

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Zwarcia w systemie elektroenergetycznym**
 Name in English: **Power Systems Faults**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Renewable Energy Systems**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052131**
 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):	120				
Form of crediting:	examination				
For group of courses mark (X) final course:					
Number of ECTS points:	4				
including number of ECTS points for practical (P) classes:					
including number of ECTS points for direct teacher-student contact (BK) classes:	2.80				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge on a power system operation.
2. Knowledge of complex number calculations.

SUBJECT OBJECTIVES

- C1. Gaining knowledge on faults occurring in power systems.
 C2. Familiarization with methods for analysis of fault waveforms and for fault identification.

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 Has knowledge on faults occurring in high voltage networks.
 PEU_W02 Has knowledge on faults occurring in medium voltage networks.
 PEU_W03 Has knowledge on analysis of fault waveforms and on fault identification.

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

- PEU_K01 Is able to independent thinking and to performing analysis of technical information.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction. Establishing conditions for passing and marking the lecture. Causes and consequences of faults, classifications of faults, aims of fault calculations.	2
Lec 2	Fault identification - digital algorithms for fault detection.	2
Lec 3	Fault identification - digital algorithms for fault direction discrimination and fault classification.	2
Lec 4	Fault calculations - application of per units, method of symmetrical components, calculations in phase co-ordinates.	2
Lec 5	Models of generators and power transformers in fault calculations.	2
Lec 6	Equivalent circuit diagrams of overhead and cable lines for symmetrical components. Modal transformation, calculations in phase co-ordinates.	2
Lec 7	Analysis of three-phase symmetrical faults. Analysis of single phase faults.	2
Lec 8	Analysis of phase-to-phase faults. Analysis of phase-to-phase-to-earth faults.	2
Lec 9	Analysis of broken conductor failure and broken conductor failure combined with phase-to-earth fault.	2
Lec 10	Requirements of international standards for fault calculations.	2
Lec 11	Earth faults in networks with isolated neutral point.	2
Lec 12	Earth faults in networks with neutral point earthed through compensating reactor and through resistor.	2
Lec 13	Microprocessor-based fault recorders and fault locators – application basics.	2
Lec 14	Fault location on power lines with use of local and two-end measurements.	2
Lec 15	Transformation of fault voltages and currents by instrument protective transformers.	2
Total hours:		30

TEACHING TOOLS USED
N1. Informative lecture.
N2. Student's own work.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation <i>F – forming (during semester)</i> <i>P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEU_W01 PEU_W02 PEU_W03	Presence at the lectures
F2(w)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Written or oral examination
P(w)	$P=0,1F1+0,9F2$	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Izykowski J., Power system faults. PRINTPAP, 2011, p. 190.
SECONDARY LITERATURE: [1] Glover J. D., Sarma M., Power system analysis and design. PWS Publishing Company Boston, second edition, 1994. [2] Michalik M., Rosołowski E., Simulation and analysis of power system transients. PRINTPAP, 2011. [3] Saha M.M., Izykowski J., Rosołowski E., Fault location on power networks. Springer-Verlag London, Series: Power Systems, 2010, 425 p.

SUBJECT SUPERVISOR
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