FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Układy energoelektroniczne w energetyce**
Name in English:	**Power electronics converters in energetics**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Electrical Power Engineering**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**ELR053218**
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 operation of power semiconductor devices and power electronics systems.
2. He knows the basic methods of mathematical description of converter systems and their control systems.
3. Understands and is able to describe the basic physical processes occurring during the conversion of electrical energy using static converters.
4. It can be used to analyze the mathematical steady-state and transient in linear and nonlinear electric circuits comprising passive components (resistors, inductance, capacitance) and active (power semiconductor devices).
5. Able to perform basic measurements of electrical devices using analog and digital oscilloscope.
6. He understands the need for continuing education and professional increasing competence.

SUBJECT OBJECTIVES

C1. To provide students with the topology power converters used in electrical equipment.

C2. To provide students with basic, applied in power electronics converters, control systems and their mathematical models.

C3. The acquisition by the student practical skills to connect systems and power electronic circuits.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	It has a basic knowledge of the principles of operation of high-power converter systems used in electrical power system
PEU_W02	Understand the physical principles of electrical energy conversion in complex systems consisting of mains power converters and load converter.
PEU_W03	Understands basic ways to adjust the output of static converters working as a power source of high power loads of various types of load and work.

relating to skills:

PEU_U01	It can determine the basic characteristics of the load and control of selected power converters.
PEU_U02	It can compile measurements in numerical and graphical form, to interpret them and draw the right conclusions.

relating to social competences:

PEU_K01	Is aware of the responsibility for their own work as a team and responsible for entire team.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	An Introduction. Review of the application areas of power electronic systems.	2
Lec 2	Diode rectifiers and controlled rectifiers.	2
Lec 3	Multi-pulse rectifier systems. Basic parameters of energy.	2
Lec 4	Transformers for multi-phase and multi-pulse converters systems.	2
Lec 5	Reactors for filter for AC circuits and DC circuits for converters.	2
Lec 6	Voltage Inverters high power with pulse width modulation.	2
Lec 7	High power, current source inverter with PWM	2
Lec 8	The impact of power converters in the power supply network. (Electromagnetic Compatibility of converters with network).	2
Lec 9	Active power filters and hybrid filter systems.	2
Lec 10	Power electronic converters used in renewable energy systems. Review of the systems.	2
Lec 11	Switching converters DC to DC.	2
Lec 12	Active rectifier with unity power factor.	2
Lec 13	Power factor correction circuitry uncontrolled rectifiers.	2
Lec 14	The basic methods of controlling the parameters of power converters.	2
Lec 15	Mathematical modeling of power converters.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. The organization of classes. Conditions for course.	2
Lab 2	Research of multi-phase diode and controlled rectifiers.	2
Lab 3	Research pulsed DC converter.	2
Lab 4	Research the characteristics of three-phase inverter with pulse width modulation.	2
Lab 5	Research converter operating as a STATCOM.	2
Lab 6	Determination of the characteristics of the resonant inverter	2
Lab 7	Research commutation circuits for three-phase thyristor inverter.	2
Lab 8	Summary of the laboratory. Course credit.	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Informative lecture using presentation slides.
N2. Laboratory practice held in student groups.
N3. Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**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*F1+0,6*F2	
F1(L)	PEU_U01 PEU_K01	Checking the preparation for classes.
F2(L)	PEU_U01 PEU_U02 PEU_K01	Activity in the conduct of laboratory measurements.
F3(L)	PEU_U02 PEU_K01	Grade for the reports performed.
P(L)	P=0,25*F1+0,25*F2+0,5*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994
[2] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika. Warszawa WNT 2014
[3] Kaźmierowski M.P., Matysik J.T.: Wprowadzenie do elektroniki i energoelektroniki O.W. Politechniki Warszawskiej, Warszawa 2005
[4] O. Ferenczi: Zasilanie układów elektronicznych, WNT, Warszawa 1989

SECONDARY LITERATURE:

[1] P. Horowitz, W. Hill: Sztuka elektroniki, WKŁ 2009
[2] Piróg S.: Energoelektronika. Kraków Wydawnictwo AGH 2005
[3] Mikołajuk K.: Podstawy analizy obwodów energoelektronicznych. Warszawa PWN 1998

SUBJECT SUPERVISOR

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