COURSE DESCRIPTION CARD - SYLLABUS

Course name
Traction and electric vehicle power systems [S2Elenerg1>SZTiPE]

Course

Field of study
Electrical Power Engineering

Year/Semester
1/2

Area of study (specialization)
Smart Grids

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 (e.g. online)
0

Tutorials
0

Projects/seminars
30

Number of credit points

4,00

Coordinators

dr inż. Michał Krystkowiak
michal.krystkowiak@put.poznan.pl

Lecturers

Prerequisites

Knowledge - Basic information in the field of electronics and power electronics

Course objective

Getting to know the properties of semiconductor elements. Getting to know the structure and principles of operation of classic and modern converter systems used in power supply systems for electric traction and electric vehicles. Getting acquainted with the probematics of the impact of power electronic systems on the power grid and methods of improving the quality of electricity conversion. Getting to know the systems enabling the recovery and storage of electricity.

Course-related learning outcomes

Knowledge:
1. the student should have knowledge of the construction and principles of operation of classic and modern converter systems used in power supply systems for electric tracking and electric vehicles.
2. the student should have knowledge of the methods of limiting the adverse impact on the supply network of power electronic systems.
3. the student should know the idea behind the operation of selected energy recovery and storage

systems used in electric traction and in electric vehicles

Skills:
1. the student will be able to use the knowledge in the field of construction and principles of operation of converter systems used in electric traction and in electric vehicles.
2. the student will be able to propose a solution to reduce the negative impact of power electronic traction systems on the supply network.
3. the student will be able to analyze whether it is possible to recover and store electricity in the selected system

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 knowledge and skills very quickly become obsolete in technology.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture:
- assessment of knowledge and skills demonstrated in the solved written test of a problem nature,
- continuous assessment, rewarding activity and substantive content of the statement.
Design:
- continuous assessment, rewarding activity and substantive content of statements,
- evaluation of the completed design task.

Programme content

Lecture:
Semiconductor elements and their properties. Complex rectifier systems with series and parallel connection, control algorithms in complex rectifier systems with series connection (symmetrical and sequential control), power transistor rectifier systems with improved transformed energy ratios, transistor power rectifier systems with the possibility of reactive power and distortion compensation, power rectifier systems with a voltage modulator in a DC circuit, modern power rectifier systems with a current modulator in a DC circuit, active parallel compensation in traction power rectifier systems, local energy storage cooperating with dedicated power electronics systems (issues including energy recovery and storage), systems enabling energy return to the alternating voltage network while ensuring high quality factors of the converted electricity, systems enabling energy storage in electric vehicles, y charging and supervision of various types of accumulator batteries, selected structures of drive converters.
Design:
Selection of semiconductor elements and conditions of their proper operation. Principles of designing security and measurement systems in power electronic systems dedicated to supplying electric traction and electric vehicles. Design and simulation tools supporting the implementation of the project. Designs of selected power electronic transformers dedicated to electric traction power supply systems and electric vehicles.

Teaching methods

Lecture: presentation of issues with the use of multimedia, illustrated with examples given on the board, discussion on problem issues, results of simulation models research.
Project: results of simulation studies, discussion of problematic issues, use of design tools.

Bibliography

Basic
1. Frąckowiak L., Energoelektronika. Cz. 2, Wydawnictwo Politechniki Poznańskiej, Poznań 20002.
2. Frąckowiak L., Januszewski S., Energoelektronika. Cz. 1, Półprzewodnikowe przyrządy i moduły energoelektroniczne, Wydawnictwo Politechniki Poznańskiej, Poznań 2001.
3. Mikołajuk K., Podstawy analizy obwodów energoelektronicznych, Państwowe Wydawnictwo Naukowe, Warszawa 1998.

4. Mohan N., Undeland N., Robins W., Power Electronics, Jon Wiley & Sons Inc., New York 1999.
5. Strzelecki R., Supronowicz H., Współczynnik mocy w systemach zasilania prądu przemiennego i metody jego poprawy, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2000.
6. Szeląg A., Trakcja elektryczna - podstawy, Oficyna Wydawnicza Politechniki Warszaswkiej, Warszawa 2019.
7. Pajchrowski T., Krystkowiak M., Matecki D., Modulation Variants in DC Circuits of Power Rectifier Systems with Improved Quality of Energy Conversion—Part I, ENERGIES, Volume 14, Issue 7, 2021.
Additional
1. Kaźmierkowski M., Krishnan R., Blaabjerg H., Control in Power Electronics, Academic Press, Amsterdam 2002.
2. Przybyszewski M., Elektryczne zespołu trakcyjne, WKŁ, 2018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50