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):	**Renewable Energy Sources**
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 shot-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:	**30**

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**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
PRIMARY LITERATURE:
[1] Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych, WNT, Warszawa, 2002. [2] PN-EN 60909-0 Prądy zwarciowe 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 zwarciowe w sieciach trójfazowych prądu przemiennego- Część 3: Prądy podwójnych, jednoczesnych i niezależnych zwarć doziemnych i częściowe prądy zwarciowe 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 **Renewable Energy Sources**

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 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