FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Układy energoelektroniczne w przemyśle**
Name in English:	**Power electronics converters in industry**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Industrial Electrical Engineering**
Level and form of studies:	**2nd level, part-time**
Kind of subject:	**optional**
Subject code:	**ELR053272**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	22		11		
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 power semiconductor devices and electronic systems.
2. It has a basic knowledge of the principles of operation of power semiconductor devices and electronic systems.
3. It can be used to analyze the mathematical steady-state and transient in cars and nonlinear electric circuits comprising passive components (resistors, inductance, capacitance) and active (power semiconductor devices).
4. Able to effectively apply the knowledge in the field of automation control systems analysis activities and automatic control of power converters.
5. Able to perform basic measurements of electrical devices using analog and digital oscilloscope.
6. He understands the need for continuing education and professional skills development.

SUBJECT OBJECTIVES

C1. Acquaint the student with the topology power converters used in electrical equipment.

C2. To acquaint the student with the basic applications of power converters, control systems and their mathematical models.

C3. Acquisition of by the student practical skills to connect power electronic systems.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	It has a knowledge of the principles of operation of high-power converter systems for use in industrial equipment.
PEU_W02	He understands the physical principles of electrical energy conversion in complex systems consisting of: the supply network, power converters and load of converters.
PEU_W03	He knows the basic problems of electromagnetic compatibility of power converters of phase-controlled,and converters cooperating with mains through the DC circuits and working in modulation mode.

relating to skills:

PEU_U01	He can connect basic measurement systems for power converters.
PEU_U02	He can determine the basic characteristics of the load and control for selected power converters.
PEU_U03	He can verify the results of measurements with theoretical knowledge and execute critically evaluate the knowledge of mathematical models: of static converters, power supply and power receivers connected to the of static converters output.

relating to social competences:

PEU_K01	He can think and act creatively.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	An Introduction. Review of application areas of power electronic converters in industrial systems. Diode rectifiers and phase-controlled rectifiers. Basic topologies high and low power.	2
Lec 2	Multi-pulse rectifiers . The basic parameters.	2
Lec 3	Magnetic components used in the circuits of power converters. Transformers for multiphase power converters . Inductors for filters in AC and DC circuits.	2
Lec 4	Application rectifiers in the basic industrial equipment: welding rectifiers, DC drive systems, traction power network.	2
Lec 5	Voltage Inverters to power AC drive systems for industry systems.	2
Lec 6	Current source inverter with PWM for industrial electrical drives.	2
Lec 7	Resonant inverters for industrial equipment.	2
Lec 8	AC-AC voltage controllers. Application in welding machine.	2
Lec 9	DC-DC converters. The use of converters DC for drive systems, DC power supply systems, industrial welders processing.	2
Lec 10	Converter systems for reactive power compensation and power electronics active filters.	2
Lec 11	Control of power converters. The influence of selected converters on the power grid.	2
	Total hours:	**22**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. The organization of classes. Conditions of the course. Safety Instructions. To familiarize students with the basic apparatus. Research the characteristics of the 12 - pulse rectifier.	2
Lab 2	Research of converter for welding machine.	2
Lab 3	Research of step up converter. Research of DC DC converter.	2
Lab 4	Research one-phase active power corrector.	2
Lab 5	Research of FC+ TRC compensator. (Fixed Capacitor +Thyristor Controlled Reactor	2
Lab 6	Summary of the laboratory. Course credit.	1
	Total hours:	**11**

TEACHING TOOLS USED
N1. Informative lecture with the use 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 PEU_K01	Written exam.
F1(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	Check preparation for classes.
F2(L)	PEU_U02 PEU_U03 PEU_K01	Activity in the conduct of laboratory measurements.
F3(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Grade for the reports made.
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] 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

Leszek Pawlaczyk, leszek.pawlaczyk@pwr.edu.pl