FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Automatyzacja systemów elektroenergetycznych**
Name in English:	**Automation of electric power systems**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Electrical Power Engineering**
Level and form of studies:	**2nd level, part-time**
Kind of subject:	**optional**
Subject code:	**ELR052578**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	22		11		
Number of hours of total student workload (CNPS):	60		30		
Form of crediting:	examination		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has the knowledge of the electric power systems.
2. Student has the basic knowledge of the control theory.
3. Student has the basic knowledge of programming in Matlab.
4. Student is capable of doing calculations of steady, short-ciruit and transient states of power systems.
5. Student is capable of using the knowledge of electric drives for creating the differential equations on the basis of control block diagrams.
6. Student can integrate control theory with power system theory.
7. Student understands the need of additional training.

SUBJECT OBJECTIVES

C1. To assimilate knowledge associated with the voltage and frequency control, short-circuit and transient processes in multi-machine power systems.

C2. To become skillful at the analysis of the voltage and frequency control, steady states, short-circuit states and transient processes in multi-machine power systems.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Student has the basic knowledge concerning the rules of the voltage and frequency control in multi-machine power systems.

PEU_W02 Student has the well-ordered knowledge concerning the computation of the steady, short-circuits and transient states of multi-machine electric power systems by Matlab.

relating to skills:

PEU_U01 Student can work out the block diagrams and differential equations for voltage and frequency regulators of the system: turbine - generator - stiff system.

PEU_U02 Student is capable of preparing input data and making the computer simulation of the states of multi-machine power system.

PEU_U03 Student is capable of concluding results obtained from the simulation of multi-machine power system.

relating to social competences:

PEU_K01 Student is aware of the responsibility for making decisions on automation of power systems.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	The scope and perspective of the automation of power systems	2
Lec 2	The DC model in the power system analysis.	2
Lec 3	The optimization of generation and transmission energy. Electrical energy market - marginal costs.	2
Lec 4	The generator model in the stability analysis of electric power systems.	2
Lec 5	Modeling the the connection of the synchronous generator with electric power network.	2
Lec 6	The local stability of unit (turbine and generator) equipped with speed governor and voltage regulator.	2
Lec 7	The automatic voltage and speed in multi-machine power systems.	2
Lec 8	The free oscillations in multi-machine power systems. Damping generator swings by power system stabilizers.	2
Lec 9	Voltage stability of power systems. Models and improvements.	2
Lec 10	Modeling the primary and secondary frequency control in an isolated power system.	2
Lec 11	Modeling the primary and secondary frequency control in interconnected power systems. Automatic power and frequency control in interconnected power systems.	2
	Total hours:	**22**

Form of classes - laboratory		**Number of hours:**
Lab 1	The rules of preparing the equivalent schemes for the analysis of steady and transient states of power systems - individual calculations.	2
Lab 2	Voltage regulation and reactive power flow calculation in multi-voltage power systems.	2
Lab 3	Investigatiion of the local stability and damping small rotor swings by power system stabilizers.	2
Lab 4	Investigation of the influence of the parameters of voltage control on the power system stability.	2
Lab 5	Primary frequency control of an isolated power systems.	2
Lab 6	Final test.	1
	Total hours:	**11**

TEACHING TOOLS USED
N1. Information lecture and multimedia presentation.
N2. Laboratory group controlled by checking knowledge and exercise performance.
N3. Checking the knowledge and acquired experience by final test.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02	Written and oral examination
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02	The mark of preparing for the laboratory exercises.
F2(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	The mark of reports.
F3(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Final laboratory test.
P(L)	P=0.3F1+0.4F2+0.3F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kremens Z., Sobierajski M.,Electric power system Analysis. Warsaw WNT 1996 . /in polish/
[2] Machowski J., Bialek J., Bumby J., Power system dynamics and stability. John Wiley and Sons 1997.
[3] Sobierajski M., Łabuzek M., Lis R., Electrical power system analysis in Matlab. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007.

SECONDARY LITERATURE:

[1]Lecture of Automation of electric power systems accessible at http://eps.pwr.wroc.pl/studenci /in polsh/
[2] Sobierajski M., Łabuzek M., Programming in Matlab. Oficyna Wydawnicza Politechniki Wrocławskiej, 2005. /in polish/
[3] Rosołowski E., Computer methods of the analysis of electromagnetic transient states . Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2009/in polsh/

SUBJECT SUPERVISOR

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