

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): **Renewable Energy Sources**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR043107**  
 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 EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Students knows principles during electrical energy transformation and phenomena in AC and DC generators.  
 PEK\_W02 Student has knowledge about AC electrical power generation from renewable energy sources.  
 PEK\_W03 Student has knowledge about DC electrical power generation from renewable energy sources.

*relating to skills:*

- PEK\_U01 Student is able to explain phenomena, parameters and properties of AC generators.  
 PEK\_U02 Student is able to explain principles, phenomena, properties and characteristics of DC generators.  
 PEK\_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:*

- PEK\_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:		<b>30</b>

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:		<b>15</b>

## TEACHING TOOLS USED

- N1. Lecture with multimedia presentation.  
 N2. Laboratory with measurement test stands.

## 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 PEK_W03	writing exam
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Laboratory preparation,
F2(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	laboratory activity
F3(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	reports
P(L)	$P=0,3 \cdot F1 + 0,3 \cdot F2 + 0,4 \cdot F3$	

## 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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### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ELR043107 - Electromechanical Systems in Renewable Energy** 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_W05	C.1 C.2	Lec1 Lec2 Lec4 Lec5 Lec13 Lec15	N.1
PEK_W02	S2OZE_W05	C.1 C.2	Lec2 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_W03	S2OZE_W05	C.1 C.2	Lec2 Lec3 Lec4 Lec5 Lec8	N.1
PEK_U01	S2OZE_U03	C.1 C.2 C.3	Lab2 Lab3	N.2
PEK_U02	S2OZE_U03	C.2 C.3	Lab5	N.2
PEK_U03	S2OZE_U03	C.2 C.3	Lab2 Lab3 Lab4 Lab5	N.2
PEK_K01	K2ETK_K07	C.3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6	N.2