

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Zabezpieczenia elektroenergetyczne - podstawy**  
 Name in English: **Power system protection - fundamentals**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, part-time**  
 Kind of subject: **optional**  
 Subject code: **ELR052262**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	20		10		
Number of hours of total student workload (CNPS):	30		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	1		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70		0.70		

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knows principles of operation of power system and power substation
2. Has knowledge about transformers and AC electrical machines construction.
3. Knows general principles and techniques of network analysis. Knows and understands mathematical transformations as for example symmetrical components method.
4. Is able to plan and safely conduct measurements as well as prepare report from it

**SUBJECT OBJECTIVES**

- C1. Acquaintance with various types of power system protection in correlation with short-circuits and other faults in power system operation  
 C2. Acquaintance with principles of operation of electrical quantities transducers  
 C3. Acquaintance with construction and principles of operation of single and multi input protection relays  
 C4. Acquaintance with principles and techniques for realization of protection systems for various type of electric objects  
 C5. Gaining practical skills for testing power system protection elements - transducers, relays.  
 C6. To get skills for selecting proper type and calculating settings of protection  
 C7. To get skills for teamwork

**SUBJECT LEARNING OUTCOMES***relating to knowledge:*

- PEU\_W01 Has knowledge about construction and operation of current and voltage transformers as well as symmetrical components filters. Has knowledge about basic operation criteria of analogue and digital protection relays  
 PEU\_W02 Knows basic operation criteria of analogue and digital protection relays and is able to describe basic characteristics single and multi input relays  
 PEU\_W03 Knows rules of arrangement and settings of protection of various electric objects

*relating to skills:*

- PEU\_U01 Is able to precise program of tests, setup measuring circuit with proper measuring instruments for research of single and multi input measuring relays  
 PEU\_U02 Is able to conduct measurements of characteristics of single relays and complete protection systems, prepare results and formulate conclusions

*relating to social competences:*

- PEU\_K01 Is conscious about responsibility for his own work and is willing to acknowledge teamwork rules.

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Overview of lecture. Fundamental notions, requirements, literature and assessment methods. Assignments for relay protection in power system	2
Lec 2	Specification of faults in electrical power system	2
Lec 3	Transducers - current and voltage transformers, symmetrical components filters	2
Lec 4	Relays and protection units. Characteristic qualities along generation of relays and development trends. Single input relays, definite time-delay relays and inverse time-delay relays	2
Lec 5	Forming of multi input relays characteristics. Directional relays and impedance relays. Differential and phase comparison relays	2
Lec 6	Transformer protection	2
Lec 7	Synchronous generators and HV motors protection	2
Lec 8	Electric lines protection	2
Lec 9	Bus protection	2
Lec 10	Evaluation test	2
Total hours:		<b>20</b>

Form of classes - laboratory		Number of hours:
Lab 1	Presentation of safety regulations and internal regulations of laboratory. Assessment rules. Overview of laboratory stations	1
Lab 2	Test of relays, current and voltage transformers	3
Lab 3	Test of single and multi input definite time-delay relays	3
Lab 4	Test of differential relays	3
Total hours:		<b>10</b>

## TEACHING TOOLS USED

- N1. Problem lecture
- N2. Lecture with use of multimedia techniques.
- N3. Laboratory with measurements traditionally arranged, work in groups
- N4. Oral assessment
- N5. Report arrangement from measurements

## 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	Writing test and oral verification
P(W)	P=F1	
F1(L)	PEU_U01 PEU_K01	Assessment of preparation quality for laboratory and activity.
F2(L)	PEU_U02 PEU_K01	Assessment of prepared laboratory reports
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] Praca zbiorowa pod red. B. Synala, Automatyka elektroenergetyczna, ćwiczenia laboratoryjne, część I: Przetworniki sygnałów pomiarowych i przekaźniki automatyki zabezpieczeniowej, część II: Układy automatyki zabezpieczeniowej i regulacyjnej skrypt Politechniki Wrocławskiej, Wrocław 1991.
- [4] Praca zbiorowa pod red. B. Synala, Automatyka elektroenergetyczna, ćwiczenia laboratoryjne. Cz. II, Układy automatyki zabezpieczeniowej i regulacyjnej, Wyd. PWr. 1991.

### SECONDARY LITERATURE:

- [1] Synal B., Rojewski W., Zabezpieczenia elektroenergetyczne – Podstawy, Podręcznik INPE dla elektryków, Zeszyt 19, 2008.

<b>SUBJECT SUPERVISOR</b>
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