

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Jakość energii elektrycznej**
 Name in English: **Power Quality**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable):
 Level and form of studies: **1st level, full-time**
 Kind of subject: **optional**
 Subject code: **ELR053305**
 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):	90				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	3				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Have basic knowledge in the field of linear circuits with sinusoidal waveforms. He knows the rules for creating circuit models and their mathematical description.
2. He has knowledge in the analysis of transients in linear electric circuits. He has knowledge of the macroscopic electromagnetic field approach.
3. He has a basic knowledge of metrology and measurement units, knows basic metrological characteristics of measuring instruments,
4. He or she is able to do basic measurements of electrical devices using analog and digital oscilloscope. Can set on the basis of measurements of nonlinear characteristics of the elements. Able to present the results in the form of numerical tables and graphics to make their interpretations and draw conclusions

SUBJECT OBJECTIVES

- C1. Understanding the concepts of electromagnetic compatibility
 C2. Understanding the principles of interaction between the elements of the power system
 C3. Knowledge of voltage quality parameters, evaluation of the impact of power quality on loads and the impact on the quality of the loads
 C4. Knowing regulations and standardization of components which improve power quality
 C5. Acquisition and consolidation of social skills including emotional intelligence skills involving the cooperation of a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the procedure observance force in academia and society

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 He or she knows the key concepts in the field of electromagnetic compatibility. He or she has extensive knowledge in the field of power quality
 PEU_W02 He knows the power requirements of the law and regulations relating to electromagnetic compatibility standards - in particular the power quality.
 PEU_W03 He or she has knowledge of the location and control the interference sources and their affect on the device. and knows the methods of overvoltage protection. He knows methods to improve the power quality and ways to reduce disturbances

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

- PEU_K01 He or she is aware of their own responsibility for their work. Properly identifies and resolves the dilemmas of working in the profession.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Electromagnetic Compatibility. Power quality parameters	2
Lec 2	Definitions of parameters determining the power quality - the conditions of measurement, presentation the impact of the distortion on electric loads	2
Lec 3	Power quality standards	2
Lec 4	Power theory in nonsinusoidal waveforms of current and voltage	2
Lec 5	The impact of disturbances on the device. Methods of testing resistance	2
Lec 6	Voltage variation. Long and short term flicker	2
Lec 7	Methods of reducing the voltage distortion - examples	2
Lec 8	Measurement methods of harmonics and interharmonics	2
Lec 9	Shielding. The effectiveness of shielding against electromagnetic interference and electrical. Shielding low-frequency magnetic fields, the materials for the construction	2
Lec 10	Harmonic filters. Examples of calculating analysis of the effectiveness of filters.	2
Lec 11	Electric energy losses due to voltage distortion	2
Lec 12	Methods of test for immunity of electrical equipment to high-frequency conducted disturbances	2
Lec 13	Measurement of disturbances emission	2
Lec 14	Electromagnetic Compatibility in radio frequency range. Electrostatic discharge (ESD) Fast transients (BURST) and high - energy surges (SURGE)	2
Lec 15	Final test	2
Total hours:		30

TEACHING TOOLS USED
N1. Traditional Lecture with audio-visual techniques

EVALUATION OF SUBJECT LEARNING OUTCOMES 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)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	test
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Kowalski Z., Jakość energii elektrycznej, Wydawnictwo Politechniki Łódzkiej, Łódź 2007 [2] Bagini A., Handbook of Power Quality, John Wiley&Sons, Ltd, 2008 [3] PN-EN 50160:2010, Voltage Characteristics in Public Distribution Systems [4] Rozporządzenie Ministra Gospodarki w sprawie szczegółowych warunków funkcjonowania systemu elektroenergetycznego. Dz. U. Nr 93 z dn. 04.05.2007r [5] Henry W. Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons, Inc., Hoboken, New Jersey 2009 [6] Hanzelka Zb., Jakość dostaw energii elektrycznej. Zaburzenia wartości skutecznej napięcia . Wyd. AGH , Kraków 2013 SECONDARY LITERATURE: [1] IEEE Std 1159-2009: IEEE Recommended Practice for Monitoring Electric Power Quality [2] Dugan R.C., Mc Gramaghan M.F., Beaty H. W., Santoso S: Electrical Power System Quality, Wyd 2. MC Graw-Hill 2002 [3] Machczyński W., Wprowadzenie do kompatybilności elektromagnetycznej. Wydawnictwo Politechniki Poznańskiej 2010

SUBJECT SUPERVISOR
Grzegorz Kosobudzki, grzegorz.kosobudzki@pwr.edu.pl