FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Układy elektromaszynowe w energetyce odnawialnej**
Name in English:	**Electromechanical Systems in Renewable Energy**
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:	**ELR053107**
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):	60		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students knows principles during electrical energy transformation (power loss, heating and cooling)
2. Students has knowledge about construction, parameters, properties and characteristics of transformers, induction and synchronous generators.
3. He can recognize the power converters using electromagnetic induction: transformers, AC machines (induction and synchronous).
4. He can explain the principles of operation of transformers and induction electric machines.
5. He can take the information from the literature in the field of transformers and electrical machines.
6. Student is aware of their own responsibility for their work and a willingness to comply with the principles of technical university graduate.

SUBJECT OBJECTIVES

C1. Basic knowledge about physical phenomena and construction of induction generators.
C2. Basic knowledge about physical phenomena and construction of synchronous generators.
C3. Measurement ability to measure characteristics of AC and DC generators.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Students knows principles during electrical energy transformation and phenomena in AC and DC generators.
PEU_W02	Student has knowledge about AC electrical power generation from renewable energy sources.
PEU_W03	Student has knowledge about DC electrical power generation from renewable energy sources.

relating to skills:

PEU_U01	Student is able to explain phenomena, parameters and properties of AC generators.
PEU_U02	Student is able to explain principles, phenomena, properties and characteristics of DC generators.
PEU_U03	Student is able to measure and analyze characteristics and parameters generators working with renewable energy sources. Student is able to work with electrical circuits safely, register electrical quantities and make reports

relating to social competences:

PEU_K01	Student is aware of their own responsibility for their work and a willingness to comply with the principles of teamwork.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Literature.	1
Lec 2	Basic principles in electrical machines. Construction of AC machines.	3
Lec 3	Principles of electrical power generation from renewable energy sources.	2
Lec 4	Magnetic field distribution in generator air gap.	2
Lec 5	Armature reaction in AC generators.	2
Lec 6	Basic parameters of asynchronous and synchronous generators.	2
Lec 7	Generators driven by high-speed turbines.	2
Lec 8	Generators driven by low-speed turbines.	2
Lec 9	Asynchronous generators- characteristics, parameters.	2
Lec 10	Synchronous generators with electromagnetic excitation- characteristics, parameters.	2
Lec 11	Synchronous generators with permanent magnets- characteristics, parameters.	2
Lec 12	Disc rotor synchronous generators.	2
Lec 13	Three-phase winding with changeable number of pole pairs- construction.	2
Lec 14	Three-phase winding with changeable number of pole pairs- application.	2
Lec 15	Generators with frequency converters, grades.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction, safety instructions.	2
Lab 2	Squirrel-cage asynchronous generator.	3
Lab 3	Slip-ring asynchronous generator.	3
Lab 4	Permanent magnet synchronous generator.	3
Lab 5	Self-excited DC generator.	3
Lab 6	Grading.	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Lecture with multimedia presentation.
N2. Laboratory with measurement test stands.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	writing exam
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Laboratory preparation
F2(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	laboratory activity
F3(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	reports
P(L)	P=0,3*F1+0,3*F2+0,4*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Plamitzer A., Maszyny elektryczne, WNT, Warszawa 1989
[2] Latek W: Zarys maszyn elektrycznych. WNT W-wa 1974 r.
[3] Antal L., Janta T., Zieliński P.: Maszyny elektryczne. Ćwiczenia laboratoryjne. Of. Wyd. PWr, Wrocław 2001.

SECONDARY LITERATURE:

[1] Dąbrowski M. Projektowanie maszyn prądu przemiennego, WNT Warszawa 1994
[2] Dąbrowski M. Konstrukcja maszyn elektrycznych, WNT W-wa 1978
[3] Gieras J. F., Wing M.: Permanent magnet motor technology, Marcel Dekker, Inc. New York, Basel 2002
[4] Glinka T., Mikromaszyny elektryczne o magnesach trwałych, Wyd. Pol. Śl. Gliwice 2002
[5] Latek W.: Maszyny elektryczne w pytaniach i odpowiedziach. WNT Wa-wa 1978 r.

SUBJECT SUPERVISOR

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