

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, part-time**
 Kind of subject: **obligatory**
 Subject code: **ELR053167**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	22		11		
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. Basic principles in electrical machines. Construction of AC machines.	2
Lec 2	Principles of electrical power generation from renewable energy sources. Principles of the magnetic field in the magnetic core (air gap) generators and the effect on induced voltages.	3
Lec 3	Interaction the armature winding to the magnetic field in AC generators.	2
Lec 4	Basic parameters of asynchronous and synchronous generators. Armature reaction in AC generators.	2
Lec 5	Generators driven by high-speed turbines – characteristics, parameters. Generators driven by low-speed turbines – characteristics, parameters.	2
Lec 6	Asynchronous generators- characteristics, parameters.	2
Lec 7	Synchronous generators with electromagnetic excitation- characteristics, parameters	2
Lec 8	Synchronous generators with permanent magnets- characteristics, parameters. Disc rotor synchronous generators.	2
Lec 9	Three-phase winding with changeable number of pole pairs- construction and application.	3
Lec 10	Generators with frequency converters (6 and 12 pulse), grades.	2
Total hours:		22

Form of classes - laboratory		Number of hours:
Lab 1	Introduction, safety instructions. General familiarization with the laboratory sets. Discussion of the principles of measurement and determination of magnetic core and windings.	1
Lab 2	Research the characteristics and parameters of an squirrel-cage asynchronous generator.	3
Lab 3	Research the characteristics and parameters of an synchronous generator with electromagnetic excitation.	3
Lab 4	Research the characteristics and parameters of an permanent magnet synchronous generator.	3
Lab 5	Summary of works, grading.	1
Total hours:		11

TEACHING TOOLS USED

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

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 PEU_W03	Test
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:

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| <ul style="list-style-type: none">[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. |
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SECONDARY LITERATURE:

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| <ul style="list-style-type: none">[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.[6] Laboratoryjne instrukcje do ćwiczeń |
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SUBJECT SUPERVISOR

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