

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Teoria przekształtników statycznych**
 Name in English: **Theory of power converters**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Renewable Energy Sources**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **ELR043222**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15			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 electronics and power electronic.
2. It has a basic knowledge of calculation steady state and transient conditions for linear and nonlinear circuits.
3. . It has a basic knowledge of automatic control systems.
4. It has a basic knowledge in the use of Fourier transform and its application to the analysis of non-sinusoidal waveforms.
5. Can apply knowledge of: differential calculus, integral and trigonometric series for the qualitative analysis of static states of linear and nonlinear circuits containing devices alignments and nonlinear components (power semiconductor devices).
6. Can apply knowledge of ordinary differential equations for the analysis of transients in electrical circuits.
7. He understands the need for continuing education and professional skills development.

SUBJECT OBJECTIVES

- C1. Acquaint the student with the topology and properties of the converter DC to AC.
 C2. Acquaint the student with the topology and properties of the converter DC to DC.
 C3. Acquaint the student with the basic topologies and principle of operation of the DC power converters for AC.
 C4. Acquaint the student with basic mathematical models and how to analyze operations converters.
 C5. The acquisition of practical knowledge of basic design elements of the power converter circuits.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 It has an knowledge of the principles of operation of power converters.
 PEK_W02 Knows the methods of mathematical description of converter systems.
 PEK_W03 Understand basic physical principles of electrical energy conversion using static converters and the impact of this process on mains and equipment supplied with the converter.

relating to skills:

- PEK_U01 Can design selected elements for the power electronic converter.
 PEK_U02 He can obtain information from the literature and use them in the design process converters.

relating to social competences:

- PEK_K01 He can think and act in a creative and enterprising.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Multi-pulse rectifiers with phase control. The waveforms of currents and voltages. Limiting the impact on mains	2
Lec 2	Operation Inverter controlled rectifiers. Reversing Systems. Converter transformers.	2
Lec 3	Switching DC converters. Step-down, and step-up converters.	2
Lec 4	Three-phase voltage inverters. Methods for control output voltage and current. Multilevel inverters.	2
Lec 5	Current source inverters (CSI). PWM techniques in CSI.	2
Lec 6	Interaction converters on mains and electric energy consumers.	2
Lec 7	Interaction converters on mains and electric energy consumers.	2
Lec 8	Cooperation power converters with the autonomous energy sources.	1
Total hours:		15

Form of classes - project		Number of hours:
Proj 1	Design of power circuit for six-pulse thyristor controlled rectifier.	2
Proj 2	Design electrical circuit for cross-system the rectifier.	2
Proj 3	Design of step-up DC converter.	2
Proj 4	Design of three-phase transistor voltage inverter.	2
Proj 5	Design of multi-level voltage inverter.	2
Proj 6	Design of step-down DC converter.	2
Proj 7	Design of resonant converter.	2
Proj 8	Credit of the project.	1
Total hours:		15

TEACHING TOOLS USED
N1. Informative lecture using presentation slides.
N2. Discussion of design tasks in class in the auditorium.
N3. Consultation.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F - forming (during semester)</i> <i>P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEK_W01 PEK_W02 PEK_W03	Written exam
F2(w)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Oral exam.
P(w)	$P=0,4 \cdot F1 + 0,6 \cdot F2$	
F1(P)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_K01	Quality assessment of the implementation of the project.
P(P)	$P=F1$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994.
- [2] Barlik R., Nowak M.: Technika tyrystorowa. Warszawa WNT 1994.
- [3] Barlik R., Nowak M.: Poradnik inżyniera energoelektronika. Warszawa WNT 2014.
- [4] Januszewski S., Świątek H., Zymmer K.: Półprzewodnikowe przyrządy mocy. Warszawa WKŁ 1999.
- [5] Frąckowiak L., Januszewski S.: Energoelektronika część 1. Wydawnictwo Politechniki Poznańskiej. 2001.
- [6] Frąckowiak L.: Energoelektronika część 2. Wydawnictwo Politechniki Poznańskiej. 1998.

SECONDARY LITERATURE:

- [1] Piróg S.: Energoelektronika. Kraków Wydawnictwo AGH 2006.
- [2] Nowacki Z.: Modulacja szerokości impulsów w napędach przekształtnikowych prądu przemiennego.
- [3] Tunia H., Winiarski B.: Podstawy energoelektroniki. Warszawa WNT 1987.
- [4] Tunia H., Kaźmierkowski M.: Automatyka napędu przekształtnikowego. Warszawa PWN 1987.
- [5] Strzelecki R., Supronowicz H.: Współczynnik mocy w systemach zasilania prądu przemiennego i metody jego poprawy. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej. 2000.
- [6] Mikołajuk K.: Podstawy analizy obwodów energoelektronicznych. Warszawa PWN 1998

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ELR043222 - Theory of power converters** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering** AND SPECIALIZATION **Renewable Energy Sources**

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	S2OZE_W15	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.3
PEK_W02	S2OZE_W15	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.3
PEK_W03	S2OZE_W15	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.3
PEK_U01	S2OZE_U10	C.5	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N.2 N.3
PEK_U02	S2OZE_U10	C.5	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N.2 N.3
PEK_K01	K2ETK_K06	C.1 C.2 C.3 C.4 C.5	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8	N.1 N.2 N.3