

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Projektowanie układów przekształtnikowych**
 Name in English: **Design of Power Converter**
 Main field of study (if applicable): **Industrial Control Engineering**
 Specialization (if applicable): **Automation of Machines, Vehicles and Apparatus**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **APR013232**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30			15	
Number of hours of total student workload (CNPS):	60			30	
Form of crediting:	examination			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	2			1	
including number of ECTS points for practical (P) classes :				1	
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40			0.70	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the principles of operation of power converters. Familiar with the basic mathematical description of power converters and their control systems.
2. Know and understand the main areas of application of power converters (power systems, electric drive systems, process equipment, etc.)
3. It can search for the information you need in the technical literature and online resources, and to verify their suitability to carry out the design task.
4. It supports software (Matlab, Mathcad, etc.) to carry out the calculation, verification, and visualization of results.
5. He understands the need for continuing education and professional skills development.

SUBJECT OBJECTIVES

- C1. To provide students with the basic parameters and characteristics of real devices converter.
 C2. The acquisition by the student practical skills the selection and design of the basic elements of power converters.
 C3. Acquisition of skills and description of the results of the design calculations.

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 It has a basic knowledge of the use of power converters in selected technological devices.
 PEU_W02 Understands the impact of the proposed design solutions of the the converter on the quality operation technological device and its impact on the environment (mains network electromagnetic compatibility, noise, etc.).
 PEU_W03 It has an elementary knowledge of manufacturers and sources of information (literature, catalogs, Internet resources) allowing you to specify the parameters of components and converters of power electronics.

relating to skills:

- PEU_U01 It can, on the basis of the data parameters of the designed device, formulate requirements for type and capacity of power converter.
 PEU_U02 Able to formulate basic requirements for the converter control system.
 PEU_U03 It can calculate the basic parameters of the components in the circuit of power converter.

relating to social competences:

- PEU_K01 He understands the need for continuous learning and skills development.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Introduction. Basic topologies: diode rectifiers and phase-controlled rectifiers.	2
Lec 2	The calculation of the basic parameters of the power rectifier circuit: the calculation of the parameters and selection of power semiconductor devices.	2
Lec 3	Transformers for power converters	2
Lec 4	Design and selection of basic components: transformers, converters, switching reactors, reactors for input and output filters.	2
Lec 5	Topology of basic DC / DC power converters.	2
Lec 6	Design of the basic elements of the power circuit of DC / DC converters.	2
Lec 7	Isolated bidirectional active DC-DC power converters.	2
Lec 8	High frequency transformers used in power converters.	2
Lec 9	Design and selection of transformers and high frequency magnetic components.	2
Lec 10	Topology of the power circuit of AC / DC / AC power converter	2
Lec 11	Design elements of the power circuit of the active rectifier, an inverter and a DC link.	2
Lec 12	Basic circuits of power active filters.	2
Lec 13	Multilevel voltage inverters.	2
Lec 14	Selection of the basic elements of multilevel power converters.	2
Lec 15	Converters used in DC power supply systems.	2
Total hours:		30

Form of classes - project		Number of hours:
Proj 1	Design of the phase-controlled rectifier.	2
Proj 2	The project of diode rectifier. Design of circuit AC. Line filters and filter of the DC.	2
Proj 3	Design of the switching power supply DC / DC converter with isolated input and output circuits.	2
Proj 4	Design of the step-down (buck) converter.	2
Proj 5	Design of DC / DC converter with high-frequency resonant circuit.	2
Proj 6	Design selected elements of the three-phase voltage source inverter.	2
Proj 7	Design selected elements of the current source inverter with modulation output current.	2
Proj 8	Crediting with grade.	1
Total hours:		15

TEACHING TOOLS USED

- N1. Lecture information using a multimedia presentation.
 N2. Project classes in student groups.
 N3. Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Written test
F2(w)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Oral exam.
P(w)	$P=0,4 \cdot F1 + 0,6 \cdot F2$	
F1(p)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity during classes.
F2(p)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Evaluation of projects
P(p)	$P=0,25 \cdot F1 + 0,75 \cdot F2$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

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| <p>[1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994.</p> <p>[2] Januszewski S., Świątek H., Zymmer K.: Półprzewodnikowe przyrządy mocy. Warszawa WKŁ 1999. [3] Kaźmierkowski M.P., Matysik J.T.: Wprowadzenie do elektroniki i energoelektroniki. WPW., Warszawa 2005.</p> <p>[4] Piróg S.: Energoelektronika. Układy o komutacji sieciowej i twardej. Wydawnictwo AGH. Kraków 2006.</p> <p>[5] Muhammad Raschid.: Power Electronics Handbook, Third Edition, Butterworth-Heinemann, 2011.</p> <p>[6] Rozanov Y., Ryvkin S., Chaplygin E., Voronin P.: Power Electronics Basics: Operating Principles, Design, Formulas, and Applications, CRC Press 2015.</p> <p>[7] Ned Mohan: Power Electronics: A First Course, Wiley 2011.</p> |
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SECONDARY LITERATURE:

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| <p>[1] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika. WNT, Warszawa 2013.</p> <p>[2] Strzelecki R., Supronowicz H.: Współczynnik mocy w systemach zasilania prądu przemiennego i metody jego poprawy. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2000.</p> <p>[3] Mikołajuk K.: Podstawy analizy obwodów energoelektronicznych. Warszawa, PWN 1998.</p> <p>[4] Branko L. Dokic: Power Electronics: Converters and Regulators, Springer, 2015.</p> <p>[5] Adrian Ioinovici: Power Electronics and Energy Conversion Systems: Fundamentals and Hard-switching Converters, Volume 1, Wiley 2013.</p> <p>[6] Marian K. Kazimierzczuk: Pulse-Width Modulated DC-DC Power Converters., Wiley 2017.</p> |
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SUBJECT SUPERVISOR

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