DESCRIPTION OF THE COURSES

- Course code: ELR 1313
- Course title: Power Quality Assessment
- Language of the lecturer: English

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*		*1*		
*Number of hours/semester**	*30*		*15*		
Form of the course completion	*Pass*		*Reports*		
ECTS credits	*3*		*2*		
Total Student's Workload	*90*		*60*		

- Level of the course (basic/advanced): basic
- Prerequisites: Mathematics, Circuit Theory
- Name, first name and degree of the lecturer/supervisor:
  Lobos, Tadeusz, prof.
- Names, first names and degrees of the team's members:
  Sikorski, Tomasz, Ph.D.
  Przemyslaw Janik, Ph. D.
- Year:.....II..... Semester:.....III.....
- Type of the course (obligatory/optional): optional
- Aims of the course (effects of the course):
  Understanding of basic phenomena and practical engineering aspects of power quality assessment in power systems.
- Form of the teaching (traditional/e-learning): traditional
- Course description:
  The course contains the basic problems and practical aspects of power quality assessment in power systems. After an introduction and general basis, the following problems are presented: classes of power quality problems, standards, interruptions, voltage sags, transient overvoltages, harmonics, long duration voltage variations, flicker, power quality measurement, disturbances mitigation methods, chosen algorithms for power quality assessment. A computer-based laboratory supplements the course.

- Lecture:

Particular lectures contents	*Number of hours*
1. Historical perspective, general overview, the need for PQ assessment, terms and definitions, international standards	*2*
2. Sources of short interruptions, reliability evaluation of power systems, causes of long interruptions, origin of interruptions, cost of interruptions, influence on equipment, example calculation, monitoring	*3*
3. Voltage sags characterization, voltage sag magnitude – theoretical	*3*

calculations, sag magnitude in non-radial and mashed systems, voltage sag duration, measurement of sag duration	
4. Three phase unbalance, seven types of three-phase unbalanced sags, phase angle jumps – monitoring and calculation, load influence on voltage sags, sags due to starting of induction motors	*2*
5. Voltage sags – equipment behavior, computers and consumer electronics, typical configuration of power supply, voltage tolerance requirements, process control equipment, adjustable-speed drives, other sensitive load	*3*
6. Voltage sags – stochastic assessment, compatibility between equipment and supply, presentation of results: voltage sag coordination chart, method of fault positions, method of critical distances	*2*
7. Mitigation of interruptions and voltage sags, overview of mitigation methods, reducing the number of faults, reducing the fault clearing time, installing mitigation equipment, redundancy through switching and parallel operation	*2*
8. Transient overvoltages, sources of transients, capacitor switching, principles of overvoltage protection, lighting protection, load switching transient problems	*2*
9. Harmonic and interharmonics distortion, total harmonic distortion and rms value, triplen harmonics, electronic power converters, arcing and saturable devices, effects of harmonic distortion	*3*
10. Harmonics – system response characteristics, capacitor and system impedance, parallel resonance, principles of controlling harmonics, filtering	*2*
11. Flicker causes and effects, different approaches to standardization, IEC fickermeter, digital time domain flickermeter, mitigation methods	*2*
12. Monitoring power quality, choosing a monitoring location, disturbance recording form, disturbance recorder connections, quantities to measure, setting monitors thresholds, finding the source of a disturbance	*2*
13. Methods and algorithms for PQ monitoring, sampling, filtering, FFT implementation, interharmonics measurements, transient monitoring and detection	*2*

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:

1. Basic simulations of disturbances with various parameters
2. Digital measurement of basic power quality indices
3. Power system parameters influence on PQ disturbance level
4. FFT implementation for harmonic distortion estimation
5. Simulation and measurement of converters harmonic distortion
6. Automatic classification of PQ disturbances

The students use already available programs in Matlab and write their own applications

- Project – the contents:
- Basic 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.

- Additional literature:

[1] Electrical Power Quality and Utilization (periodic magazine)

- Conditions of the course acceptance/credition:

* - depending on a system of studies