

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Modelowanie maszyn elektrycznych**
 Name in English: **Modelling of electrical machines**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Renewable Energy Sources**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **ELR043109**
 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. Knowledge of Electrical Engineering Fundamentals
2. Knowledge of Electrical Machines Fundamentals

SUBJECT OBJECTIVES

- C1. The achievement of grounds of electromagnetic modeling of induction machines operating as motors or self-excited generators
- C2. Knowledge of possibility application of modern numerical techniques for modeling of induction machines operating as motors or generators.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 Student has knowledge of two-dimensional field-circuit modeling of induction machines
- PEK_W02 Student is able to describe performance characteristics of induction machines operating as motor or generator in dynamic and steady-states.

*relating to skills:**relating to social competences:*

- PEK_K01 Acquirement and strengthen of social competences in self-reliant work, persistent engineering education and obey customs and principles of academic society.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Course schedule and requirements. Mathematical basics of field - circuit modeling of electrical machines.	2
Lec 2	The basic electromagnetic quantities and equations.	2
Lec 3	Electrostatic, magnetostatic and magnetodynamic fields.	2
Lec 4	Outline of the finite element method (FEM).	2
Lec 5	The FEM applied to 2D electromagnetic field problems.	2
Lec 6	Meshing methods for 2D domains.	2
Lec 7	The two dimensional FE model of induction machine	2
Lec 8	Field-circuit equations of windings of induction machines	4
Lec 9	Accounting for movement in modeling of induction machines	2
Lec 10	Accounting for skew effect in modeling of induction machines	2
Lec 11	Methods of electromagnetic torque calculation	2
Lec 12	Flux linkages and inductance of windings	2
Lec 13	Determination of performance characteristics, losses and efficiency	2
Lec 14	Written test	2
Total hours:		30

TEACHING TOOLS USED
N1. Multimedia and traditional presentation.

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 PEK_W02 PEK_K01	Written test
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: <ol style="list-style-type: none"> Hameyer K., Belmans R.: Numerical modeling and design of electrical machines and devices, WITT Press, Southampton, 1999 Di Barbra P., Savini A., Wiak S. : Field models in electricity and magnetism, Springer, 2008 Sadiku Matthew N.O. : Numerical techniques in electromagnetics, CRC Press, 2001 Jianming Jin: The finite element method in electromagnetics, John Wily & Sons, Inc., 2002 Bianchi Nicola: Electrical machine analysis using finite elements, CRC Taylor & Francis Group, 2005. Meunier Gerard : The finite element method for electromagnetic modeling, John Wily & Sons, Inc., 2008 Flux 2D v. 11.1, User guide, CEDRAT, 2012 SECONDARY LITERATURE: <ol style="list-style-type: none"> Champan S.J.: Electric machinery fundamentals, McGraw-Hill, N.Y., 2005 Zienkiewicz O.C., Taylor R.L., Zhu J.Z.: The finite element methods: its basis and fundamentals, Elsevier B-H, Amsterdam, 2005

SUBJECT SUPERVISOR
Krzysztof Makowski, krzysztof.makowski@pwr.edu.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR043109 - Modelling of electrical machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy Sources**

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	S2OZE_W16	C.1	Lec1 Lec2 Lec3 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1
PEK_W02	S2OZE_W16	C.2	Lec4 Lec5 Lec6	N.1
PEK_K01	K2ETK_K01	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1