

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Sterowanie i regulacja w elektroenergetyce**  
 Name in English: **Power system operation and control**  
 Main field of study (if applicable): **Control Engineering and Robotics**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **optional**  
 Subject code: **ARR042203**  
 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):	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. Knows principles of operation of power system and power stations as well as technologies of power generation and transmission
2. Has knowledge about dynamics, statistics and quality and stability of automatics

**SUBJECT OBJECTIVES**

- C1. Acquaintance with structure of managing and rules of operation of power system in normal and abnormal conditions  
 C2. Acquaintance with functions and operation criteria of power system automatics  
 C3. Acquaintance with definition of various conditions of power system operation, reasons of accidents as well as method preventing them  
 C4. Gaining practical skills for electrical circuits assembling, measurement making and testing of regulators used in power system automation

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Has knowledge about the hierarchical structure of managing and control of power system  
 PEK\_W02 Understands and is able to describe of control criteria of turbine, synchronous generator, power transformer and capacitor bank

*relating to skills:*

- PEK\_U01 Is able to design measuring circuit and select proper measuring equipment  
 PEK\_U02 Is able to connect measurement circuit for testing of synchronous generator excitation controller, transformer voltage controller and capacitor banks controlle

*relating to social competences:*

- PEK\_K01 Is conscious about responsibility for his work and ready to work in team

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Hierarchical structure and operation states of electrical power system	2
Lec 2	Development of Polish Electrical Power System and selected statistical data	2
Lec 3	Block diagram of turbo-generation unit and its basic controllers	2
Lec 4	Main characteristics of turbine controller	2
Lec 5	Turbine with controller mathematical model in transient states. Frequency collapse phenomenon	2
Lec 6	Synchronous generators regulation. Generation characteristic, operating chart, role of limiters	2
Lec 7	Synchronous generator excitation units construction and properties	2
Lec 8	Mathematical model of controllers of generating unit for simulation of transient and steady state behavior. Voltage collapse phenomenon	2
Lec 9	Design and mathematical model of transformer tap-changer. Structure and algorithms of controller units	2
Lec 10	Sources of reactive power in electrical power system. Capacitance banks regulation	2
Lec 11	Grouped and centralized power and frequency control in electric power system	2
Lec 12	Complex regulation of voltage and reactive power in electric power system	2
Lec 13	Distributed control of voltages and reactive power	2
Lec 14	Distributed generation as controlled source of voltage and reactive power for a medium voltage network	2
Lec 15	Telemetry and telecontrol	2
Total hours:		<b>30</b>

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	Testing of generator controller	3
Lab 3	Testing of transformer voltage controller	3
Lab 4	Testing of capacitor banks controller	3
Lab 5	Synchronization of generator with electrical network	3
Total hours:		<b>15</b>

TEACHING TOOLS USED
N1. Specialized lecture
N2. Report arrangement from measurements

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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)	PEK_W01 PEK_W02	Oral and writing test
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02	Assessment of prepared laboratory reports
F2(L)	PEK_U01 PEK_U02	Activity during laboratory
P(L)	P=0,5F1+0,5F2	

PRIMARY AND SECONDARY LITERATURE
<b>PRIMARY LITERATURE:</b>
[1] Machowski J., Regulacja i stabilność systemu elektroenergetycznego. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2007.
[2] Kremens Z., Sobierajski M., Analiza systemów elektro-energetycznych, WNT, Warszawa, 1996.
[3] Machowski J., Bialek S., Bumby J., Power system dynamics and stability, John Wiley and Sons, 1998
[4] Zajczyk R., Modele matematyczne systemu elektroenergetycznego do badania elektromechanicznych stanów nieustalonych i procesów regulacyjnych, Wydawnictwo PG, 2003
<b>SECONDARY LITERATURE:</b>
[1] Polish Instruction of Transmission System Operation and Maintenance
[2] Outlines developed by the teacher

**SUBJECT SUPERVISOR**

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**MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
ARR042203 - Power system operation and control  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Control Engineering and Robotics**

<b>Subject educational effect</b>	<b>Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)</b>	<b>Subject objectives</b>	<b>Programme content</b>	<b>Teaching tool number</b>
PEK_W01	K1AIR_ASE_W08	C.1	Lec1 Lec2	N.1
PEK_W02	K1AIR_ASE_W08	C.2 C.3	Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_U01	K1AIR_ASE_U09	C.4	Lab1 Lab2 Lab3 Lab4 Lab5	N.2
PEK_U02	K1AIR_ASE_U09	C.4	Lab2 Lab3 Lab4 Lab5	N.2
PEK_K01	K1AiR_K09	C.4	Lab2 Lab3 Lab4 Lab5	N.2