

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Ocena jakości energii**  
 Name in English: **Power Quality Assessment**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable): **Control in Electrical Power Engineering**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR051331**  
 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. Knows basic laws of electrical engineering and electrical quantity.
2. Is able to implement fundamental mathematical formulation in software environment as Matlab etc.
3. Understands the need and possibility of lifelong learning, achieving new skills professional as well as personal and social.

**SUBJECT OBJECTIVES**

- C1. Getting the knowledge about different power quality disturbances, origin and impact of power quality disturbances  
 C2. Getting the knowledge about power quality indices as well as standards and regulations dedicated to limits and methods of power quality assessment  
 C3. Acquire practical skills of application of fundamental algorithms used in identification of power quality parameters as well as method of assessment and reporting

**SUBJECT LEARNING OUTCOMES***relating to knowledge:*

- PEU\_W01 Have general knowledge about power quality issues including relations to electromagnetic compatibility  
 PEU\_W02 Know legislative formulation and regulation concerning limits in power quality  
 PEU\_W03 Know the structure and range of power quality report

*relating to skills:*

- PEU\_U01 Decide and select limits of power quality disturbances for particular electrical equipments  
 PEU\_U02 Implement fundamental algorithms used in calculation of parameters of the power quality disturbances  
 PEU\_U03 Is able to join the origin of power quality disturbances with its potential influence on condition of work of electrical equipment

*relating to social competences:*

- PEU\_K01 Is responsible for entrusted task, exhibits creative attitude and cooperation in team

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Crucial issues and definitions of power quality, legislative documents, standards and regulations, review and classification of power quality disturbances, power quality disturbances linked to electromagnetic compatibility,	2
Lec 2	Power quality disturbances in relations to electromagnetic compatibility. Review and classification of power quality disturbances.	2
Lec 3	Methods of measurement and algorithms for disturbances of main frequency. Origin of power quality disturbances and potential impact on the operation of electrical power systems elements.	2
Lec 4	Methods of measurement and algorithms for disturbances of voltage. Origin of power quality disturbances and potential impact on the operation of electrical power systems elements. Example of emission and immunity test of the electrical equipments.	2
Lec 5	Methods of measurement and algorithms for disturbances of voltage and current waveform. Origin of power quality disturbances and potential impact on the operation of electrical power systems elements. Example of emission and immunity test of the electrical equipments.	2
Lec 6	Methods of measurement and algorithms for disturbances of symmetry and power balance. Origin of power quality disturbances and potential impact on the operation of electrical power systems elements.	2
Lec 7	Methods of measuring and assessment of the quality of electricity supply in low voltage and medium voltage power systems, the limits for the power quality disturbances, meaning of quality of the supply for distribution system operator.	2
Lec 8	Methods of measuring and assessment of the quality of electricity supply in high voltage power systems, the limits for the power quality disturbances, meaning of quality of the supply for transmission system operator.	2
Lec 9	Review of power quality recorders. Scope of the report of power quality, distribution of real measurements for the power quality report.	2
Lec 10	Discussion of exemplary power quality report. Examples of power quality disturbances finder.	2
Lec 11	Power quality monitoring systems, distributed measurement systems, time synchronization, on-line access.	2
Lec 12	Power quality monitoring systems, data based tools in the evaluation of the multipoint measurement data.	2
Lec 13	Selected methods of reducing or elimination of voltage disturbances.	2
Lec 14	Selected methods of reducing or elimination of voltage and current waveform disturbances.	2
Lec 15	Oral test, defence of power quality report	2
Total hours:		<b>30</b>

Form of classes - laboratory		Number of hours:
Lab 1	Information about the regulation of work in the laboratory, requirements for passing the course, distribution of the instructions and additional materials	1
Lab 2	Algorithms for voltage dips assessment. Part 1.	2
Lab 3	Algorithms for voltage dips assessment. Part 2.	2
Lab 4	Algorithms for harmonics assessment. Part 1.	2
Lab 5	Algorithms for harmonics assessment. Part 2.	2
Lab 6	Configuration of power quality recorder and assessment of the selected power quality parameters on the basis of real measurement at the laboratory setup. Part 1.	2
Lab 7	Configuration of power quality recorder and assessment of the selected power quality parameters on the basis of real measurement at the laboratory setup. Part 2.	2
Lab 8	Discussion the reports on particular laboratories, final marks, additional term of the laboratory.	2
Total hours:		<b>15</b>

## TEACHING TOOLS USED

- N1. Lectures with multimedia presentation
- N2. Organization of the laboratory work in subgroup

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEU_W01 PEU_W02 PEU_W03	Oral test, assessment of power quality report
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Evaluation of preparing for laboratories
F2(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Evaluation of reports on particular laboratories
P(L)	$P=0,2 \cdot F1 + 0,8 \cdot F2$	

PRIMARY AND SECONDARY LITERATURE	
<b>PRIMARY LITERATURE:</b> [1] Arrillaga J. Watson N. R.: Power System Quality Assessment, John Wiley & Sons, New York, 2000. [2] Bollen M. H. J.: Understanding Power Quality Problems Voltage Sags and Interruptions, IEEE Press, New York, USA, 2000. [3] Dugan R. C., McGranaghan M. F., Beaty H. W.: Electrical Power Systems Quality, McGraw-Hill, New York, USA, 1986.	
<b>SECONDARY LITERATURE:</b> [1] Electrical Power Quality and Utilization - Journal [2] Leonardo Energy – Power Quality Guide	

SUBJECT SUPERVISOR
Tomasz Sikorski, tomasz.sikorski@pwr.edu.pl