

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Energoelektronika w automatyce przemysłowej**
 Name in English: **Power electronics in industry automation**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Renewable Energy Sources**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **ELR043221**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		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 electronic systems and power electronics.
2. It has a basic knowledge of automatic control systems.
3. It has a basic knowledge of machinery, equipment and electric drives.
4. It can effectively apply knowledge of electrical circuit theory to describe power electronics systems
5. He can perform basic measurements of electrical quantities using analog instruments, digital instruments and an oscilloscope.

SUBJECT OBJECTIVES

- C1. Familiarize students with the basic knowledge concerning the specifics of the work of electric power converters in industrial automation systems.
- C2. To acquaint the student with the basic characteristics of the converters cooperating with electrical machines and electrical equipments.
- C3. The acquisition of practical knowledge of construction measurement systems to determine the characteristics of the actual converter systems.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 It has an elementary knowledge of the use of power converters as power components in systems of automatic control of industrial equipment.
- PEK_W02 Has an elementary knowledge on how to control the output parameters of power converters.
- PEK_W03 Knows the basic conditions for co-operation of electrical machinery and electrical equipment with power electronic converters.

relating to skills:

- PEK_U01 He can arrange testing of power electronic systems
- PEK_U02 He can determine the basic characteristics of power converters operating as part of the control system.
- PEK_U03 It can present the results in numerical and graphical form and to interpret them. He can draw conclusions from the measurements.

relating to social competences:

- PEK_K01 He can think and act in a creative and enterprising.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Controlled rectifier in the automated driving systems DC. Controlled rectifier in systems welding of metals.	2
Lec 2	Controlled Rectifiers in DC transmission grids.	2
Lec 3	AC thyristor controllers in systems soft start AC motors.	2
Lec 4	DC converters in vehicle propulsion systems.	2
Lec 5	Voltage inverters in automated systems AC drives.	2
Lec 6	Resonant inverters in industrial heating systems.	2
Lec 7	The use of inverters as active filters and rectifiers.	2
Lec 8	Mathematical modeling of converters.	1
Total hours:		15

Form of classes - laboratory		Number of hours:
Lab 1	Getting Acquainted with the positions of the laboratory. Principles of measurements.	2
Lab 2	Research single phase cycloconverter.	2
Lab 3	Research single phase AC controller with integration control.	2
Lab 4	Research single- phase inverter with DC circuit with closed-loop control.	2
Lab 5	Research cooperation: three-phase inverter with external power source.	2
Lab 6	Research power supply with high frequency transformer.	2
Lab 7	The test of DC power converter.	2
Lab 8	Crediting with grade.	1
Total hours:		15

TEACHING TOOLS USED

- N1. Lectures using multimedia techniques.
 N2. Laboratory test performed on specialized research positions in 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	Written exam
F2(w)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Oral exam
P(w)	$P=0,4 \cdot F1 + 0,6 \cdot F2$	
F1(L)	PEK_U01 PEK_K01	Evaluation of preparation for laboratory.
F2(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Activity during laboratory classes.
F3(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Evaluation reports conducted laboratory measurements.
P(L)	$P=0,25 \cdot F1 + 0,25 \cdot F2 + 0,5 \cdot F3$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994.
- [2] Kaźmierkowski M.P. ,Matysik J.T.: Wprowadzenie do elektroniki i energoelektroniki. WPW., Warszawa 2005.
- [3] O. Ferenczi: Zasilanie układów elektronicznych. Zasilacze impulsowe, WNT, Warszawa 1989
- [4] Zasilanie układów elektronicznych: Zasilacze ze stabilizatorami o pracy ciągłej. Przetwornice DC-DC. , WNT, Warszawa 1988.
- [4] Borkowski A.: Zasilanie urządzeń elektronicznych, Warszawa, WKiŁ, 1990
- [5] Muhammad Raschid.: Power Electronics Handbook, Third Edition, Butterworth-Heinemann, 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 **ELR043221 - Power electronics in industry automation** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering** AND SPECIALIZATION **Renewable Energy Sources**

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	S2OZE_W15	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.3
PEK_W02	S2OZE_W15	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.3
PEK_W03	S2OZE_W15	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.3
PEK_U01	S2OZE_U10	C.3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3
PEK_U02	S2OZE_U10	C.3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3
PEK_U03	S2OZE_U10	C.3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3
PEK_K01	K2ETK_K06	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.1 N.2 N.3