

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): **Control Engineering and Robotics**  
 Specialization (if applicable): **Automation of Machines, Vehicles and Apparatus**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **optional**  
 Subject code: **ARR043232**  
 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 EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 It has a basic knowledge of the use of power converters in selected technological devices.  
 PEK\_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.).  
 PEK\_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:*

- PEK\_U01 It can, on the basis of the data parameters of the designed device, formulate requirements for type and capacity of power converter.  
 PEK\_U02 Able to formulate basic requirements for the converter control system.  
 PEK\_U03 It can calculate the basic parameters of the components in the circuit of power converter.

*relating to social competences:*

- PEK\_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, the calculation of the transformers to power converters.	2
Lec 3	Designing the basic elements of the protection for rectifiers and inverters.	2
Lec 4	Design and selection of basic components: transformers, converters, switching reactors, reactors for input and output filters.	2
Lec 5	Basic topology converters DC / DC converter operating with high frequency. Designing the basic elements of the power circuit of the converter.	2
Lec 6	Topology and design of the basic elements of the power converter circuit AC / DC / AC. Design elements of the inverter circuit and a DC link.	3
Lec 7	The basic elements of the control system converters. Draft selected elements of the converter control system.	2
Total hours:		<b>15</b>

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:		<b>15</b>

### TEACHING TOOLS USED

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

### EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Written test
F2(W)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Oral exam.
P(W)	$P=0,4 \cdot F1 + 0,6 \cdot F2$	
F1(P)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Activity during classes.
F2(P)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Evaluation of projects
P(P)	$P=0,25 \cdot F1 + 0,75 \cdot F2$	

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

- [1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994.  
 [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.  
 [4] Piróg S.: Energoelektronika. Układy o komutacji sieciowej i twardej. Wydawnictwo AGH. Kraków 2006.  
 [5] Muhammad Raschid.: Power Electronics Handbook, Third Edition, Butterworth-Heinemann, 2011.  
 [6] Rozanov Y., Rylvkin S., Chaplygin E., Voronin P.: Power Electronics Basics: Operating Principles, Design, Formulas, and Applications, CRC Press 2015.  
 [7] Ned Mohan: Power Electronics: A First Course, Wiley 2011.

### SECONDARY LITERATURE:

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

## SUBJECT SUPERVISOR

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### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ARR043232 - Design of Power Converter** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics** AND SPECIALIZATION **Automation of Machines, Vehicles and Apparatus**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	S2AMPU_W12	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7	N.1 N.2 N.3
PEK_W02	S2AMPU_W12	C.1	Lec1 Lec3 Lec5 Lec6 Lec7	N.1 N.2 N.3
PEK_W03	S2AMPU_W12	C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7	N.1 N.2 N.3
PEK_U01	S2AMPU_U11	C.1 C.2 C.3	Proj1 Proj3 Proj4 Proj5 Proj6 Proj7	N.1 N.2 N.3
PEK_U02	S2AMPU_U11	C.2	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N.1 N.2
PEK_U03	S2AMPU_U11	C.1 C.2 C.3	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N.1 N.2 N.3
PEK_K01	K2AiR_K01	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8	N.1 N.2 N.3