

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Energoelektronika 1**
 Name in English: **Power electronics 1**
 Main field of study (if applicable): **Control Engineering and Robotics**
 Specialization (if applicable):
 Level and form of studies: **1st level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ARR043206**
 Group of courses: **NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of: differential calculus, integrals, ordinary differential equations, trigonometric Fourier series.
2. He knows the basics of electrical circuit theory.
3. Knows the basic analog and digital electronics circuits.
4. It has a basic knowledge on the description of continuous and discrete automatic control systems.

SUBJECT OBJECTIVES

- C1. To provide students with the characteristics of static and dynamic core power semiconductor devices.
 C2. To provide students with the basic system topology power converters.
 C3. To provide students with basic mathematical models and methods of analysis of power converters operating.
 C4. To provide students with the principle of operation of control systems of power converters.
 C5. To provide students with basic applications, power electronic systems.
 C6. To acquaint the student with the source materials in the field of power electronics

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 It has a basic knowledge of the principles and application of the selected power semiconductor devices.
 PEK_W02 It has a basic knowledge of the principles of power electronics systems and their static and dynamic properties.
 PEK_W03 Understand the fundamental physical processes occurring during the conversion of electrical energy by means of static converters.

*relating to skills:**relating to social competences:*

- PEK_K01 It takes an active position during a lecture. He understands the need for self-learning.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Modern semiconductor devices their characteristics and field of application.	2
Lec 2	Protection systems devices and power semiconductor. Cooling of power electronic devices	2
Lec 3	The commutation process in rectifiers. External characteristics and control characteristics rectifiers. Inverter mode controlled rectifiers.	2
Lec 4	Diode Rectifiers. Controlled rectifiers. The waveforms of currents and voltages.	2
Lec 5	AC Voltage Regulators.	2
Lec 6	DC-DC converters. Step down and step up converters.	2
Lec 7	Voltage source inverters. Regulation of output voltage and current.	2
Lec 8	Sinusoidal PWM. Space -vector modulation.	2
Lec 9	Current source inverters (CSIs). Application of current source inverter.	2
Lec 10	Power factor correction circuits. Active filters.	2
Lec 11	Resonant converts. Zero-current-switching converter and zero voltage switching converter.	2
Lec 12	Cycloconverters. Matrix converter.	2
Lec 13	Systems control of power converters	2
Lec 14	The main areas of application of power electronic devices. Interaction converters on mains	2
Lec 15	Final test.	2
Total hours:		30

TEACHING TOOLS USED

- N1. Informative lecture using presentation slides.
 N2. Own work. Self-education.
 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	Final test
F2(w)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Oral answer
P(w)	$P=0,4F1+0,6F2$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Tunia H., Winiarski B.: Energoelektronika. Warszawa WNT 1994.
- [2] Januszewski S., Świątek H., Zymmer K.: Półprzewodnikowe przyrządy mocy. Warszawa WKŁ 1999.
- [3] Kaźmierkowski M.P., Matysik J.T.: Wprowadzenie do elektroniki i energoelektroniki. WPW., Warszawa 2005.
- [4] Piróg S.: Energoelektronika. Układy o komutacji sieciowej i twardej. Wydawnictwo AGH. Kraków 2006.
- [5] Muhammad Raschid.: Power Electronics Handbook, Third Edition, Butterworth-Heinemann, 2011.
- [6] Rozanov Y., Ryvkin S., Chaplygin E., Voronin P.: Power Electronics Basics: Operating Principles, Design, Formulas, and Applications, CRC Press 2015.
- [7] Ned Mohan: Power Electronics: A First Course, Wiley 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
ARR043206 - Power electronics 1
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

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	K1AiR_W28	C.1	Lec1 Lec2	N.1 N.2 N.3
PEK_W02	K1AiR_W28	C.2 C.3	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.2 N.3
PEK_W03	K1AiR_W28	C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.2 N.3
PEK_K01	K1AiR_K01	C.6	Lec15	N.1 N.2 N.3