

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: **ELR031331**
 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): | 60 | | 30 | | |
| Form of crediting: | crediting with grade | | 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. 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 EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 Have general knowledge about power quality issues including relations to electromagnetic compatibility
 PEK_W02 Know legislative formulation and regulation concerning limits in power quality
 PEK_W03 Know the structure and range of power quality report

relating to skills:

- PEK_U01 Decide and select limits of power quality disturbances for particular electrical equipments
 PEK_U02 Implement fundamental algorithms used in calculation of parameters of the power quality disturbances
 PEK_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:

- PEK_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: | | 30 |

| 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: | | 15 |

| TEACHING TOOLS USED |
|---|
| N1. Lectures with multimedia presentation |
| N2. Organization of the laboratory work in subgroup |

| 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 | Oral test, assessment of power quality report |
| P(W) | P=F1 | |
| F1(L) | PEK_U01 PEK_U02 PEK_U03 PEK_K01 | Evaluation of preparing for laboratories |
| F2(L) | PEK_U01 PEK_U02 PEK_U03 PEK_K01 | Evaluation of reports on particular laboratories |
| P(L) | P=0,2*F1+0,8*F2 | |

| PRIMARY AND SECONDARY LITERATURE | |
|--|--|
| PRIMARY LITERATURE: [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. | |
| SECONDARY LITERATURE: [1] Electrical Power Quality and Utilization - Journal [2] Leonardo Energy – Power Quality Guide | |

| SUBJECT SUPERVISOR |
|---|
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR031331 - Power Quality Assessment
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Control in Electrical Power Engineering**

| 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 | S2CPE_W13 | C.1 C.2 C.3 | Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 | N.1 |
| PEK_W02 | S2CPE_W13 | C.2 | Lec1 Lec2 | N.1 |
| PEK_W03 | S2CPE_W13 | C.1 C.2 C.3 | Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 | N.1 |
| PEK_U01 | S2CPE_U12 S2CPE_U14 | C.3 | Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 | N.2 |
| PEK_U02 | S2CPE_U12 S2CPE_U14 | C.3 | Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 | N.2 |
| PEK_U03 | S2CPE_U12 S2CPE_U14 | C.3 | Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 | N.2 |
| PEK_K01 | K2ETK_K01 K2ETK_K02 | C.2 C.3 | Lec15 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 | N.2 |