FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Modelowanie systemu elektroenergetycznego**
Name in English:	**Power System Modelling**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Renewable Energy Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**ELR032534**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30			15	
Number of hours of total student workload (CNPS):	90			30	
Form of crediting:	examination			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	3			1	
including number of ECTS points for practical (P) classes :				1	
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10			0.70	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basics of mathematical analysis and linear algebra.
2. Knowledge of basics of power systems.
3. Abilities of developing computer programs and performing calculation in the Matlab environment.

SUBJECT OBJECTIVES

C1. Acquiring knowledge in the scope of modern concepts of power system modelling.
C2. Acquiring competence in solving the problems of the power system state estimation and estimation of loads in distribution system.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 The student has knowledge on models for different states of power systems.
PEK_W02 The student knows principles of power system model reduction.
PEK_W03 The student knows principles of real-time modelling of power system.

relating to skills:

PEK_U01 The student is able to choose models of power system elements for given case of calculations.
PEK_U02 The student is able to determine required power-system-model reduction for given case of calculations.
PEK_U03 The student is able to evaluate a process of real-time power-system modeling.

relating to social competences:

PEK_K01 The student is able to think and act creatively

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	An introduction to the lecture, program of the lecture, requirements. General principles of modelling.	2
Lec 2	Models for steady states analyses scope of utilisation.	2
Lec 3	Models for transient analyses scope of utilisation.	2
Lec 4	Power system model reduction: types of equivalents. Network transformation.	2
Lec 5	Power system model reduction: aggregation of generating units, equivalent model of the external subsystem.	2
Lec 6	Real-time modelling of power system: need of real-time modelling, main problems, general approaches.	2
Lec 7	Summation of modelling for different power system analyses. Test.	2
Lec 8	Weighted least squares (WLS) power system state estimation. Alternative formulations of the power system state estimation.	2
Lec 9	Network observability analysis.	2
Lec 10	Bad data detection and identification.	2
Lec 11	Network parameter estimation. Topology error processing.	2
Lec 12	State estimation using ampere measurements.	2
Lec 13	State estimation of distribution system specific problems.	2
Lec 14	Estimation of loads in distribution system.	2
Lec 15	Summation of estimation problems for power system. Test	2
	Total hours:	**30**

Form of classes - project		**Number of hours:**
Proj 1	Power system model reduction	2
Proj 2	Weighted least squares power system state estimation in the polar coordinate system.	4
Proj 3	Weighted least squares power system state estimation in the rectangular coordinate system	4
Proj 4	Network observability analysis	2
Proj 5	Bad data identification.	1
Proj 6	Topology verification.	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Multimedia presentation.
N2. Information lecture.
N3. Preparation in the form of reports.
N4. The Matlab programs.

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 PEK_W03	activity at the classes
F2(W)	PEK_W01 PEK_W02 PEK_W03	tests
F3(W)	PEK_W01 PEK_W02 PEK_W03	exam
P(W)	P=0.1 F1 + 0.2 F2 + 0.7 F3	
F1(P)	PEK_U01 PEK_U02 PEK_U03	activity at the classes
F2(P)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	reports from the classes
P(P)	P=0.3 F1 + 0.7 F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Łukomski R., Okoń T., Wilkosz K., Power system modelling. Wrocław University of Technology, 2011.
[2] Abur A., Exposito A. G., Power system state estimation. New York, Marcel Dekker, Inc. 2004.
[3] Machowski J., Białek J.W.,Bumby J. R., Power system dynamics and stability, New York, John Willey & Sons 1997.

SECONDARY LITERATURE:

Publikacje w czasopismach z zakresu elektroenergetyki

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR032534 - Power System Modelling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy 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	S2RES_W15	C.1	Lec1 Lec2 Lec3	N.1 N.2
PEK_W02	S2RES_W15	C.1	Lec4 Lec5	N.1 N.2
PEK_W03	S2RES_W15	C.1	Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_U01	S2RES_U16	C.2	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6	N.3 N.4
PEK_U02	S2RES_U16	C.2	Proj1	N.3 N.4
PEK_U03	S2RES_U16	C.2	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6	N.3 N.4
PEK_K01	S2RES_K01	C.2	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6	N.3