

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Sterowanie pracą przekształtników energoelektronicznych**  
 Name in English: **Control of power electronics converters**  
 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: **obligatory**  
 Subject code: **ELR043220**  
 Group of courses: **NO**

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

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. It has a basic knowledge of analysis and synthesis of linear and nonlinear circuits.
2. It has a basic knowledge of design and operation of of electronic devices and circuits, and basics power electronics.
3. It has a basic knowledge of electrical machines and electromechanical drive systems.
4. It has a basic knowledge of automatic control systems.
5. Can apply knowledge in the field of electrical circuit theory to analyze transients in linear and nonlinear circuits.
6. Can apply knowledge of control theory to the analysis and synthesis of control systems
7. He understands the need for continuing education and professional skills development.

**SUBJECT OBJECTIVES**

- C1. To acquaint the student with the basic principles of nonlinear control, impulse automatic control systems.  
 C2. Familiarize students with the basic mathematical models and method of operation analysis power converters.  
 C3. To acquaint the student with the basic applications of power electronic systems used in renewable energy system.

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 He has expertise in the field of power electronics systems working with renewable energy sources.  
 PEK\_W02 He knows the principle of control and automatic regulation of power electronics converters.  
 PEK\_W03 He has knowledge of the applications of power electronics in renewable energy.

*relating to skills:**relating to social competences:*

- PEK\_K01 He can think and act in a creative way.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Power Semiconductor Devices. Basic gate control.	2
Lec 2	Multi-phase thyristor rectifier. Control of the output voltage.	2
Lec 3	Control the output current rectifiers. Adaptive regulators.	2
Lec 4	Control of DC DC converters.	2
Lec 5	One, two and four quadrant switching converters.	2
Lec 6	Voltage inverter and current inverters.	2
Lec 7	Multilevel inverters.	2
Lec 8	Controls of inverters.	2
Lec 9	Pulse-width-modulated (PWM)	2
Lec 10	Closed loop operation of inverters.	2
Lec 11	Controls of current source inverters.	2
Lec 12	Control of three-phase active rectifier.	2
Lec 13	Control of converters for wind generators with variable speed.	2
Lec 14	Mathematical modeling of power converters.	2
Lec 15	Final test.	2
Total hours:		<b>30</b>

TEACHING TOOLS USED
N1. Informative lectures using presentation slides.
N2. Individual work, self-study.
N3. Consultation.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F - forming (during semester)</i> <i>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 test
P(w)	$P=0,4*P1+0,6*P2$	

PRIMARY AND SECONDARY LITERATURE
<b>PRIMARY LITERATURE:</b> <ul style="list-style-type: none"> <li>[1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994.</li> <li>[2] Januszewski S., Świątek H., Zymmer K.: Półprzewodnikowe przyrządy mocy. Warszawa WKŁ 1999.</li> <li>[3] Kaźmierkowski M.P., Matysik J.T.: Wprowadzenie do elektroniki i energoelektroniki. WPW., Warszawa 2005.</li> <li>[4] Piróg S.: Energoelektronika. Układy o komutacji sieciowej i twardej. Wydawnictwo AGH. Kraków 2006.</li> <li>[5] Muhammad Raschid.: Power Electronics Handbook, Third Edition, Butterworth-Heinemann, 2011.</li> <li>[6] Rozanov Y., Ryvkin S., Chaplygin E., Voronin P.: Power Electronics Basics: Operating Principles, Design, Formulas, and Applications, CRC Press 2015.</li> <li>[7] Ned Mohan: Power Electronics: A First Course, Wiley 2011</li> </ul> <b>SECONDARY LITERATURE:</b> <ul style="list-style-type: none"> <li>1] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika. WNT, Warszawa 2013.</li> <li>[2] Strzelecki R., Supronowicz H.: Współczynnik mocy w systemach zasilania prądu przemiennego i metody jego poprawy. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2000.</li> <li>[3] Mikołajuk K.: Podstawy analizy obwodów energoelektronicznych. Warszawa, PWN 1998.</li> <li>[4] Branko L. Dokic: Power Electronics: Converters and Regulators, Springer, 2015.</li> <li>[5] Adrian Ioinovici: Power Electronics and Energy Conversion Systems: Fundamentals and Hard-switching Converters, Volume 1, Wiley 2013.</li> </ul>

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ELR043220 - Control of power electronics converters**  
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_W02	C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.2 N.3
PEK_W02	S2OZE_W02	C.1 C.2	Lec3 Lec4 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N.1 N.2 N.3
PEK_W03	S2OZE_W02	C.1 C.3	Lec1 Lec2 Lec5 Lec6 Lec7 Lec13	N.1 N.2 N.3
PEK_K01	K2ETK_K06	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2 N.3