

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): **Industrial Electrical Engineering**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR042211**  
 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 EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_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  
 PEK\_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.  
 PEK\_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:*

- PEK\_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	Currents and voltages in steady state of phase- to-ground short - circuit in MV network (insulated, compensated and resistive grounded neutral). 2	2
Lec 10	Transients under ground faults in MV networks - transient currents and overvoltage	2
Lec 11	Multiple short-circuits	2
Lec 12	Methods of limiting short-circuit currents in power systems	2
Lec 13	Causes, effects and calculation methods of voltage sags. Transformation of voltage sags.	2
Lec 14	Methods of prediction of voltage sags number. Methods mitigation of voltage sags.	2
Lec 15	Evaluation test	2
Total hours:		<b>30</b>

TEACHING TOOLS USED
N1. Problem lecture
N2. Lecture with use of multimedia techniques

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 PEK_K01	Writing and oral evaluation test
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE
<b>PRIMARY LITERATURE:</b> [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. <b>SECONDARY LITERATURE:</b> [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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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ELR042211 - Short-circuits in power systems**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**  
AND SPECIALIZATION **Industrial Electrical 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	K2ETK_W03	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12	N.1 N.2
PEK_W02	K2ETK_W03	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12	N.1 N.2
PEK_W03	K2ETK_W03	C.2 C.3	Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec13 Lec14	N.1 N.2
PEK_K01	K2ETK_K03	C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2