FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Symulacja elektromagnetycznych stanów przejściowych**
Name in English:	**Electromagnetic transients simulation**
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:	**ARR042118**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should have the basic knowledge of fundamentals of circuit theory and mathematical analysis, including basics of differential equations.
2. Student should have the basic knowledge of 3-phase circuits and theory of symmetrical components.
3. Student should know how to analyse steady states and transients in AC one- and three-phase circuits

SUBJECT OBJECTIVES

C1. To provide knowledge of methods for simulation of one- and three-phase circuits.
C2. Learning how to formulate digital models of electrical circuits.
C3. To provide knowledge of how to utilize the simulation results for measurements and dynamic circuit analysis.
C4. Familiarization with principles of simulation of the complex network with electrical and electro-mechanical elements.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Student gets the knowledge on formulation of discrete models of linear electrical circuits for analysis of their dynamical states.

PEK_W02 Student gets the knowledge regarding application of selected computer tools for simulation of basic electrical and electro-mechanical phenomena.

relating to skills:

PEK_U01 Student is able to prepare mathematical and simulation models of one- and three-phase electric circuits.

PEK_U02 Student is able to apply results of simulations for analysis of dynamic phenomena in electric circuits.

relating to social competences:

PEK_K01 Student can act independently and cooperate within a group working on a complex engineering project

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	General introduction – aims of the course. Establishing conditions for passing and marking the course. Principles of preparing the RLC mathematical and computer model.	2
Lec 2	Digital models of voltage and current sources; simplified models of switches.	2
Lec 3	Models of electric lines: lumped and distributed parameters model. Bergeron's method.	2
Lec 4	Digital model of a single-phase line of lumped and distributed parameters and frequency-dependent parameters.	2
Lec 5	Formulation of voltage nodal equations related to linear circuits. Determination of initial conditions.	2
Lec 6	Modelling of nonlinear resistance, inductance and capacitance.	2
Lec 7	Determination and solution of circuit models according to the state variable principle.	2
Lec 8	Qualified test	1
	Total hours:	**15**

Form of classes - project		Number of hours:
Proj 1	Presentation of health and safety rules, and general regulations of the laboratory. Establishing conditions for passing and marking the project course. General familiarization with the ATPDraw graphical editor of the ATP-EMTP program	2
Proj 2	Modelling of single-phase circuits composed of RLC elements	2
Proj 3	Modelling of the three-phase networks with power transformer.	2
Proj 4	Transmission lines modelling with instrument transformers.	2
Proj 5	Modelling of measurement elements with application of MODELS module.	2
Proj 6	Simulations of induction motors	2
Proj 7	Simulation of the synchronous generator with the excitation system control.	2
Proj 8	Additional term.	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Informative lecture
N2. Simmulation program ATP-EMTP
N3. Project reports

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	attendance on lectures
F1(W)	PEK_W01 PEK_W02	Qualified test
P(W)	P=0,1*F1+0,9*F2	
F1(P)	PEK_U01 PEK_U02	Activity in the project work
F2(P)	PEK_U01 PEK_U02 PEK_K01	Project reports
P(P)	P = 0,3F1 + 0,7F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] ROSOŁOWSKI E., Komputerowe metody analizy elektromagnetycznych stanów przejściowych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2009.
[2] http://zas.ie.pwr.wroc.pl/ER/przyklady_D1/index.html - przykłady niektórych modeli wraz z plikami źródłowymi do programu ATP-EMTP.

SECONDARY LITERATURE:

[1] WATSON N., ARRILAGA J., Power systems electromagnetic transients simulation. The Institution of Electrical Engineers, 2003.
[2] Michalik M., Rosołowski E., Simulation and analysis of power system transients. PRINTPAP, 2011.
[3] AMETANI A., NAGAOKA N., BABA Y., OHNO T., Power System Transients. Theory and Applications. CRC Press. Taylor & Francis Group, 2014.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR042118 - Electromagnetic transients simulation
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	K2AiR_W02 K2AiR_W03 S2ASE_W06	C.1 C.2	Lec1 Lec2 Lec3 Lec4	N.1
PEK_W02	K2AiR_W02 K2AiR_W03 S2ASE_W06	C.3 C.4	Lec5 Lec6 Lec7 Lec8	N.1
PEK_U01	K2AiR_U02 K2AiR_U03 S2ASE_U04	C.3 C.4	Proj1 Proj2 Proj3 Proj4	N.2 N.3
PEK_U02	K2AiR_U02 K2AiR_U03 S2ASE_U04	C.3 C.4	Proj5 Proj6 Proj7 Proj8	N.2 N.3
PEK_K01	K2AiR_K02	C.3 C.4	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8	N.2 N.3