COURSE DESCRIPTION CARD - SYLLABUS

Course name
Diagnostics of power quality in electromobility [S2Elmob1>DJEwE]

Course

Field of study
Electromobility

Year/Semester
1/2

Area of study (specialization)
Energy Processing Systems

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
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr hab. inż. Grzegorz Wiczyński prof. PP
grzegorz.wiczynski@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of electrical engineering, metrology and signal theory. Basic knowledge of electronics. The ability to effectively self-educate in the field related to the subject. Awareness of the need to broaden one's competences and demonstrate readiness to cooperate within the team.

Course objective

Getting to know selected issues in the field of the diagnosis of power quality in electromobility. Getting to know selected current problems of evaluation of power quality in power grids.

Course-related learning outcomes

Knowledge:
1. Student has in-depth and structured knowledge in the field of analysis and synthesis of circuits.
2. Student has extensive knowledge of diagnostic methods, including non-invasive, signal processing and analysis of measurement data.
3. Student knows the methods of diagnostics and assessment of power quality, especially in charging systems for energy storage in hybrid and electric vehicles.
4. Student has extensive knowledge in the field of measurements of electrical quantities also with the

use of remotely controlled systems.
5. Student has in-depth knowledge of the development of experimental results.

Skills:
1. Student is able to plan and carry out experiments involving computer simulations and measurements of electrical quantities in electric and hybrid vehicle systems and their charging infrastructure.
2. Student can, when formulating and solving complex and unusual engineering tasks and simple research problems, apply a systemic approach.
3. Student is able to determine the directions of further learning, organize the process of self-education and indicate the directions of professional development of other people.

Social competences:
1. Student understands that in the field of technology, knowledge and skills are rapidly devaluing, which requires their constant supplementation.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
evaluation of knowledge and skills by tests. The test pass threshold is 51%. Considering activities of students in the laboratory classes and/or lectures.
Laboratory:
The skills acquired during laboratory exercises are verified on the basis of reports prepared by students, and/or a final test, and/or ongoing control of students' preparation for the exercise. Passing the laboratory classes requires performing all exercises and obtaining positive grades for all verified activities.

Programme content

The program content covered in lectures includes:
- legal and normative bases for the evaluation of power quality, including in power networks cooperating with systems used for the needs of electromobility;
- measurement of selected parameters determining power quality, taking into account signals occurring in typical systems used in electromobility;
- impact of charging electric vehicles on supply voltages in the power grid;
- impact of poor quality of supply voltage on the process of charging electric vehicles;
- assessment of the quality of supply voltage in electromobility;
- issues related to broadly understood diagnostics of power quality in electromobility.

The program content covered in laboratory classes is closely related to the program content covered in lecture classes. As part of laboratory classes, students:
- perform measurements of parameters determining power quality, with particular emphasis on signals typical for electromobility;
- perform measurements of active power and reactive power for signals typical for electromobility;
- examine the impact of selected electrical/power electronic systems used in electromobility on supply voltages in the power grid;
- examine the impact of poor quality supply voltage on selected electrical/power electronic systems.

Course topics

Lecture:
- Legal and normative bases for evaluation of power quality.
- Measurement of frequency of distorted signals.
- Measurement of harmonics, interharmonics, supraharmonics and THD of periodic and non-periodic signals.
- Description and measurement of voltage variation.
- Influence of active and reactive power changes on voltage changes.
- Flicker caused by voltage variation.
- The impact of charging electric vehicles on the supply voltage in the power grid.
- The impact of poor quality supply voltage on the process of charging electric vehicles.
- Assessment of power quality of the supply voltage in electromobility (e.g. electric locomotives).

Laboratory:
- Measurement of parameters determining power quality, with particular emphasis on signals typical for electromobility.
- Measurement of active power and reactive power for signals typical for electromobility.
- The impact of selected electrical/power electronic systems used in electromobility on the supply voltage in the power grid.
- Influence of poor quality supply voltage on selected electrical/power electronic systems.

Teaching methods

Lecture: Multimedia presentations (including figures, photos, videos) with examples given on the blackboard. Theoretical issues are presented in close connection with practice.
Laboratory: performing laboratory exercises alone or in teams, with the help and under the supervision of the teacher.

Bibliography

Basic:
1. Standards for distributed systems, e.g. in the field of energy meters and communication protocols with them.
2. Electromagnetic Compatibility Standards.
3. Regulation of the Minister of Climate and Environment of 28 May 2023 on detailed conditions for the functioning of the power system. Journal of Laws, 2023.
4. Z. Kowalski, Jakość energii elektrycznej , Wyd. PŁ, Łódź, 2007.
5. J. Szabatin, Podstawy teorii sygnałów, WKiŁ, Warszawa 2003.
6. G. Wiczyński, Badanie wahań napięcia w sieciach elektrycznych, Wyd. PP, Poznań, 2010.
7. Z. Hanzelka, Jakość dostawy energii elektrycznej. Zaburzenia wartości skutecznej napięcia, Wyd. AGH, Kraków, 2013.
8. Kuwałek P., Wiczyński G., Monitoring Single-Phase LV Charging of Electric Vehicles, Sensors, vol. 23, no. 1, art. no. 141, 2023.

Additional:
1. D. Zmarzły, Badania jakości energii w wybranej farmie wiatrowej, Wyd. PO, Opole, 2014.
2. T. Sikorski, Monitoring i ocena jakości energii w sieciach elektroenergetycznych z udziałem generacji rozproszonej, Wyd. PWr, Wrocław, 2013.
3. T. Tarasiuk, Ocena jakości energii elektrycznej w okrętowych systemach elektroenergetycznych z wykorzystaniem procesorów sygnałowych, Wyd. Akademii Morskiej, Gdynia, 2009.
4. P. Ruszel, Kompatybilność elektromagnetyczna elektronicznych urządzeń pomiarowych, Wyd. PWr, Wrocław, 2008.
5. K.L. Kaiser, Electromagnetic compatibility handbook, CRC Press, 2005.
6. A. Bień, Metrologia jakości energii elektrycznej w obszarze niskoczęstotliwościowych zaburzeń napięcia sieci, Wyd. AGH, Kraków, 2003.
7. R. Schaumann, Van Valkenburg, E. Mac, Design of analog filters, Oxford University Press, 2001.
8. www.electropedia.org

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