COURSE DESCRIPTION CARD - SYLLABUS

Course name
Power electronic systems control [S2Elmob1-SPE>SSE]

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
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge - Basic knowledge in the field of electrical engineering, electronics, power electronics, processor technology and programming. Skills - The ability to effectively self-educate in the field related to the chosen field of study; the ability to make the right decisions when solving complex tasks and formulating problems in the field of broadly understood electrical engineering and microprocessor technology. Competences - The student is aware of expanding his competences, shows readiness to work in a team, the ability to comply with the rules applicable during lectures, laboratory and design classes.

Course objective

Getting acquainted with the construction, principle of operation and control algorithms of power electronic converters dedicated to electromobility. Getting acquainted with the architecture and capabilities of selected digital platforms, with particular emphasis on DSP. Getting acquainted with the principles of design and selection of structures and parameters of control systems of converters operating in a closed control system. Familiarization with the testing procedures of physical systems.

Course-related learning outcomes

Knowledge:
1. The student should have knowledge of the construction, operation and properties of modern power electronic systems and processor systems used in electromobility.
2. The student should have knowledge of the structures and criteria for the selection of regulators in closed-loop control systems.
3. The student should have knowledge on how to implement and test control algorithms in physical power electronic systems.

Skills:
1. The student will be able to use knowledge in the construction and operation of modern power electronic systems.
2. The student will be able to propose optimal control algorithms for selected converter systems.
3. The student will be able to implement and test control algorithms for power electronic converters in selected digital platforms.

Social competences:
1. The student understands the importance of knowledge in solving problems and improving professional, personal and social competences.
2. The student is aware that in technology knowledge and skills become obsolete very quickly.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
- assessment of knowledge and skills demonstrated in a problem-based written test,
- continuous evaluation, rewarding activity and substantive content of the statement.
laboratory:
- continuous evaluation, rewarding activity and substantive content of the statement.
Design:
- evaluating the design task, verifying the effectiveness of the implemented algorithms for controlling power electronic systems.

Programme content

Overview of parameters of selected digital platforms. Identification of object parameters. PWM algorithms. Structures and parameters of controllers in the control path. Security systems in power electronics.

Course topics

Lecture:
Review of digital platforms used in control systems of power electronic converters, with particular emphasis on signal processors. Review of control algorithms for drive converters enabling regenerative braking. Control algorithms for systems that enable bi-directional energy flow (from AC grid to DC storage and from DC storage to AC voltage grid). Control systems for battery chargers used in electromobility (CC and CV operating modes, state of charge measurement). Protection systems in control systems of power electronic converters.
Laboratory:
Development and implementation of selected control algorithms in a digital platform based on, among others, on the DSP processor. Development and implementation of security algorithms. Carrying out test procedures enabling verification of the correct functioning of the implemented algorithms.
Design:
Selection of the structure and parameters of the high-current part of selected power electronic converters. Selection of structures and parameter settings of controllers implemented in the control path. Selection of measurement signal conditioning systems.

Teaching methods

Lectures - presentation of issues with the use of multimedia, illustrated with examples given on the board, discussion of problematic issues. Laboratories and project - the use of dedicated hardware

platforms and commissioning tools of selected digital platforms with particular emphasis on DSP.

Bibliography

Basic:
1. Strzelecki R., Supronowicz H., Power factor in AC power systems and methods of its improvement, Publishing House of the Warsaw University of Technology, Warsaw 2000.
2. D. Kishan, R. Kannan, B. Reddy, P. Prajov, Power electronics for electric vehicles and energy storage, 2023.
3. A. Dębowski, Automatyka, basics of theory, Warsaw 2023.
4. Technical documentation of selecteddigitalplatforms.
5. Technical documentation of the ALS-G3-1369 system.

Additional:
1. Kaźmierkowski M., Krishnan R., Blaabjerg H., Control in Power Electronics, Academic Press, Amsterdam 2002.
2. H. Kowalski, DSP processors for practitioners, BTC 2020.

Breakdown of average student's workload

	Hours	ECTS
Total workload	77	3,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00