FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Elektroenergetyczna Automatyka Zabezpieczeniowa**
Name in English:	**Power System Protection**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Control in Electrical Power Engineering**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR032231**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		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. Student has structured and theoretically founded knowledge necessary to understand the purpose and tasks of modern power system protection
2. Student has a basic understanding of the criteria and methods of protection and automation solutions to the basic components of the power system
3. Is able to select setting as well as to connect and coordinate the work of one – and many inputs measuring relays in power protections
4. Is able to perform properly and effectively basic research as well as field tests of digital and analog measuring executive units of protection
5. Is able to conduct work in a team and understands the need for continuous education

SUBJECT OBJECTIVES

C1. Acquaintance of a student with modern solutions of power system protections
C2. The acquisition of practical knowledge and skills for setting the criteria quantities to protect electric machines, devices and power networks
C3. Creation of skills and ability to use modern methods, techniques and measurement tools for testing relays and protection systems
C4. The acquisition of practical knowledge and skills related to completion of circuits of power system automation, carrying out measurements and preparation of test protocols

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:	
PEK_W01	student has structured and theoretically founded knowledge necessary to understand the purpose and tasks of modern protection and restitution automation for low – and middle voltage power networks
PEK_W02	Has structured and theoretically founded knowledge necessary to selection of operation criteria of protection and restitution automation for low and middle voltage networks as well as to ways of solution for fundamental elements of electric power system (generators, transformers, motors, power lines)
relating to skills:	
PEK_U01	Can handle the protections tester. Is able to link protection with current and voltage measuring circuits as well as with these for ground faults and control in MV-line models
PEK_U02	Can select and perform setting of triping values for MV and LV protection
PEK_U03	Is able to evaluate the characteristics of basic criteria for operation of protection of electric power objects
relating to social competences:	
PEK_K01	He has a sense of responsibility for him own work and a willingness to comply with the principles of teamwork

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Acquaintance with the subject the requirements of completion, principles of power system protection and basic definitions	2
Lec 2	Relays and relaying systems, new generation of digital relays, the trend in progress	2
Lec 3	Converters of measuring quantities, measuring current and voltage transformers	2
Lec 4	Filters of symmetrical components	2
Lec 5	Fault detection criteria in machines and electrical equipment	2
Lec 6	Methodology for setting of input parameters for simple one-input relay systems	2
Lec 7	Fault detection criteria in electric power networks	2
Lec 8	Ways of setting of multi-input relay systems (directional, differential and distance protection)	2
Lec 9	Protection of synchronous and asynchronous generators	2
Lec 10	Protection of MV and LV power transformers	2
Lec 11	Protection of MV and LV electric motors of high power	2
Lec 12	Disturbances in transmission and distribution el. power networks	2
Lec 13	Distribution MV and LV power network protections	2
Lec 14	Protection of HV and MV transmission power networks	2
Lec 15	The objectives and operation principles of preventive and restitution automation	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction to the rules of safety and to internal procedure applicable in the lab. Determination of completion criteria. Presentation of the lab stands and acquaintance with physical models of protections as well as with performance criteria	3
Lab 2	Examinations of zero sequence current filters	3
Lab 3	Investigation of protection of inverse (dependent) time characteristics	3
Lab 4	Examination of AC motor protection	3
Lab 5	Examination of distance protection	3
Lab 6	Examination of automatic restoration system	3
Lab 7	Examination of auto-reclosing unit	3
Lab 8	Examination of differential protection of the power networks	3
Lab 9	Examination of generator protection	3
Lab 10	Completion and arrears exercises	3
	Total hours:	**30**

TEACHING TOOLS USED
N1. Lecture with the use of audiovisual techniques, multimedia presentations, transparencies
N2. Laboratory testing conducted in the traditional manner in students group
N3. A report of the measurements

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	Oral and written exam
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02 PEK_U03	Checking and assessment of preparation for lab exercises
F2(L)	PEK_U01 PEK_U02 PEK_U03	Evaluation of reports performer exercises
P(L)	P=0,4F1+0,6F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

Horowitz S.H., Phadke A.G., Power System Relaying, RSP England, 1992.
Ungrad H., Winkler W., Wiszniewski A., Protection Techniques in Electrical Energy Systems, Marcel Dekker Inc., New York, 1995.
Winkler W., Wiszniewski A., Automatyka zabezpieczeniowa w systemach elektroenergetycznych, WNT, Warszawa 2004.
Synal B., Elektroenergetyczna automatyka zabezpieczeniowa : podstawy, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003.
Praca zbiorowa por red. B. Synala, Automatyka Elektroenergetyczna, ćwiczenia laboratoryjne cz.I : Przetworniki sygnałów pomiarowych i przekaźniki automatyki zabezpieczeniowej, cz.II : Układy automatyki zabezpieczeniowej i regulacyjnej, Skrypt Politechniki Wrocławskiej, Wrocław 1991.

SECONDARY LITERATURE:

Wróblewski J., Zespoły elektroenergetycznej automatyki zabezpieczeniowej : zasady budowy, WNT, Warszawa 1993.
Wiszniewski A., Algorytmy pomiarów cyfrowych w automatyce elektroenergetycznej, WNT,Warszawa 1990

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR032231 - Power System Protection
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Control in Electrical Power Engineering**

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	S2CPE_W03	C.1	Lec1 Lec2 Lec3 Lec4 Lec5 Lec7 Lec15	N.1
PEK_W02	S2CPE_W03	C.2	Lec6 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_U01	S2CPE_U04	C.3 C.4	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10	N.2 N.3
PEK_U02	S2CPE_U04	C.3 C.4	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10	N.2 N.3
PEK_U03	S2CPE_U04	C.3 C.4	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10	N.2 N.3
PEK_K01	S2CPE_K01	C.1 C.2 C.3 C.4	Lec15 Lab1 Lab10	N.1 N.2 N.3