

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: **ELR043272**
 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):	54		27		
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 EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 It has a knowledge of the principles of operation of high-power converter systems for use in industrial equipment.
 PEK_W02 He understands the physical principles of electrical energy conversion in complex systems consisting of: the supply network, power converters and load of converters.
 PEK_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:

- PEK_U01 He can connect basic measurement systems for power converters.
 PEK_U02 He can determine the basic characteristics of the load and control for selected 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, power supply and power receivers connected to the of static converters output.

relating to social competences:

- PEK_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 voltage inverter with PWM as reactive power compensator.	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 EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <i>F - forming (during semester) 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 exam.
F1(w)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Oral exam.
P(w)	$P=0,4 \cdot F1 + 0,6 \cdot F2$	
F1(L)	PEK_U01 PEK_K01	Check preparation for classes.
F2(L)	PEK_U02 PEK_U03 PEK_K01	Activity in the conduct of laboratory measurements.
F3(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Grade for the reports made.
P(L)	$P=0,25 \cdot F1 + 0,25 \cdot F2 + 0,5 \cdot F3$	

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

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ELR043272 - Power electronics converters in industry** 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_W11	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11	N.1 N.3
PEK_W02	S2ETP_W11	C.1 C.2	Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10	N.1 N.3
PEK_W03	S2ETP_W11	C.1 C.2	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11	N.1 N.3
PEK_U01	S2ETP_U09	C.2 C.3	Lab1 Lab2 Lab3 Lab4 Lab5	N.2 N.3
PEK_U02	S2ETP_U09	C.1 C.3	Lab1 Lab2 Lab3 Lab4 Lab5	N.2 N.3
PEK_U03	S2ETP_U09	C.1 C.2 C.3	Lab1 Lab2 Lab3 Lab4 Lab5	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 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6	N.1 N.2 N.3