

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Systemy elektroenergetyczne**
 Name in English: **Electric power systems**
 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: **obligatory**
 Subject code: **ARR042503**
 Group of courses: **NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has the knowledge of analysis, matrices, differentiation, integration, matrix equations and numerical methods.
2. Student has the basic knowledge of the analysis methods of 3- and 1-phase electric circuit in the coordination set of ABC and 012.
3. Student is capable of using Ohm's and Kirchhoff's laws and matrices to solve steady and short-circuit states of linear electric circuits.
4. Student is capable of using the electrical engineering knowledge for modeling energy sources and receivers of energy.
5. Student understands the need of various knowledge to integrate.

SUBJECT OBJECTIVES

- C1. To assimilate knowledge associated with the transmission and distribution of electricity.
 C2. To get to know modeling power system elements in steady and short circuit states.
 C3. To become skillful at the analysis of voltage, current, active and reactive power in radial systems.
 C4. To become skillful at the analysis of currents in balanced and unbalanced short-circuits.
 C5. To become skillful at the analysis of stability of radial power systems.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 Student has the knowledge concerning the steady state model creation and the load flow methods and short-circuit.
 PEK_W02 Student has the knowledge concerning the analysis of the stability of radial transmission systems.

*relating to skills:**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	Contemporary problems of generation and transmission electricity. Equivalent scheme of overhead and cable lines and transformers.	2
Lec 2	Equivalent scheme of overhead and cable lines and transformers.	2
Lec 3	Modeling and calculating the radial transmission network. Individual work no. 1.	2
Lec 4	Mathematical model of the computation of load flow in transmission networks.	2
Lec 5	Balanced short-circuit. Matrix equations, the equivalent voltage source of electric power systems.	2
Lec 6	Short-circuit calculation according to IEC. Example short-circuit analysis.	2
Lec 7	Unbalanced short-circuit. The symmetrical components method. Equivalent schemes and parameters in the symmetrical components of 012.	2
Lec 8	Currents and voltages in short-circuit. Individual work no. 2.	2
Lec 9	One-phase short-circuit in the middle voltage network.	2
Lec 10	Equation of generator rotor. Local stability of generator connected to electric power system.	2
Lec 11	The analysis of stability - equal area criterion. Individual work no. 3.	2
Lec 12	Voltage and frequency control in electric power systems.	2
Lec 13	Electric power systems with the large amount of dispersed generation	2
Lec 14	The quality of electrical energy.	2
Lec 15	Smart power grids - introduction.	2
Total hours:		30

TEACHING TOOLS USED
N1. Information lecture and multimedia presentation.
N2. Presenting problems in the form of individual controlled work.

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	Individual work no. 1 concerning load flow in radial network.
F2(w)	PEK_W01	Individual work no. 2 concerning balanced and unbalanced short-circuits in multi-voltage system.
F3(w)	PEK_W02	Individual work no. 3 concerning the stability analysis of radial transmission systems.
P(w)	$P=0.4F1+0.4F2+0.2F3$	

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/
SECONDARY LITERATURE: [1] Kacejko P., Dispersed generation in electric power system. Wydawnictwa Politechniki Lubelskiej 2004. /in polish/

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR042503 - Electric power systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

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	K1AiR_W15 K1AiR_W25	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_W02	K1AiR_W15 K1AiR_W25	C.2 C.3	Lec2 Lec3 Lec4 Lec15	N.1
PEK_K01	K1AiR_K05	C.1 C.2 C.3 C.4 C.5	Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.2