COURSE DESCRIPTION CARD - SYLLABUS

Course name

Electrochemical sources of energy

Course

Field of study	Year/Semester
Chemical and process engineering	1/1
Area of study (specialization)	Profile of study
Chemical engineering	general academic
Level of study	Course offered in
Second-cycle studies	Polish
Form of study	Requirements
full-time	compulsory

Number of hours

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

Number of credit points

1

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

A student starting this laboratory should have basic knowledge about energy conversion and storage systems. One should also have knowledge about energy sources, their processing and storage. A students knows basic definitions of the nominal values of energy storage devices: current, voltage, potential, capacity, energy, power.

Course objective

Providing students detailed knowledge about energy storage devices, their construction and performance. Acquaintance students with electrochemical techniques most commonly used in the laboratory. Practical familiarization with electrode materials production methods. Explanation of basic nominal values methods calculation.

Course-related learning outcomes

Knowledge

1. understanding the phenomena associated with charge storage. (K_W07)

2. ability to calculate basic nominal values describing energy storage devices performance (capacity, energy, power, charging/discharging efficiency). (K_W12)

Skills

1. has an ability to interpret results obtained with basic electrochemical techniques. (K_U01)

2. ability to build simple energy storage devices (electrochemical cell/capacitor). (K_U10)

Social competences

1. understands the need to search for alternative energy sources to protect the environment. (K_K02)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Acquired knowledge and skills as a part of laboratory exercises are verified by 20-minutes entrance tests carried out during each class. Tests consist of 3-5 open-ended questions, with different scores. The pass threshold of each test is 51% of the total points. Each test should be passed. In the case of insufficient points collected by a student or a student absence during classes, a deadline for repetition/corrections is provided. Questions will be prepared based on test issues send to students by University eKursy system.

If the classes will be held remotely, they will be conducted via the eKursy platform. Each laboratory exercise will be performed and recorded by the teacher in the form of a video presentation. Each exercise in the form of a video presentation will be shared on the university eKursy system. Entry tests will be conducted through the University eKursy system before each class. The conditions for completing the course remain the same.

Programme content

1. Primary cell: Leclanché

2. Secondary cell: nickel-hydride

3. Electrochemical capacitor

Teaching methods

1. Realisation of tasks given by the teacher - practical exercises.

Bibliography

Basic

1. A. Czerwiński, Akumulatory, baterie, ogniwa, Wydawnictwo Komunikacji i Łączności WKŁ

1. F. Beguin, E. Frackowiak, Carbons for Electrochemical Energy Storage and Ceonversion Systems, 2009, CRC Press.

2. A. J. Bard, L. R. Faulkner, Electrochemical Methods, 2000, John Wiley & Sons Inc.

3. F. Beguin, E.Frackowiak, M. Lu, Supercapacitors: Materials, Systems, and Applications, 2013.

4. V. S. Bagotsky, Fundamentals of Electrochemistry, 2005, John Wiley and Sons.

Additional

1. A. F. Dalebrook, W. Gan, M. Grasemann, S. Moreta, G. Laurenczy, Hydrogen storage: beyond conventional methods, Chem. Commun., 2013, 49, 8735-8751.

2. K. Jurewicz, E. Frackowiak, F. Béguin, Towards the mechanism of electrochemical hydrogen storage in nanostructured carbon materials Appl. Phys. A, 2004, 981, 78.

3. C. Fangyi, L. Jing, T. Zhanliang, C. Jun, Functional Materials for Rechargeable Batteries, 2011.

4. A. K. Shukla, S.Venugopalan, B. Hariprakash, Nickel-based rechargeable batteries, volume 100, issues 1–2, 2001, pages 125-148.

5. S. Sonal, J. Shikha, PS Venkateswaran, K. T. Avanish, R. N. Mansa, K. P. Jitendra, G. Sanket, Hydrogen: A sustainable fuel for future of the transport sector, Renewable and Sustainable Energy Reviews, volume 51, 2015, pages 623-633.

6. Sunita Sharmaa Sib, Krishna Ghoshal, Hydrogen the future transportation fuel: From production to applications, Renewable and Sustainable Energy Reviews, volume 43, 2015, pages 1151-1158.

7. Schlapbach, A. Züttel, Hydrogen-storage materials for mobile applications, Nature, volume 414, issue 6861, 2001, pages 353-358.

8. Z. Rogulski, A. Czerwiński, Cathode modification in the Leclanché cell, Journal of Solid State Electrochemistry, 2003, volume 7, issue 2, pages 118–121.

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,0
Classes requiring direct contact with the teacher	15	0,5
Student's own work (literature studies, preparation for laboratory classes, preparation for entrance tests, preparing reports) [1]	10	0,5

[1] delete or add other activities as appropriate