FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Przekształtniki energoelektroniczne w układach zasilania i sterowania 2**
Name in English:	**Power converters in supply and control 2**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Industrial Electrical Engineering**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR043214**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the principles of operation of power converter in power supply systems AC and DC.
2. It has knowledge of the principles of magnetic components used in static converters
3. He understands the physical principles of electrical energy conversion in complex systems consisting of: the supply network, power converters and load of converters.
4. Able to perform basic measurements of electrical devices using analog and digital oscilloscope.
5. Able to elaborate a measurement performance.
6. Able to elaborate a measurement performance.
7. It has a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. To familiarize students with complex mathematical models of power converters used in supply systems.
C2. Student acquaintance with analog and digital control circuits of voltage converters.
C3. Acquisition of practical knowledge necessary for the construction of measuring systems for supply coverters

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Has knowledge of the principle of operation of complex converters for power supplies.
PEK_W02	He knows the main mathematical models of power converters working in different operating modes.
PEK_W03	He knows the principles of analog and digital control of voltage converters.

relating to skills:

PEK_U01	He can connect basic measurement systems for power converters.
PEK_U02	He can connect basic measurement systems for power converters.
PEK_U03	He can verify the results of measurements with theoretical knowledge and execute critically evaluate the knowledge of mathematical models of static converters.

relating to social competences:

PEK_K01	Is aware of the responsibility for their own work as a team and responsible for the whole team.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Continuos models of converters.	2
Lec 2	Models of converters of contiunuos conduction mode (CCM).	2
Lec 3	Models of converters of discontiunuos conduction mode (DCM)	2
Lec 4	Real elements used in voltage converter systems.	2
Lec 5	Mathematical models of converters, consisting of real elements.	2
Lec 6	Analog control of voltage converters.	2
Lec 7	Digital control of voltage converters.	2
Lec 8	Final test	1
	Total hours:	**15**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. The organization of classes. Conditions for course credition.	2
Lab 2	Research of power semiconductor devices.	2
Lab 3	Research the characteristics of thyristor voltage regulators.	2
Lab 4	Research the characteristics of three-phase voltage regulator.	2
Lab 5	Research the characteristics of thyristor phase-controlled rectifier with output filter.	2
Lab 6	Examination of the characteristics of a thyristor rectifier six pulse for certain types of output filters	2
Lab 7	Research the characteristics of six-pulse rectifier, and its impact on the mains.	2
Lab 8	Research the characteristics of resonant converter DC / DC.	2
Lab 9	Test of forward converter.	2
Lab 10	Test of voltage inverter works with a AC network (UPS)	2
Lab 11	Test of pulsed DC power supply.	2
Lab 12	Research single-phase inverter with closed-loop control.	2
Lab 13	Study of transistor inverter with PWM with output filter.	2
Lab 14	Test of linear DC power supply.	2
Lab 15	Summary of the laboratory. Credit of the laboratory.	2
	Total hours:	**30**

TEACHING TOOLS USED
N1. Laboratory exercises carried out for bench laboratory.
N2. Self-prepare for laboratory classes.
N3. Consultation.
N4. Lecture using audiovisual presentation.
N5. Own work. Literatury studies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02 PEK_W03	Written test.
F2(W)	PEK_W01 PEK_W02 PEK_W03	Oral answer.
P(W)	P=0,4*F1+0,6*F2	
F1(L)	PEK_U01 PEK_K01	Check preparation for classes.
F2(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Activity in the conduct of laboratory measurements.
F3(L)	PEK_U02 PEK_U03 PEK_K01	Grade for the reports.
P(L)	P=0,25*F1+0,25*F2+0,5*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] L. Pawlaczyk, Z. Załoga Energoelektronika. Ćwiczenia laboratoryjne. Oficyna Wydawnicza Politechniki Wrocławskiej 2005.
[2] Barlik R., Nowak M.: Technika tyrystorowa. Warszawa WNT 1994.
[3] Januszewski S., Świątek H., Zymmer K.: Półprzewodnikowe przyrządy mocy. Warszawa WKŁ 1999.
[4] Frąckowiak L., Januszewski S.,: Energoelektronika część 1. Wydawnictwo Politechniki Poznańskiej.2001.
[5] Frąckowiak L.: Energoelektronika część 2. Wydawnictwo Politechniki Poznańskiej.1998.

SECONDARY LITERATURE:

[1] Piróg S.: Energoelektronika. Kraków Wydawnictwo AGH 1998.
[2] Tunia H., Winiarski B.: Podstawy energoelektroniki. Warszawa WNT 1987
[3] O. Ferenczi: Zasilanie układów elektronicznych, WNT, Warszawa 1989
[4] P. Horowitz, W. Hill: Sztuka elektroniki, WKŁ 2009
[5] Janke W.: Właściwości impulsowych przekształtników napięcia stałego. Wydawnictwo Uczelniane Politechniki Koszalińskiej, 2017.
[6] Barlik R., Nowak M.: Energoelektronika - elementy, podzespoły układy, Oficyna Wydawnicza Politechniki Warszawskiej, 2014.
[7] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika T.1, T2, PWN, 2017.
[8] Wu K. C: Switch Mode Power Converters, Academic Press,2006.

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR043214 - Power converters in supply and control 2
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Industrial Electrical Engineering**

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	S2ETP_W02	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7	N.3 N.4 N.5
PEK_W02	S2ETP_W02	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7	N.3 N.4 N.5
PEK_W03	S2ETP_W02	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7	N.3 N.4 N.5
PEK_U01	S2ETP_U04	C.1	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.1 N.2 N.3
PEK_U02	S2ETP_U04	C.2 C.3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.1 N.2 N.3
PEK_U03	S2ETP_U04	C.2 C.3 C.4	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.1 N.2 N.3
PEK_K01	K2ETK_K01	C.1 C.2 C.3 C.4	Lec8 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.1 N.2 N.3