

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Automatyka zabezpieczeniowa i regulacyjna rozproszonych źródeł energii**
 Name in English: **Automatic control and relay protection of dispersed energy sources**
 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: **ELR052217**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		30		
Number of hours of total student workload (CNPS):	90		60		
Form of crediting:	examination		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	3		2		
including number of ECTS points for practical (P) classes :			2		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10		1.40		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows working principles of electrical distribution networks and power substations
2. Has basic knowledge of power system protection
3. Knows methods and technology of energy production from fossil and renewable sources
4. Is able to correctly conduct testing of digital as well as analog relay protection units
5. Is able to use MATLAB/ Simulink software

SUBJECT OBJECTIVES

- C1. Acquaintance with problems of operation of dispersed generation in distribution network
- C2. Acquaintance with rules of equipping dispersed power sources with relay protections and automatic controllers
- C3. Acquaintance with requirements for controls of frequency/active power and voltage/reactive power in distribution network with dispersed power sources
- C4. Obtaining of practical skills for accomplishment tests of relay protection and automatics of distributed energy sources
- C5. Obtaining of practical skills for accomplishment simulations of dispersed sources operation in distribution network using MATLAB/SimPowerSys toolbox..
- C6. Obtaining of practical skills for application of modern methods, technics and tools for protective relay testing.
- C7. Obtaining of practical skills for protective relay test report compilation.

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 Knows conditions for safe operation of dispersed sources in distribution network and the principles for equipping of dispersed sources with relay protection and automatic controllers
 PEU_W02 Knows and is able to describe requirements for frequency/active power and voltage/reactive power control in power network with dispersed sources
 PEU_W03 Understands requirements for automatic control and relay protection of small generating units under islanded operation

relating to skills:

- PEU_U01 Is able to determine appropriate settings of protection relay and to perform functional testing of protection device with use of protection relay test equipment.
 PEU_U02 Is able to prepare data, insert them to MATLAB model and perform simulations of dispersed sources operated in distribution network.
 PEU_U03 Is able to elaborate research results and draw conclusions

relating to social competences:

- PEU_K01 Is responsible for his own work and ready for teamwork

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Characterization of distribution network with dispersed sources from point of view of safe operation	2
Lec 2	Characterization of dispersed sources from point of view of their impact on operation of distribution network	2
Lec 3	Control and protection of small power plants with synchronous and/or asynchronous generators	2
Lec 4	Control and protection of dispersed generators connected to the network through converters	2
Lec 5	Safety automation for distribution network cooperated with dispersed sources	2
Lec 6	Automatic voltage regulation in distribution network with dispersed sources	2
Lec 7	Islanded operation of distributed generation	2
Lec 8	Relay protection and automatic control of distributed generation under islanded operation	1
Total hours:		15

Form of classes - laboratory		Number of hours:
Lab 1	Laboratory safety and internal regulations presentation. Grading rules assessment. General overview of laboratory stations.	3
Lab 2	Testing of main protection of small synchronous generator	3
Lab 3	Computer simulation of impact of dispersed generation on power flow and voltage level in distribution network	3
Lab 4	Computer simulation of dispersed generation impact on short circuit currents in distribution network	3
Lab 5	Simulation of islanded operation of distributed generation	3
Lab 6	Protection relay test equipment.	2
Lab 7	Acquaintance with structure (input/output circuits) and operation principle of chosen digital protection relay.	4
Lab 8	Protection relay testing of a chosen protection relay of dispersed energy sources - determination of operating characteristics.	8
Lab 9	Final laboratory - analysis of student reports.	1
Total hours:		30

TEACHING TOOLS USED

- N1. Problem lecture
 N2. Lecture with use of audiovisual techniques, multimedia presentation.
 N3. Traditionally arranged measurement laboratory with working in groups
 N4. Laboratory of computer simulations traditionally arranged with working in groups
 N5. Assessment by oral questioning
 N6. Preparation of report from tests

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	Writing and oral exam
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Assessment of preparation to laboratory and activity during laboratories
F2(L)	PEU_U03	Test reports assessment
P(L)	P=0,5F1+0,5F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Synal B. Rojewski W. Dzierżanowski W.: Elektroenergetyczna automatyka zabezpieczeniowa – podstawy, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003
 [2] Winkler W., Wiszniewski A., Automatyka zabezpieczeniowa w systemach elektroenergetycznych, WNT, Warszawa 2004.
 [3] Kacejko P.: Generacja rozproszona w systemie elektroenergetycznym. Wydawnictwo Uczelniane. Politechnika Lubelska 2004.
 [4] Lubiński Z.: Elekrownie wiatrowe w systemie elektroenergetycznym. WNT, Warszawa 2006.

SECONDARY LITERATURE:

- [1] Konspekty wykładów
 [2] Instrukcje laboratoryjne

SUBJECT SUPERVISOR
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