COURSE DESCRIPTION CARD - SYLLABUS

Course name
Extraction methods

Course

Field of study
Chemical and Process Engineering

Year/Semester
1/2

Area of study (specialization)
Chemical Engineering

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	30	
Tutorials	Projects/seminars	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Wydział Technologii Chemicznej

60-965 Poznań, ul. Berdychowo 4 , pok. 124A

Responsible for the course/lecturer:
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Centrum Dydaktyczne Wydziału Technologii Chemicznej, pok. 126A

60-965 Poznań, ul. Berdychowo 4

Prerequisites

The student starting this course should have basic knowledge of separation processes, with particular emphasis on multi-stage processes. He should also have basic knowledge of inorganic and organic chemistry. He should also have the ability to obtain information from the indicated sources and be ready to cooperate as part of the team.

Course objective

Provide students with knowledge focused on extraction processes regarding the separation of both organic and inorganic chemical compounds. Developing students' skills in solving problems that arise

while analyzing issues related to metal recycling and the recovery of various types of raw materials from waste water streams.

The aim of the laboratory exercises is to familiarize students with the laboratory technique of reactive extraction in the mixer-settler system, operation of mixing equipment and separation of two-phase solutions.

Course-related learning outcomes

Knowledge

1. K_W03 The student has an extended and in-depth knowledge in the field of chemistry and other related areas of science, allowing to formulate and solve complex tasks related to chemical engineering.

2. K_W04 The student has knowledge of complex chemical processes, including the appropriate selection of materials, raw materials, apparatus and devices for the implementation of chemical processes and the characterization of the obtained products.

3. K_W9 The student has knowledge of environmental protection problems related to the implementation of industrial chemical processes.

Skills

1. K_U01 The student has the ability to obtain and critically evaluate information from literature, databases and other sources and to formulate opinions and reports on this basis.

2. K_U02 The student has the ability to work in a team and to lead a team.

3. K_U012 The student is able to properly use natural resources in industry, guided by the principles of environmental protection and sustainable development.

Social competences

1. K_K02 The student is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment and the related responsibility for decisions.

2. K_K01 The student understands the need for lifelong learning; is able to inspire and organize the learning process of other people; is aware of the importance and non-technical aspects and effects of engineering activities, including its impact on the environment, and the related responsibility for decisions made.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired as part of the lecture is verified during the exam conducted in the form of a multiple-choice test. The exam will be conducted on the eCourses platform. The test consists of 20-40 questions (closed and open), scored differently. Passing threshold: 51% of points. The rating will be given according to the following criteria: 51%-60% (3.0), 60%-72% (3.5); 72%-85% (4,0), 85%-93% (4,5), 93%-100% (5,0). The credit issues on the basis of which the questions are developed will be passed on to students during the lecture.

Passing the laboratory consists in obtaining credit from:

1. Oral answer to questions from the material contained in the exercises and from the given issues (each question is evaluated at a maximum of 5 points).

2. Final colloquium. The rating from the colloquium will be issued according to the scale given below (Points Rating): 0-7.5 ndst; 8.0-9.0 dst; 9.5-10.5 dst plus; 11.0-12.0 db; 12.5-13.5 db plus; 14.0-15.0 bdb. The scope of material required for the colloquium will be given during the classes.

3. Performing all laboratory exercises provided for in the study program.

4. Obtaining passing of reports from performed exercises.

5. The final grade will be based on the average of the grades from the colloquium and the grades from the oral answers.

Programme content

1. General characteristics of extraction processes.

2. Leaching processes.

3. Processes of dissolving metals.

4. Reactive extraction.

5. Used extractants. Division and application.

6. Copper hydrometallurgy.

7. Hydrometallurgy of nickel and cobalt.

8. Special processes: gold hydrometallurgy, ocean concretions.

9. Isolation of organic compounds.

Laboratory:

1. Effect of the type of extractant on copper(II) extraction with benzophenone oxime and DEHPA.

2. Kinetics of extraction of copper (II) with nonylbenzophenone oxime.

3. Effect of temperature on cobalt extraction rate (extractant 0.3M DEHPA).

4. Effect of nickel(II) concentration on the degree of extraction with DEHPA.

5. Efficiency of Ni(II) stripping with H2SO4 and HCl.

6. Extraction of zinc(II) from waste hydrochloric acid with TBP.

Teaching methods

1. Lecture: multimedia presentation.

2. Laboratory exercises: multimedia presentation and carrying out the tasks given by the teacher - practical exercises.

Bibliography

Basic

1. Mariusz Bogacki, Procesy ekstrakcyjne w hydrometalurgii, Wydawnictwo Politechniki Poznańskiej, 2012.

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

Additional

1. Hans-Joerg Bart, Reactive Extraction, Springer-Verlag, Berlin Heidelberg, 2001.

2. Jan Rydberg, Claude Musikas, Gregory R. Choppin, Priniples and Practices of Solvent Extraction, Marcel Dekker, Inc., New York, 1992.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	40	1,5

[1] delete or add other activities as appropriate