FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Zabezpieczanie i sterowanie rozproszonymi źródłami energii**
Name in English:	**Protection and Control of Distributed Energy Sources**
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:	**ELR042137**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		15		15
Number of hours of total student workload (CNPS):	60		30		30
Form of crediting:	examination		crediting with grade		crediting with grade
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		1
including number of ECTS points for practical (P) classes :			1		1
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		0.70

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should have the basic knowledge of fundamentals of circuit theory and basics of differential calculus.
2. Student should know how to analyse steady states and transients in linear circuit
3. Student should have ability to think and act in a creative way. Student should have ability to work in a team.

SUBJECT OBJECTIVES

C1. To provide knowledge of methods related to electric power network protection.
C2. Learning how to formulate criteria and schemes for fault detection in power networks.
C3. To provide knowledge of modelling and simulation of transient phenomena in electric power lines.
C4. Learning how to control of distributed generation system.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Student gets the knowledge on description of phenomena accompanying faults in power networks.
PEK_W02 Student gets the knowledge regarding the applied criteria in protective relays.

relating to skills:

PEK_U01 Student is able to model linear elements and branches and also a power transmission line with distributed parameters, in particular, applying the ATP-EMTP programme.
PEK_U02 Student is able to define basic fault detection criteria for protection of distributed generation networks.
PEK_U03 On the base of literature survey student is able to prepare a presentation related to protection and control of distribution networks.

relating to social competences:

PEK_K01 Student can act independently and cooperate within a group working on a complex engineering project.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	General introduction – aims of the course. Establishing conditions for passing and marking the course. Principle of the line and generators protection.	2
Lec 2	Principle of the MV network protection depending on neutral grounding..	2
Lec 3	Methods of distributed generation interconnection with the network.	2
Lec 4	Influence of distributed generation connection with the network from the protection point of view.	2
Lec 5	Methods applied for loss of mains detection..	2
Lec 6	Protection and control of the photovoltaic generation station.	2
Lec 7	Algorithms applied for DFIG and wind turbine control.	2
Lec 8	Algorithms applied for DFIG and wind turbine control.	1
	Total hours:	**15**

Form of classes - laboratory		**Number of hours:**
Lab 1	Presentation of health and safety rules, and general regulations of the laboratory. Establishing conditions for passing and marking the project course. General familiarization with the ATP-EMTP program.	2
Lab 2	Simulation of transmission line with distributed parameters. Analysis of interconnection between distributed generation and the utility network.	2
Lab 3	Testing of the synchronous generation with excitation control scheme.	2
Lab 4	Simulation of double fed induction generator connection to the network.	2
Lab 5	Simulation analysis of the algorithms applied for loss of mains detection.	2
Lab 6	Simulation analysis of the over-current protection.	2
Lab 7	Simulation analysis of the over-current transformer protection.	2
Lab 8	Additional term	1
	Total hours:	**15**

Form of classes - seminar		**Number of hours:**
Sem 1	Introduction. Establishing conditions for passing and marking the seminar subject.	2
Sem 2	Individual presentation by students of the prepared subjects.	12
Sem 3	Summary, pass.	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Informative lecture.
N2. Simulation program ATP-EMTP.
N3. Lab reports.
N4. Presentation of the prepared theme

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	Attendance on lectures
F2(W)	PEK_W01 PEK_W02	exam
P(W)	P=0,1*F1+0,9*F2	
F1(L)	PEK_U01 PEK_U02	Project reports
F2(L)	PEK_U01 PEK_U02	Activity in the project work
P(L)	P=0,3*F1+0,7*F2	
F1(S)	PEK_U03 PEK_K01	Presentation of the prepared theme
F2(S)	PEK_U02 PEK_U03	Activity in the seminar work
P(S)	P=0,1*F1+0,9*F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] ELMOR W.A., PROTECTIVREE LAYING THEORYAN D APPLICATIONS. MARCELD EKKEIRN,C . D E., 2004
[2] http://www.rose.pwr.wroc.pl/index_a.htm - materiały do kursu
[3] LUND H., Renewable Energy Systems. Elsevier Inc. 2010.

SECONDARY LITERATURE:

[1] QUASCHNING V., Understanding Renewable Energy Systems. Earthscan 2005.
[2] JENKINS N. ALLAN R., CROSSLEY P., KIRSCHEN D., STRBACET G., Embedded generation. The Institution of Electrical Engineers, London 2000.
[3] ACKERMANN T. (editor), Wind power in power systems. John Wiley & Sons, Ltd, Chichester 2005

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR042137 - Protection and Control of Distributed Energy Sources
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy Systems**

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	S2RES_W02	C.1 C.2	Lec1 Lec2 Lec3 Lec4	N.1
PEK_W02	S2RES_W02	C.1 C.2	Lec5 Lec6 Lec7 Lec8	N.1
PEK_U01	S2RES_U02	C.3 C.4	Lab1 Lab2 Lab3 Lab4	N.2 N.3
PEK_U02	S2RES_U02	C.3 C.4	Lab5 Lab6 Lab7 Lab8	N.2 N.3
PEK_U03	S2RES_U07	C.3 C.4	Sem1 Sem2 Sem3	N.4
PEK_K01	K2ETK_K01 K2ETK_K06	C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.3 N.4