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):	**Control Engineering and Robotics**
Specialization (if applicable):	**Automation and Control in Electrical Power Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ARR042512**
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):	120		30		
Form of crediting:	examination		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	4		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.80		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 EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Student has the basic knowledge concerning the rules of the voltage and frequency control in multi-machine power systems.
PEK_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:

PEK_U01	Student can work out the block diagrams and differential equations for voltage and frequency regulators of the system: turbine - generator - stiff system.
PEK_U02	Student is capable of preparing input data and making the computer simulation of the states of multi-machine power system.
PEK_U03	Student is capable of concluding results obtained from the simulation of multi-machine power system.

relating to social competences:

PEK_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.	2
Lec 4	Electrical energy market - marginal costs in the optimization of generation and transmission.	2
Lec 5	The generator model in the stability analysis of electric power systems.	2
Lec 6	Modeling the the connection of the synchronous generator with electric power network.	2
Lec 7	The local stability of unit (turbine and generator) equipped with speed governor and voltage regulator.	2
Lec 8	The automatic voltage and speed in multi-machine power systems.	2
Lec 9	The free oscillations in multi-machine power systems.	2
Lec 10	Damping generator swings by power system stabilizers.	2
Lec 11	Transient stability of multi-machine power systems.	2
Lec 12	Voltage stability of power systems. Models and improvements.	2
Lec 13	Modeling the control of rotational speed of turbogenerators and hydrogenerators.	2
Lec 14	Modeling the primary and secondary frequency control in an isolated power system.	2
Lec 15	Automatic power and frequency control in interconnected power systems.	2
	Total hours:	**30**

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 transient stability by numerical integration of differential equations.	2
Lab 5	Investigation of the influence of the parameters of voltage control on the power system stability.	2
Lab 6	Primary frequency control of an isolated power systems.	2
Lab 7	Investigation of voltage stability of transmission system.	2
Lab 8	Final test.	1
	Total hours:	**15**

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 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	Written and oral examination
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02	The mark of preparing for the laboratory exercises.
F2(L)	PEK_U01 PEK_U02 PEK_U03	The mark o reports
F3(L)	PEK_U01 PEK_U02 PEK_U03	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 polish/

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR042512 - Automation of electric power systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**
AND SPECIALIZATION **Automation and Control in Electrical Power 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	S2ASE_W01 S2ASE_W03	C.1	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_W02	S2ASE_W03	C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.3
PEK_U01	S2ASE_U02	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3
PEK_U02	S2ASE_U02	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3
PEK_U03	S2ASE_U02	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.1 N.2
PEK_K01	K2AiR_K06	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.1 N.2