COURSE DESCRIPTION CARD - SYLLABUS

Course name
Nanomaterials for energy storage [S1IChiP1>NdME]

Course

Field of study
Chemical and Process Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student has a basic knowledge of chemistry, physics and mathematics acquired from the first degree of study in the fields of chemical and process engineering. The student is aware of the limitations of their own knowledge and understands the need for further improvement (further training).

Course objective

The aim of the course is to provide students with knowledge of the modification of nanomaterials for the electric energy storage. The lecture will be devoted to production and modification methods of carbon nanomaterials, i.e. graphene, carbon nanotubes, nanofibers and others. Applications of nanomaterials in electrochemistry will be discussed.

Course-related learning outcomes

Knowledge:
1. has knowledge of complex electrochemical processes, including the appropriate selection of materials, raw materials, methods, techniques, apparatus and equipment for the implementation of electrochemical processes and construction of chemical power sources. [k_w3]
2. has extended knowledge in the field of kinetics, thermodynamics and surface phenomena of

electrochemical processes. [k_w4]
3. has expanded knowledge of the latest electrochemical and material technologies, including advanced materials and nanomaterials technologies used in chemical power sources. [k_w6]
4. has solid knowledge in the field of occupational safety and health. [k_w10]
4. is able to critically assess the practical usefulness of using new achievements in electrochemical engineering of chemical power sources. [k_u17]
5. knows and obeys the safety rules related to the performed work. [k_u19]

Skills:
1. has the ability to communicate with specialists and non-specialists in the field of electrochemical engineering in the case of chemical power sources utilization. [k_u4]
2. has extended skills to analyze and solve problems related to electrochemical engineering in the field of chemical power sources, using theoretical, experimental and simulation methods for this purpose. [k_u10]
3. is able to critically analyze industrial electrochemical processes in galvanic cells and batteries and introduce modifications and improvements in this area, using the acquired knowledge, including

Social competences:
1. is aware of the need for lifelong learning and professional development. [k_k1]
2. is aware of the limitations of science and technology related to electrochemical engineering in the field of chemical power sources, including environmental protection. [k_k2]
3. can think and act in a creative way. [k_k6]
4. understands the need to provide the public with information on the current state and directions of development of electrochemical engineering, on the principles of use and handling of products of electrochemical processes in chemical power sources, about the risks associated with the acquisition and distribution of raw materials in the electrochemical industry. [k_k7]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
1. Written final exam.

Programme content

1. The specificity of electrochemical processes.
2. Mechanism and kinetics of electrode processes.
3. Preparation and modification of carbon nanomaterials, i.e. graphene, carbon nanotubes, nanofibers and others.
4. The use of modern nanomaterials in chemical power sources.

Course topics

Issues related to the modification of nanomaterials for electrical energy storage.

Teaching methods

1. Supply methods (lectures).

Bibliography

Basic
1. A. Czerwiński, Akumulatory, bateria, ogniwa, WKŁ, Warszawa 2005.
Additional
2. A. Ciszewski, Podstawy inżynierii elektrochemicznej, Wydawnictwo Politechniki Poznańskiej, Poznań 2004.
3. A. Kisza, Elektrochemia. Tom I: Jonika, WNT, Warszawa 2000.
4. A. Kisza, Elektrochemia. Tom II: Elektrodyka, WNT, Warszawa 2000.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	25	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	10,00