FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Energoelektronika**
Name in English:	**Power Electronics**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Renewable Energy Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR033228**
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):	90		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	3		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. He knows the basics of the electrical circuits. Have basic knowledge in the field of linear and nonlinear circuits. He knows the rules for creating models of peripheral and their mathematical description. He has expertise in the analysis of transients in electric circuits.
2. It know the basic knowledge on the description of automatic control systems.
3. It has a basic knowledge in the field of electronic components, describes their function circumferential model. He knows and has a simple analog and digital systems.
4. He can correctly and effectively apply the knowledge of differential and integral calculus of functions of one variable to the qualitative and quantitative analysis of static states of linear and nonlinear circuits containing semiconductor devices.
5. Able to perform basic measurements of electrical devices using analog and digital oscilloscope.
6. He understands the need for further training and knows the (second-and third-degree, postgraduate courses).

SUBJECT OBJECTIVES

C1. To provide students with the characteristics of static and dynamic core power semiconductor devices.
C2. To provide students with the basic topology of the power systems of power converters.
C3. To provide students with basic mathematical models and methods of analysis of power converters work.
C4. Acquiring basic skills to apply the measurement technique for determining the characteristics of static power converters.
C5. To provide students with the basic characteristics of the real power electronic systems.
C6. Acquiring the ability to develop research results, their interpretation and the interpretation and critical evaluation.

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 and their impact on the control parameters and dynamic power electronic converter.

relating to skills:

PEK_U01	It can connect to the scheme basic measurement systems of power converters.
PEK_U02	It can estimate the fundamental values of the elements of the measurement system.

relating to social competences:

PEK_K01	Is aware of the responsibility for their own work as a team and responsible for the whole team.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Power Semiconductor Switches: Diodes, Thyristors, Triacs, Gate-Turn-Off thyristors, Bipolar Junction Transistor, Metal Oxide Semiconductors Field Effect Transistor, Insulated Gate Bipolar Transistor	2
Lec 2	Drive and snubber Circuits.	2
Lec 3	Diode Rectifier. Phase-controlled Rectifiers and Inverters.	2
Lec 4	Three Phase Converters. Current Commutation Phenomena. External characteristics rectifiers	2
Lec 5	Current and voltage Distortion. Higher harmonic currents mains.	2
Lec 6	A-C Voltage Controllers: Single Phase A-C Voltage Controllers, Three Phase A-C Voltage Controllers. Common Applications.	2
Lec 7	Cycloconverters. Common Applications.	2
Lec 8	Phase Control Systems for Rectifiers, A-C Voltage Controllers and Cycloconvertors.	2
Lec 9	DC-DC Switch Mode Converters: Step-Down Choppers, Step-Up Choppers. Four- Quadrant Choppers.	2
Lec 10	DC-DC converters with isolated output.	2
Lec 11	Voltage Source Inverters. Single Phase Inverters. Three Phase Inverters.	2
Lec 12	Pulse width modulation in inverter.	2
Lec 13	Resonant Converters. Common Applications.	2
Lec 14	Control Systems for DC-DC Converters and Inverters.	2
Lec 15	Course credit.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. The organization of classes. Conditions of the course. To familiarize students with the basic apparatus	2
Lab 2	Testing of SCR thyristor.	2
Lab 3	Testing of triggering systems.	2
Lab 4	Testing of thyristor rectifier.	2
Lab 5	Testing of AC Voltage Controller.	2
Lab 6	Testing of three phase voltage inverter.	2
Lab 7	Testing of Three Phase PWM Inverter	2
Lab 8	Course credit.	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Informative lecture using presentation slides.
N2. Own work, individual preparation for laboratory classes.
N3. Consultation.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Final test.
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02	Check preparation for classes.
F2(L)	PEK_U01 PEK_U02 PEK_K01	Activity in the conduct of laboratory measurements.
F3(L)	PEK_U01 PEK_U02 PEK_K01	Appraisal reports made
P(L)	P=0,25*F1+0,25*F2+0,5*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Yuriy Rozanov: Power Electronics Basics: Operating Principles, Design, Formulas, and Applications, ORC, 2015
[2] Branko L. Dokic: Power Electronics: Converters and Regulators, Springer, 2015.
[3] Bogdan M. Wilamowski, J. David Irwin: Power Electronics and Motor Drives (The Industrial Electronics Handbook) CRC Press 2011
[4] A. Trzynadlowski: Introduction to Modern Power Electronics, CRC, 2002

SECONDARY LITERATURE:

[1] Adrian Ioinovici: Power Electronics and Energy Conversion Systems: Fundamentals and Hard-switching Converters, Volume 1, Wiley 2013.
[2] Mukund R. Patel: Introduction to Electrical Power and Power Electronics, CRC Press, 2012
[3] Muhammad Rashid: POWER ELECTRONICS HANDBOOK, ORC, 2010
[4] Euzeli dos Santos: Advanced Power Electronics Converters: PWM Converters Processing AC Voltages (IEEE Press Series on Power Engineering), 2014
[5] Marian P. Kazmierkowski, Ramu Krishnan: Control in Power Electronics: Selected Problems. 2004

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR033228 - Power Electronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy Systems**

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	S2RES_W01	C.1	Lec1 Lec2 Lec3	N.1 N.3
PEK_W02	S2RES_W01	C.2 C.3	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.3
PEK_W03	S2RES_W01	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.3
PEK_U01	S2RES_U01	C.4	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3
PEK_U02	S2RES_U01	C.4 C.5 C.6	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3
PEK_K01	S2RES_K02	C.1 C.2 C.3 C.4 C.5 C.6	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3