

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Zakłócenia w układach elektroenergetycznych**
 Name in English: **Short-circuits in power systems**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Electrical Power Engineering**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052211**
 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):	60				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	2				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge about construction and principles of operation of power lines, power transformers and AC electrical machinery
2. Knows principles of operation of power system and power substations
3. Knows principles and techniques for mathematical description of AC circuits
4. Knows how to use matrix calculation and complex numbers calculations

SUBJECT OBJECTIVES

- C1. Acquaintance with causes, course and effects of faults in power system
 C2. Gaining knowledge necessary for understanding principles and methods for fault quantities calculation
 C3. Gaining knowledge necessary for estimation the intensity of contingencies in power systems and selection of proper means for limiting its effects.
 C4. Acquaintance with engineer responsibility for protection of designed and operating equipment

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 To know and understand cases and effects of short-circuits and characteristic qualities of short-circuit quantities and its relationship with phenomenon occurring in power lines and machinery
 PEU_W02 To know rules for mathematic representation of rotating machines, lines, transformers and reactors in equivalent circuit diagrams for symmetrical components. To understand approach and methodology of short-circuit currents and voltages calculation.
 PEU_W03 To know mechanisms of voltage sags occurrence and overvoltage caused by short-circuits in HV power systems.

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

- PEU_K01 Is conscious about decision making responsibility of electrical engineer

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Overview of power systems fault types and statistics.	2
Lec 2	Causes and effects of short-circuits in power systems.	2
Lec 3	Sources of short-circuit currents in power systems.	2
Lec 4	Symmetrical components equivalent circuits for short-circuits representation.	2
Lec 5	Transformation of symmetrical components by transformers with various winding connection groups.	2
Lec 6	Currents and voltages in various places of power systems caused by symmetrical faults.	2
Lec 7	Currents and voltages in various places of power systems caused by unsymmetrical phase-to-phase faults.	2
Lec 8	Currents and voltages in various places of solidly grounded power systems caused by phase-to-ground faults.	2
Lec 9	An example of the calculation of short-circuit currents in accordance with valid standards.	2
Lec 10	Currents and voltages in a steady state of phase-to-ground short - circuit in MV network (insulated, compensated and resistive grounded neutral).	2
Lec 11	Transients under ground faults in MV networks - transient currents and overvoltage.	2
Lec 12	Multiple short-circuits. Faults with a break in a phase.	2
Lec 13	Methods of limiting short-circuit currents in power systems.	2
Lec 14	Causes, effects and calculation methods of voltage sags. Transformation of voltage sags. Methods of mitigation of voltage sags.	2
Lec 15	Evaluation test.	2
Total hours:		30

TEACHING TOOLS USED

- N1. Problem lecture
N2. Lecture with use of multimedia techniques

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 PEU_K01	Writing and oral evaluation test
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych, WNT, Warszawa, 2002.
[2] PN-EN 60909-0 Prądy zwarciove w sieciach trójfazowych prądu przemiennego- Część 0: Obliczanie prądów.

SECONDARY LITERATURE:

- [1] Synal B., Rojewski W., Dzierżanowski W.: Elektroenergetyczna automatyka zabezpieczeniowa. Podstawy, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2003
[2] PN-EN 60909-3 Prądy zwarciove w sieciach trójfazowych prądu przemiennego- Część 3: Prądy podwójnych, jednoczesnych i niezależnych zwarć doziemnych i częściowe prądy zwarciove płynące w ziemi.

SUBJECT SUPERVISOR

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