

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Sterowanie przekształtników statycznych**
 Name in English: **Control of static converters**
 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: **APR013228**
 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 knowledge of analysis and synthesis of linear and nonlinear circuits.
2. It has a knowledge of design and operation of of electronic devices and circuits, and basics power electronics.
3. It has a knowledge of electrical machines and electromechanical drive systems.
4. It has a 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 provide students with the principles of non-linear control, pulse, closed systems of automatic control.
 C2. To provide students with the mathematical models and the way of job analysis converters.
 C3. To provide students with the principle of operation of control systems and control of power converters.

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 It has a knowledge of the control of power semiconductor devices.
 PEU_W02 It has a knowledge in the field of power electronics systems.
 PEU_W03 He knows the methods of mathematical description of converter systems.

relating to skills:

- PEU_U01 Able to organize research on industrial power electronic converters.
 PEU_U02 It can determine the characteristics of the power converters operating as elements of the control system.
 PEU_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:

- PEU_K01 He can think and act in a creative and enterprising.

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	Phase controlled three phase AC voltage controllers.	2
Lec 7	Control of voltage inverters	2
Lec 8	Multilevel inverters.	2
Lec 9	Pulse-width-modulated (PWM).	2
Lec 10	Vector control of inverters.	2
Lec 11	Closed loop operation of inverters.	2
Lec 12	Controls of current source inverters.	2
Lec 13	Control of three-phase active rectifier.	2
Lec 14	Control converters mains of variable frequency.	2
Lec 15	Mathematical modeling of power converters.	2
Total hours:		30

Form of classes - laboratory		Number of hours:
Lab 1	Introduction to the lab program.	2
Lab 2	The testing of the gate driver for thyristors.	2
Lab 3	Test of the control system for three-phase rectifier.	2
Lab 4	The test of the control of three-phase AC -AC voltage regulator.	2
Lab 5	Tests of the control system for three-phase inverter.	2
Lab 6	Tests of the control system for three-phase PWM inverter.	2
Lab 7	Tests of the control system for resonant inverter.	2
Lab 8	Crediting with grade.	1
Total hours:		15

TEACHING TOOLS USED

- N1. Informative lectures using presentation slides.
 N2. Measurement Laboratory.
 N3. Consultation.
 N4. Individual work, self-study.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation <small>F - forming (during semester) P - concluding (at semester end)</small>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEU_W01 PEU_W02 PEU_W03	Written exam.
F2(W)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Oral exam.
P(W)	$P=0,4 \cdot F1 + 0,6 \cdot F2$	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Evaluation of preparation for laboratory.
F2(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity during laboratory classes.
F3(L)	PEU_U01 PEU_U02 PEU_U03 PEU_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:

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| <ul style="list-style-type: none">[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., Ryvkin 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. |
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SECONDARY LITERATURE:

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| <ul style="list-style-type: none">[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. |
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SUBJECT SUPERVISOR

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