COURSE DESCRIPTION CARD - SYLLABUS

Course name
Chemical power sources [S2TCh2-ES>CŹP]

Course

Field of study
Chemical Technology

Year/Semester
1/2

Area of study (specialization)
Applied Electrochemistry

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
45

Laboratory classes
60

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

7,00

Coordinators

dr inż. Tomasz Rozmanowski
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Lecturers

Prerequisites

Has basic knowledge in the field of chemical and electrochemical technology, chemical engineering, electrical engineering and electronics, knows the principles of construction, operation and selection of devices, reactors used in electrochemical technology. Student understands the need for continuous training and raising their professional and personal competences.

Course objective

Transfer of knowledge on the methods of direct conversion of chemical reaction energy into electricity, principles of construction and functioning of chemical power sources.

Course-related learning outcomes

Knowledge:
1. Has knowledge of complex chemical processes, including relevant material selection, raw materials, methods, techniques, apparatus and equipment for implementation of chemical processes and the characterization of the obtained products - [K_W3]
2. Has well-established and extended knowledge of the selected specialty - [K_W11]

Skills:
1. Is able to properly verify concepts of engineering solutions in relation to the state of knowledge in chemical technology and engineering - [K_U11]
2. Has the skills necessary to work in an industrial environment and in research teams - [K_U18]
3. Has the ability to use the knowledge acquired under the chossen specialty in professional work- [K_U23]

Social competences:
1. Is aware of the need for lifelong learning and professional development - [K_K1]
2. Has formed awareness of the limitations of science and technology related to chemical technology, including environmental protection - [K_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Knowledge acquired as part of the lecture is verified by a 60-minute written exam. In exceptional circumstances, it is possible to pass remotely in the form of a test containing multiple-choice and open-ended questions. Passing threshold: 50% of points.
2. Skills acquired as part of the laboratory are verified on the basis of the written tests. In exceptional circumstances, it is possible to pass remotely in the form of a test. Passing threshold: 50% of points.

Programme content

1. Galvanic cells and electrolysis - a brief introduction.
2. Thermodynamic equilibria of electrode substances and electrolytes.
3. Primary cells with aqueous and non-aqueous electrolytes. Construction of zinc-manganese cells with acid and alkaline electrolytes. Electrode reactions, their mechanisms and discharge curves. Primary lithium cells with solid, liquid and dissolved electrodes - reactions and construction.
4. Acid and alkaline batteries. Lead-acid battery: reactions, construction, electrodes design, production and operation. Nickel-cadmium and silver-zinc batteries: reactions, construction, electrodes design, special features.
5. Power sources with high specific energy and long cyclic life; lithium-ion and hydride batteries. Reaction equations and mechanisms and construction of cells.
6.Hydrogen as an energy carrier.
7. Hydrogen-oxygen, methanol and high-temperature fuel cells: electrode reactions, construction, advantages and disadvantages.
8. Primary and secondary metal-air hybrid cells. Construction, electrode reactions and types of electrode design.
8. Electrochemical capacitors -construction and principle of operation .
9. Electrochemical cells with non-metallic electrodes - construction and electrode reactions.

Teaching methods

Lecture: multimedia presentation, illustrated with examples on the blackboard.
Laboratory classes: multimedia presentation illustrated with examples given on a blackboard and performance of tasks given by the teacher - practical classes.

Bibliography

Basic:
1. A. Czerwiński, Ogniwa, akumulatory, baterie, Wydawnictwa Komunikacji i Łączności, Warszawa 2012.
2. C. Vincent, B. Scrosati, Modern Batteries: An Introduction to Electrochemical Power Sources, Butterworth Heinemann, Oxford 1997.

Additional:
1. A. Ciszewski , Podstawy inżynierii elektrochemicznej, Wydawnictwo Politechniki Poznańskiej, Poznań 2004.
2. J. Gomółka, F. Kowalczyk, A. Franke, Współczesne chemiczne źródła prądu, Wydawnictwo Ministerstwa Obrony Narodowej, Warszawa 1977.
3. M. Barak, Electrochemical power sources - Primary & secondary battries, Institution of Electrical Engineers, London and New York 1980.

Breakdown of average student's workload

	Hours	ECTS
Total workload	175	7,00
Classes requiring direct contact with the teacher	109	4,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	66	2,50