

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Modelowanie cyfrowe w elektroenergetyce**
 Name in English: **Digital Modelling in Power Systems**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Electrical Power Engineering**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR042113**
 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 basics of differential calculus.
2. Student should know how to formulate digital models of electrical circuits and to conduct analyses regarding accuracy, stability and frequency characteristics.
3. Student should know how to analyse steady states and transients in linear circuits.

SUBJECT OBJECTIVES

- C1. To provide knowledge of methods for preparing simulation models of one- and three-phase circuits.
- C2. Learning how to formulate digital models of electrical circuits and to conduct analyses regarding accuracy, stability and frequency characteristics.
- C3. To provide knowledge of modelling a power line with distributed parameters.
- C4. Familiarization with principles of using professional simulative programs, in particular with ATP-EMTP program as an example, for simulating transients in electrical circuits.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 Student gets the knowledge on description of models for linear electrical circuits with use of differential equations and their numerical solution applying different numerical procedures of integration.
- PEK_W02 Student gets the knowledge regarding evaluation of accuracy and stability of the solution of a differential equation in a numerical way.

relating to skills:

- PEK_U01 Student is able to model linear elements and branches and also a power transmission line with distributed parameters, in particular, applying a graphical editor of this program, forms a structure of a simulative model, sets simulation parameters
- PEK_U02 Student is able to apply results of computer simulation to analyse of dynamic 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. Introduction into ATP-EMTP program: structure of the program and its characteristic. Modelling of 3-phase network with lumped parameters.	2
Lec 2	Modelling of overhead and cable lines with distributed parameters	2
Lec 3	3-Phase transformer modelling; representation of electric and magnetic circuits.	2
Lec 4	Modelling of instrument transformers; representation of the relay input circuits.	2
Lec 5	Representation of the induction motors; electric and mechanical circuit model.	2
Lec 6	Synchronous generator model. Parameter calculation.	2
Lec 7	Wind generation modelling: electric and mechanic parts.	2
Lec 8	Qualified test.	1
Total hours:		15

Form of classes - laboratory		Number of hours:
Lab 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 ATP-EMTP program.	2
Lab 2	Simulation of transmission line with distributed parameters. Measurement of the symmetrical components.	2
Lab 3	Simulation of 3-phase transformer. Test of the transformer energising.	2
Lab 4	Simulation of the instrument transformers with the relay input chain.	2
Lab 5	Simulation of the induction motors. Test of start and load changing.	2
Lab 6	Testing of the synchronous generation with excitation control scheme.	2
Lab 7	Simulation of wind generation station with control scheme.	2
Lab 8	Additional term.	1
Total hours:		15

TEACHING TOOLS USED

- N1. Informative lecture.
 N2. Simulation program.
 N3. Lab reports.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02	Attendance on lectures
F2(W)	PEK_W01 PEK_W02	Qualified test
P(W)	$P = 0,1F1 + 0,9F2$	
F1(L)	PEK_U01 PEK_U02 PEK_K01	Activity in the lab
F2(L)	PEK_U01 PEK_U02 PEK_K01	Lab reports
P(L)	$P = 0,3F1 + 0,7F2$	

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 – examples with completed ATP-EMTP models.

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.

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR042113 - Digital Modelling in Power Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Electrical Power 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	K2ETK_W03 S2EEN_W05	C.1 C.2	Lec1 Lec2 Lec3 Lec4	N.1
PEK_W02	K2ETK_W03 S2EEN_W05	C.1 C.2	Lec5 Lec6 Lec7 Lec8	N.1
PEK_U01	K2ETK_U01 S2EEN_U05	C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3
PEK_U02	K2ETK_U01 S2EEN_U05	C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3
PEK_K01	K2ETK_K02	C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3