COURSE DESCRIPTION CARD - SYLLABUS

Course name

Wired and wireless charging systems for electric vehicles

Course

Field of study

Electromobility

Year/Semester

3/6

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

15

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

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Prerequisites

Knowledge - Basic knowledge of electrical engineering, electromagnetic field theory, electronics and power electronics, as well as microprocessor systems.

Skills - The ability to effectively self-educate in a field related to the chosen field of study; the ability to make the right decisions when solving simple tasks and problems in the field of electrical engineering, electronics and power electronics.

Competences - The student is aware of expanding his competences, demonstrates readiness to work in a team, the ability to comply with the rules of lecture and laboratory classes.

Course objective

Discussion of the latest achievements and application solutions concerning the wireless electricity transmission systems used in electromobility.

Course-related learning outcomes

Knowledge

1. The student has theoretically ordered knowledge of wireless power systems,
2. The student has advanced knowledge of electromagnetism, electronics and power electronics necessary to understand the phenomena occurring in wireless systems,
3. The student has knowledge of digital electronic and power electronic systems,
4. The student has basic knowledge necessary to understand the economic, ecological and other non-technical determinants of engineering activities.

Skills

1. The student is able to design and develop documentation of an engineering task, in accordance with the given specification and with the use of appropriate methods and tools,
2. The student is able to design and develop simple electronic systems and devices used in electromobility in relation to the infrastructure for powering and charging batteries,
3. The student is able to test and diagnose simple systems and devices related to wireless electricity transfer systems and to use them in accordance with the requirements and technical documentation

Social competences

1. The student understands the importance of improving professional, personal and social competences,
2. The student is aware that knowledge and skills in the field of electromobility are evolving rapidly,
3. The student understands the need to formulate and transfer information and opinions on the positive and negative aspects of electromobility to the public.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:

- evaluation of knowledge and skills demonstrated in the solved written test of a problem nature,
- continuous assessment - during each class - rewarding activity and substantive content of the statement).

Laboratory classes:

- test and awarding the knowledge necessary to carry out individual laboratory exercises,
- continuous assessment - during each class - of the student's activity and level of knowledge and skills, as well as social competences related to working in a team,
- assessment of knowledge and skills related to the implementation of laboratory tasks, assessment of the report on the performed exercise.

Project classes:

- assessment of knowledge and skills related to the implementation of project tasks,- continuous assessment of the student's activity and the level of his knowledge and skills.

Obtaining partial grades for activity during classes, especially for:
- preparing answers to questions and problem tasks given by the teacher,
- the effectiveness of applying the acquired knowledge while solving a research problem,
- the ability to cooperate as part of a team practically carrying out a detailed task in the laboratory.

Programme content

Lectures:

Construction of the vehicle's electrical system (terms: electric drive, types of converters used, types of batteries used, charging systems); The process of charging and discharging batteries; Breakdown of electric vehicle charging systems; plug-in charging, inductive charging, capacitive charging, pantograph charging; V2G system - vehicle as an energy source (vehicle-to-grid). Construction, processing and method of electric energy transfer in wireless inductive and capacitive charging systems. Types of coil systems (spiral, polarized, non-polarized, DD, DDQ, BP, TPP type coils; H and Hc structure solenoids) used in induction systems; types of capacitive systems; DC / AC and AC / DC converters used in wireless systems, high-frequency resonant inverters and resonant rectifiers. Dynamic charging systems (while in motion) for electric vehicles. Design methods for wireless charging systems.

Laboratory classes:

Implementation of laboratory exercises in the field of:

- tests of high-frequency resonant class D, E and EF inverters,
- research on high-frequency resonant rectifiers;
- research and analysis of the operating states of induction wireless energy transfer systems,
- research and analysis of operating states and capacitive systems of wireless energy transfer.

Project classes:

Implementation of 2 engineering projects, i.e .:
- a design for an inductive charging system for a battery system, and
- a project on a capacitive charging system for a battery system.

Teaching methods

Lectures - presentation of issues using multimedia, illustrated with examples given on a board, discussion of problem issues

Laboratory - implementation of simulation and laboratory tests of selected components and systems for wireless electricity transfer.

Project classes - project implementation.

Bibliography

Basic

1. Trivino Cabrera, Alicia, González- González, José M., Aguado Sánchez, José A., Wireless Power Transfer for Electric Vehicles: Foundations and Design Approach, Springer 2020.
2. Chun T. Rim, Chris Mi, Wireless Power Transfer for Electric Vehicles and Mobile Devices, EEE Wiley John and Sons Publication, 2018
3. Johnson I Agbinya, Wireless Power Transfer, River Publishers, Series in Communications, 2012.
4. Kazimierczuk Marian K., Czarkowski Dariusz, Resonant power converters, IEEE Wiley John and Sons Publication, 2011.
5. Kaczmarczyk Zbigniew, Poprawa właściwości energetycznych falowników klasy E przez maksymalizację wykorzystania tranzystora, Wydawnictwo Politechniki Śląskiej, 2009 r

Additional

Scientific articles and publications in the field of wireless energy transmission systems.

Breakdown of average student's workload

	Hours	ECTS
Total workload	105	4,0
Classes requiring direct contact with the teacher	55	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	50	1,5

[1] delete or add other activities as appropriate