COURSE DESCRIPTION CARD - SYLLABUS

Course name
Methods of Metal Recovery

Course

Field of study
Environmental Protection Technologies

Year/Semester
I/1

Area of study (specialization)
-

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	0	0
Tutorials	**Projects/seminars**	
15	0	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge of the basic principles of environmental protection related to chemical production and waste management.

The ability to obtain information from literature, databases and other sources related to chemical sciences, the ability to interpret them, draw conclusions and formulate opinions.

Course objective

Obtaining knowledge in the field of contemporary technologies for obtaining metals (including copper, zinc, aluminum) in pyro-, hydro- and electrometallurgical processes.

Course-related learning outcomes

Knowledge

1. In-depth knowledge of material balance as well as problems of obtaining raw materials (mainly metals) from natural resources and from secondary sources/wastes.[K_W01, K_W02]

2. In-depth knowledge of contemporary methods of metal recovery from natural resources and from secondary sources/wastes. [K_W03]

3. Detailed knowledge covering selected issues in the field of environmental protection in metal recovery processes.[K_W03, K_W13, K_W16, K_W17]

Skills

1. The ability to plan, prepare and present a presentation on the implementation of a research task and conduct substantive discussion on this topic.[K_U04]

2. The ability to work independently and in a team.[K_U16]

3. The ability to calculate the material balance of systems/installations with and without a chemical reaction.

Social competences

1. The ability to use professional literature, integrate obtained information, interpret it and critically assess and formulate competent opinions and reports on this basis.[K_K01]

2. The awareness of personal responsibility for team achievements in professional work.[K_K04]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam (lecture)

Test (tutorials)

Assessment of the team presentations on a given topic (tutorials)

Programme content

The lecture presents contemporary technologies for the production of copper, zinc, lead, silver, aluminum, nickel, cobalt and other accompanying metals with pyrometallurgical, electrochemical and hydrometallurgical processes, and issues of flotation, leaching of metals from ores, scrap, batteries and digestion of alloys, recovery of metal ions by classical and unconventional extraction. The issues of process physicochemistry, efficiency and selectivity of extraction and stripping, technologies, apparatus and environmental problems resulting from the processing of ores (ecological disasters) are considered. As a part of the tutorials, basic concepts of mass balance are introduced and mass balances of devices related to pyrometallurgical processes are solved. In addition, students prepare a topic based on the latest scientific and technical literature related to the recovery of metals relevant to the global economy and prepare a presentation on this topic. As a part of the tutorials, the method of determining extraction stages in multi-stage con-current and counter-current extraction is also presented.

Teaching methods

Lecture, discussion, work with scientific literature, preparation of presentations, problem solving

Bibliography

Basic

1. Z. Pater, Podstawy metalurgii i odlewnictwa, Wyd. Politechniki Lubelskiej, Lublin 2014. Wersja elektroniczna dostępna na: http://bc.pollub.pl/dlibra/publication/8929/edition/8711/content?ref=desc

2. K. Schmidt, J. Sentek, J. Raabe, E. Bobryk, Podstawy technologii chemicznej. Procesy w przemyśle nieorganicznym. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2004.

2. A. Ciszewski, Technologia chemiczna. Procesy elektrochemiczne, Wydawnictwo Politechniki Poznańskiej, Poznań 2008.

3. Z. Ziołkowski, Ekstrakcja cieczy w przemyśle chemicznym, PWT, Warszawa 1961.

4. A. Sobczyńska, J. Szymanowski, ”Bilanse masowe procesów stacjonarnych”, Wydawnictwo Politechniki Poznańskiej, Poznań 2003.

Additional

1. Metals in wastes, pod red.: K. Wieszczycka; B. Tylkowski; K. Staszak, DE GRUYTER, Berlin 2018.

2. J. Rydberg, M. Cox, C. Musicas, G. R. Coppin, Solvent extraction and practice, Taylor & Francis, 2004. E-book in: MyiLibrary (na stronach biblioteki głównej PP: http://www.ml.put.poznan.pl/pl/1_2_1.html#m).

3. C.K. Gupta, Chemical Metallurgy - Principles and Practice. Wiley VCH, Weinheim 2003.

4. J. Kępiński, Technologia Chemiczna Nieorganiczna, PWN, Warszawa,1984.

5. J. Szymanowski, Ekstrakcja miedzi hydroksyoksymami, PWN, Warszawa, Poznań 1990.

6. F.K. Crundwell, M.S. Moats, V. Ramachandran, T.G. Robinson, W.G. Davenport, Extractive Metallurgy of Nickel, Cobalt and Platinum-Group Metals, Elsevier, Oxford 2011. E-book na: Referex Engineering (na stronach biblioteki głównej PP).

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3
Classes requiring direct contact with the teacher	45	1,8
Student's own work (literature studies, preparation for tutorials, preparation for tests/exam, presentation preparation)[1]	30	1,2

[1] delete or add other activities as appropriate