unit processes

Social competences:

K1) Is aware of the continuous, rapid expansion of knowledge in the field of inorganic chemistry, geochemistry and technological solutions in the chemical and related industries, and against this background - the level of his knowledge in this field, which causes his determination and active attitude in further study and assimilation new knowledge on his own initiative

K2) Is aware that knowledge on chemical subjects (including inorganic chemistry) is widely used in the chemical and related industries; understands in this connection and reckons with the necessity of practical use of acquired knowledge and skills in the future; is aware of the responsibility associated with this

K3) Understands the need and has a habit of continuous learning and raising their knowledge and qualifications

Course objective

Acquiring by the students the knowledge about mineral natural raw materials used in technologies of rare element production, methods of their initial preparation for further processing as well as about the properties and applications of final products obtained. Particular emphasis will be placed on

familiarizing students with industrial chemical methods of enriching ores and concentrates of metallic rare elements. To familiarize students with the negative effects of the mineral industry of rare elements on the environment and how to mitigate the negative effects of this impact

Course-related learning outcomes

Knowledge

1. The student knows the types and the genesis (geological and geochemical conditions) of the formation of rare element deposits and has general knowledge about their distribution on a global scale (K_W06, K_W07)

2. Has knowledge of the properties and applications of rare elements and on technologies used for their production on an industrial scale using natural mineral resources (K_W06, K_W07)

3. Knows the unit operations used in the processing of mineral resources (in the mineral industry) and the general principles of their selection (K_W10)

4. Knows the development trends of the mineral industry of rare elements and connected with them problems of raw materials (K_W11)

5. Has knowledge of the impact of the mineral industry on the environment and knows how to protect the environment against the negative effects of this impact (K_W14)

Skills

1. Is able to assess in terms of the technological usefulness the unit operations used in the processing of rare element minerals (K_U16, K_U18)

2. Is able to select enrichment processes (especially chemical enrichment) for a specific type of raw materials (concentrates) of rare elements and a specific technological system (K_U16, K_U18)

3. Is able to indicate the main factors of harmful effects on the environment, related to the specific type of mineral being processed and the processing technologies selected for this purpose (K_U15, K_U16)

Social competences

1. The Student is able to disseminate and popularize the latest technological solutions in the mineral industry of rare elements (K_K07)

2. Is aware of the need to enrich mineral resources as part of pro-ecological activities that support sustainable development (K_K02, K_K04, K_K05)

3. Understands the need for an appropriate approach to the processing operations of a particular mineral, which taking into account not only engineering, technological and economic aspects of the project, but also socio-environmental (K_K02, K_K04)

4. Is aware of the impact of engineering activities carried out under the processing of mineral resources obtained from the earth's crust (including mining operations) on the quality of the environment (K_K02)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The form of the final verification of learning outcomes/obtaining a grade in the subject, is chosen by students during the first class in the semester. The two options to choose from are: independent preparation of an extensive paper on a topic given by the teacher (a different topic for each student) or a final test, consisting of 20-40 closed and open (problem) questions of varying difficulty (variously scored) - threshold for passing: 50% of the total number of points. The final grade for the subject will be the grade for the prepared paper, or the grade for the final test, issued on the basis of the number of points obtained. The grades are issued using the grading scale in force at the Poznań University of Technology. Depending on the form of conducting the classes, the test will be carried out remotely or stationary.

Programme content

1. Introduction to geology of chemical elements: geochemical classification, isomorphic affinity and dispersion of elements; general systematics and characteristics of useful mineral deposits; minerals and ores; economic evaluation of mineral deposits; technological classifications of rare elements

2. Basics of mechanical enrichment of ores and minerals; overview of the most important methods of mechanical enrichment

3. Basics of chemical enrichment of ores and minerals: flotation - flotation factors and their applica-tion; flotation regulators; foaming agents in the flotation process; ion and foam flotation and new flotation methods; enrichment and production of metals by amalgamation; amalgamation hydrome-tallurgy; high temperature amalgamation metallurgy

4. The use of chlorine in the processing of ores of rare metals: chlorinating agents and their use; mechanism of chlorination reaction with the use of metal chlorides; chlorination of compounds with the metal present in several oxidation states; production of chlorides of rare metals

5. Separation of rare metals from solution: basics of the extractive equilibria; review of the most technologically important extraction systems; extraction in hydrometallurgy; adsorption processes; cementation; hydrometallurgical processing of ores and concentrates; separation of metals from solution by reduction with hydrogen

6. Production of selected rare elements - the chemistry and technological bases of the used pro-cesses: copper, cadmium, mercury, titanium, vanadium, molybdenum, tungsten, cobalt, nickel, lithium, beryllium, gallium, boron, germanium; technology of production of precious metals

Teaching methods

The lecture based on multimedia presentations containing relevant examples; as a supplement, additional examples with explanations, resulting from the current interest of students during the discussion at the lecture.

Bibliography

Basic

1. A. Polański, Geochemia i surowce mineralne. Wyd. Geol. Warszawa 1988

2. J. Drzymała, Podstawy mineralurgii, Oficyna Wydawnicza Politechniki Wrocławskiej 2001

3. J. Marciniak-Kowalska, E. Konopka, Wzbogacanie chemiczne kopalin, skrypt AGH, Kraków 1982

4. B. Jeżowska-Trzebiatowska, S. Kopacz, T. Mikulski, Pierwiastki rzadkie. Część 1, Występowanie i technologia, PWN, Warszawa-Wrocław 1976

5. M. Saternus, A. Fornalczyk, J. Dankmeyer-Łączny, Chemia ogólna dla metalurgów, Wydawnictwo Politechniki Śląskiej, Gliwice 2011

6. J. Barcik, M. Kupka, A. Wala, Technologia metali. Metalurgia ekstrakcyjna, Wydawnictwo Uniwersytetu Śląskiego, Katowice 1998

7. J. Blaschke, Procesy technologiczne w przeróbce kopalin użytecznych, Wydaw. Akademii Górniczo-Hutniczej im. S.Staszica, Kraków 1987

8. W. Charewicz, Pierwiastki ziem rzadkich. Surowce, technologie, zastosowanie, WNT, W-wa 1990

Additional

1. A. Bolewski, Miedź-Cu. Surowce mineralne świata. Wyd. Geol. Warszawa 1977

2. J. Szymanowski, Ekstrakcja miedzi hydroksyoksymami, PWN, Warszawa-Poznań 1990

3. F. Łętowski, Podstawy Hydrometalurgii, WNT, Warszawa 1975

4. A. Bielański, Chemia nieorganiczna, PWN, Warszawa 2010

5. S. Siekierski, Chemia pierwiastków, SNS, Warszawa 1998

6. W. Trzebiatowski, Chemia nieorganiczna, PWN, Warszawa 1988

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	40	1,6
Student's own work (literature studies as part of preparation for current lectures, preparation for the final colloquium or writing a paper on a given topic) [1]	35	1,4

[1] delete or add other activities as appropriate