

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Automatyka zabezpieczeniowa - podstawy**
 Name in English: **Power system protection - fundamentals**
 Main field of study (if applicable): **Industrial Control Engineering**
 Specialization (if applicable):
 Level and form of studies: **1st level, full-time**
 Kind of subject: **optional**
 Subject code: **APR012202**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		15		
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 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
5. Understands necessity of continuous knowledge and skills expansion as professional as well as personal and social.

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 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	2
Lec 5	Single input relays, definite time-delay relays and inverse time-delay relays	2
Lec 6	Forming of multi input relays characteristics. Directional relays and impedance relays	2
Lec 7	Differential and phase comparison relays	2
Lec 8	Distance relays	2
Lec 9	Synchronous generators protection	2
Lec 10	Transformer protection	2
Lec 11	HV motors protection	2
Lec 12	MV distribution network protection	2
Lec 13	EHV Transmission networks protection	2
Lec 14	Bus protection	2
Lec 15	Protection of distributed generation	2
Total hours:		30

Form of classes - laboratory		Number of hours:
Lab 1	Presentation of safety regulations and internal regulations of laboratory. Assessment rules. Overview of laboratory stations.	3
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
Lab 5	Test of directional protection of HV lines	3
Total hours:		15

TEACHING TOOLS USED
<p>N1. Problem lecture</p> <p>N2. Lecture with use of multimedia techniques.</p> <p>N3. Laboratory with measurements traditionally arranged, work in groups</p> <p>N4. Oral assessment</p> <p>N5. Report arrangement from measurements</p> <p>N6. Consultation and discussion</p>

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	Oral and writing exam
P(W)	P=F1	
F1(L)	PEU_U01	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
<p>PRIMARY LITERATURE:</p> <p>[1] Syнал B. Rojewski W. Dzierżanowski W., Elektroenergetyczna automatyka zabezpieczeniowa - podstawy, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003</p> <p>[2] Winkler W., Wiszniewski A., Automatyka zabezpieczeniowa w systemach elektroenergetycznych, WNT, Warszawa, 2004.</p> <p>[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.</p> <p>[4] Praca zbiorowa pod red. B. Synala, Automatyka elektroenergetyczna, ćwiczenia laboratoryjne. Cz. II, Układy automatyki zabezpieczeniowej i regulacyjnej, Wyd. PWr. 1991.</p> <p>SECONDARY LITERATURE:</p> <p>[1] Syнал B., Rojewski W., Zabezpieczenia elektroenergetyczne - Podstawy, Podręcznik INPE dla elektryków, Zeszyt 19, 2008.</p> <p>[2] Catalogues of relay protection offered by producers</p>

SUBJECT SUPERVISOR
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