COURSE DESCRIPTION CARD - SYLLABUS

Course name
Modeling of electrochemical electricity storage [S2Elmob1-PAiME>MEMEE]

Course

Field of study
Electromobility

Year/Semester
1/2

Area of study (specialization)
Alternative Fuels and Energy Storage

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
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of electrical engineering and forms and methods of energy conversion. Knowledge of methods for analyzing transients in electrical circuits. Ability to integrate and solve differential equations using numerical methods. Ability to interpret transmitted messages and effective education in the field related to energy storage and hybrid systems, as well as teamwork. Ability to use IT tools needed for modeling (e.g. Matlab, Visual Studio C #).

Course objective

Providing students with knowledge related to the construction and modeling of electrochemical energy storage systems used in electromobility. Obtaining the ability to solve engineering problems related to the study and analysis of the operation and durability of energy storage in electric and hybrid vehicles.

Course-related learning outcomes

Knowledge:
Has a structured knowledge of the methods of modeling electrochemical energy storage as well as the types and principles of operation of various types of storage.

Skills:
He can develop a model of an electrochemical energy storage and implement it in a computer.
Is able to identify the parameters of the energy storage model.
He can conduct a computer simulation to analyze the functioning of electrochemical batteries and make a critical analysis of the results obtained.

Social competences:
He understands the importance of popularizing activities regarding the latest achievements in the field of electromobility

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: The knowledge acquired during the lecture is verified during the written test, which takes place during the last lecture. The assessment consists of open questions, scored according to the level of difficulty. Passing threshold: 50% of points. Completion issues are sent to the starost of the group by e-mail using the university's e-mail system 2 weeks before the completion date.
Project: Evaluation of individual and team projects. Evaluation of current progress in science.

Programme content

Advanced methods of modeling electrochemical energy storage systems and identifying model parameters.

Course topics

Lecture:
Parameters characterizing electricity storage and their durability. Advanced models of selected energy storages (modeling of lead-acid batteries, lithium-ion batteries, supercapacitors, fuel cells) used in vehicles. Battery operation supervision and voltage balancing systems.
Project:
Identification of parameters of battery and supercapacitor models. Methods of modeling the durability of electrochemical (PbO2, Li-Ion) energy storage. Modeling of lead-acid and lithium-ion batteries, supercapacitors, fuel cells. Designing energy storage systems (selection of components).

Teaching methods

Multimedia presentation, illustrated with examples given on the board, initiating discussion during the lecture. Additional materials placed in the eKursy system.

Bibliography

Basic:
1. Leszek Kasprzyk, Wybrane zagadnienia modelowania ogniw elektrochemicznych i superkondensatorów w pojazdach elektrycznych, Poznan University of Technology Academic Journals. Electrical Engineering - 2019, Issue 101, s. 3-55.
2. Andrzej Czerwiński, Akumulatory, baterie, ogniwa. Wydawnictwa Komunikacji i Łączności, Warszawa, 2012.
3. Akumulatory elektryczne - Terminologia PN-88/E-01004 Polski Komitet Normalizacji Miar i Jakości.

Additional:
1. Fuchs G., Lunz B., Leuthold M., Sauer D. U.: Technology Overview on Electricity Storage, RWTH Aachen, 2012.
2. Barsali, Stefano, and Massimo Ceraolo: Dynamical models of lead-acid batteries: Implementation issues. IEEE Transactions on energy conversion 17.1 (2002): 16-23.
2. Hariharan Krishnan S., Piyush Tagade, Sanoop Ramachandran. Mathematical Modeling of Lithium Batteries: From Electrochemical Models to State Estimator Algorithms. Springer, 2017
3. Akumulatory do napędu pojazdów elektrycznych drogowych - Część 3: Badania dotyczące działania i trwałości (kompatybilne w ruchu kołowym pojazdy do ruchu miejskiego) PN-EN 61982-3 / Polski Komitet Normalizacyjny

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00