COURSE DESCRIPTION CARD - SYLLABUS

Course name
Power electronic systems in electromobility [S2Elmob1>SEwE1]

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
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge - Basic knowledge in the field of electrical engineering, electronics and power electronics. 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 simple tasks and formulating problems in the field of broadly understood electrical engineering. 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 and laboratory classes.

Course objective

Getting acquainted with the construction, principle of operation and properties of converters dedicated to supplying electric traction. Getting acquainted with widely understood systems enabling bi- directional flow of electricity. Familiarizing yourself with the solutions used in DC fast charging stations. Familiarization with dedicated drive converters. Discussion of systems cooperating with various types of electricity storage.

Course-related learning outcomes

Knowledge:
1. The student should have knowledge about the construction, operation and properties of modern power electronic systems used in electromobility.
2. The student should have knowledge of the impact of converter systems on the power grid and know the selected methods of increasing the efficiency of electricity conversion in these systems.
3. The student should have knowledge of converter systems cooperating with electricity storage.

Skills:
1. The student should have knowledge about the construction, operation and properties of modern power electronic systems used in electromobility.
2. The student should have knowledge of the impact of converter systems on the power grid and know the selected methods of increasing the efficiency of electricity conversion in these systems.
3. The student should have knowledge of converter systems cooperating with electricity storage.

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.

Exercises:
1. Continuous assessment, rewarding the increase in the ability to use the learned rules and methods.
2. Assessment of knowledge and skills related to the exercise.
3. Obtaining additional points for activity during classes, especially for:
- proposing to discuss additional aspects of the issue,
- the effectiveness of applying the acquired knowledge while solving a given problem,
- the ability to cooperate as part of a team practically carrying out a detailed task in the laboratory,
- remarks related to the improvement of teaching materials.

Programme content

Control and protection systems in power electronic converters. Closed regulation systems. Battery BMS systems. Electricity recovery.

Course topics

Lecture and exercises:
Traction power systems with PFC function. Traction power supply systems, enabling the storage of electric energy obtained in the braking process of rail vehicles. Construction and principle of operation of DC charging stations for electric vehicles (including bi-directional - energy consumption and return to the grid). Converter systems enabling the return of energy to the alternating voltage grid from various types of DC storage. Converter systems enabling operation in off-grid mode using DC storage. Dedicated drive converters for electric vehicles (DC intermediate circuits and output circuits supplying the electric motor of a given type, structures enabling regenerative braking). Construction and principle of operation of DAB systems with galvanic separation. On-board chargers for Li-Ion batteries installed in electric vehicles. Active and passive BMS systems.

Teaching methods

Lectures:
Presentation of issues with the use of multimedia, illustrated with examples given on the board, discussion of problematic issues.
Exercises:
Multimedia presentation, presentation illustrated with examples given on the blackboard and carrying out the tasks given by the teacher - practical exercises.

Bibliography

Basic:
1. Mohan N., Undeland N., Robins W., Power Electronics, Jon Wiley & Sons Inc., New York 1999.
2. Strzelecki R., Supronowicz H., Współczynnik mocy w systemach zasilania prądu przemiennego i metody jego poprawy, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2000.
3. D. Kishan, R. Kannan, B. Reddy, P. Prajov, Power electronics for electric vehicles and energy storage, 2023.
4. M. Werner, The electric vehicle conversion handbook, H.P.Books, U.S., 2011.
5. L. A.Kumar, S. A. Alexander, Power converters for electric vehicles, CRC Press, 2020.
6. D. Andrea, Battery management systems for large lithium-ion battery, Artech House Publisher, 2010.

Additional:
1. Kaźmierkowski M., Krishnan R., Blaabjerg H., Control in Power Electronics, Academic Press, Amsterdam 2002.
2. S. Davis, Reading about electric vehicle design, 2023.

Breakdown of average student's workload

	Hours	ECTS
Total workload	83	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	38	1,50