

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, part-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052177**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	11		11		
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 LEARNING OUTCOMES*relating to knowledge:*

- PEU_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.
 PEU_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:

- PEU_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, conducts a simulation and analyses waveforms of signals from a modelled system.
 PEU_U02 Student is able to apply results of computer simulation to analyse of dynamic electric circuits.

relating to social competences:

- PEU_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	3-Phase transformer modelling; representation of electric and magnetic circuits..	2
Lec 2	Modelling of electric network with lumped parameters.	2
Lec 3	Modelling of instrument transformers and input measurement chains	2
Lec 4	Power station model with synchronous generator and control schemes	2
Lec 5	Modelling of wind generator with active and reactive power control scheme.	2
Lec 6	Qualified test.	1
Total hours:		11

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 EMTP-ATP program.	2
Lab 2	Simulation of faults in MV networks. Symmetrical components measurement	2
Lab 3	Simulation and analysis of the induction motors. Test of start and load changing..	2
Lab 4	Simulation and analysis of the induction motors. Test of start and load changing..	2
Lab 5	Simulation of the instrument transformers with the relay input chain.	2
Lab 6	Additional term	1
Total hours:		11

TEACHING TOOLS USED
N1. Informative lecture
N2. Simulation program ATP-EMTP
N3. Lab reports

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEU_W01 PEU_W02	Attendance on lectures
F2(w)	PEU_W01 PEU_W02	Qualified test
P(w)	$P=0,1 \cdot F1 + 0,9 \cdot F2$	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Activity in the project work
F2(L)	PEU_U01 PEU_U02 PEU_K01	Lab reports
P(L)	$P=0,3 \cdot F1 + 0,7 \cdot F2$	

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

SUBJECT SUPERVISOR
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