

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Systemy elektroenergetyczne 2**
 Name in English: **Electric Power Systems 2**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable):
 Level and form of studies: **1st level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR042506**
 Group of courses: **NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has the knowledge of the analysis methods of steady and short-circuits states in electric power systems.
2. Student has the basic knowledge of the control theory in the field of dynamic stability of technical systems.
3. Student has the basic knowledge of programming in Matlab.
4. Student is capable of using differentiation and integration for the analysis of steady and transient states of linear electric circuits.
5. Student is capable of using the knowledge of electric drives for modeling the generator in subtransient , transient and synchronous states.
6. Student is capable of using Matlab for the analysis of electric power system states.
7. Student can work in a team.
8. Student understands the need of various knowledge to integrate.

SUBJECT OBJECTIVES

- C1. To assimilate knowledge associated with the voltage and frequency control in electric power systems.
 C2. To become skillful at the analysis of steady, short-circuits and transient states of electric power system examples

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

PEK_W01 Student has the basic knowledge concerning the rules of the voltage and frequency control and the power system stability.

PEK_W02 Student has the well-ordered knowledge concerning the computation of the steady, short-circuits and transient states of electric power systems.

relating to skills:

PEK_U01 Student can work out the equivalent schemes of power system in steady, short-circuits and transient states and calculate the equivalent parameters.

PEK_U02 Student is capable of preparing input data and making computer simulation of power system states. PEK_U03. Student is capable

relating to social competences:

PEK_K01 Student is aware of the responsibility for making decisions on power systems.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Introduction to the analysis of transient electromechanical states.	2
Lec 2	The small disturbance of power systems.	2
Lec 3	Using the equal area method for the stability examination. Individual work.	2
Lec 4	The quality of electric energy - requirement and standards.	2
Lec 5	The voltage control in electric power systems.	2
Lec 6	The voltage stability of electric power systems.	2
Lec 7	The frequency control in electric power systems.	2
Lec 8	Smart power grids.	1
Total hours:		15

Form of classes - laboratory		Number of hours:
Lab 1	Introduction - the health and safety requirements, the rules of making laboratory exercises	2
Lab 2	Load flow calculation in radial transmission system.	2
Lab 3	Preparing equivalent schemes and input data for load flow computation in per unit.	2
Lab 4	Iterative computation of load flow in power system.	2
Lab 5	The control of voltage and tap transformers to minimize the transmission power losses.	2
Lab 6	Preparing equivalent schemes and parameters in the symmetrical component system of 012.	2
Lab 7	The computation of the initial symmetrical short-circuit currents supplied by independent sources.	2
Lab 8	The computation of the initial, peak, breaking and thermal equivalent short-circuit currents according to IEC.	2
Lab 9	Preparing the input data file for the analysis of unsymmetrical short-circuits. Computing the impedance matrix in the symmetrical component system of 012.	2
Lab 10	The computation of the initial current in 1-phase and 2-phase short-circuits in the solidly grounded network.	2
Lab 11	Limiting the short-circuit currents and checking the effectiveness of the solidly grounding.	2
Lab 12	The analysis of 1-phase short-circuit in the middle voltage network.	2
Lab 13	Badanie stabilności metodą równych pól układu przesyłowego: system sztywny - generator.	2
Lab 14	Simultaing the transient stability of single generator system by numerical integration.	2
Lab 15	Final test.	2
Total hours:		30

TEACHING TOOLS USED

- N1. Information lecture and multimedia presentation.
 N2. Presenting problems in the form of individual controlled work.
 N3. Laboratory group controlled by checking knowledge and exercise performance.
 N4. Checking the knowledge and acquired experience by final test.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <small>F - forming (during semester) P - concluding (at semester end)</small>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02	Individual work
F2(W)	PEK_W01 PEK_W02	Written examination.
P(W)	$P=0.4F1+0.6F2$	
F1(L)	PEK_U01 PEK_U02	The mark of preparing for the laboratory exercises.
F2(L)	PEK_U01 PEK_U02	The mark of reports.
F3(L)	PEK_U01 PEK_U02	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] Kacejko P., Machowski J., Short-circuits in electric power systems. Warsaw WNT 2002. /in polish/
 [3] Electric power system lecture accessible at <http://eps.pwr.wroc.pl/studenci>. /in polish/

SECONDARY LITERATURE:

- [1] Kacejko P., Dispersed generation in electric power system. Wydawnictwa Politechniki Lubelskiej 2004. /in polish/
 [2] Sobierajski M., Łabuzek M., Programming in Matlab. Oficyna Wydawnicza Politechniki Wrocławskiej, 2005. /in polish/
 [3] Lecture of Informatics in electrical engineering accessible at <http://eps.pwr.wroc.pl/studenci> /in polsh/

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ELR042506 - Electric Power Systems 2** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical 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	K1ETK_W33	C.1	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2
PEK_W02	K1ETK_W33	C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.3 N.4
PEK_U01	K1ETK_U22	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.3 N.4
PEK_U02	K1ETK_U22	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.3 N.4
PEK_K01	K1ETK_K05	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.1 N.2