

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Maszyny elektryczne z magnesami trwałymi**
 Name in English: **Permanent magnet electrical machines**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Industrial Electrical Engineering**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **ELR043105**
 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:	examination		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.
3. Students has knowledge about construction, parameters, properties and characteristics of AC and DC machines.
4. Student is able to recognize of electrical machines: transformers.
5. Student is able to explain principles of transformers, AC and DC machines.
6. Student is able to measure and analyze characteristics of transformers, AC and DC machines.
7. Student is able to obtain information about electrical machines.
8. Student is able to identify and solve problems of engineering.
9. 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 in electrical machines excited by permanent magnets.
 C2. Knowledge about construction, parameters and properties of permanent magnet electrical machines.
 C3. Knowledge about permanent magnet electrical machines working with voltage converters.
 C4. Measurement ability to measure characteristics of the permanent magnet electrical machines.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 Student knows principles during electrical energy transformation and phenomena in permanent magnet electrical machines
 PEK_W02 Student has knowledge about construction, principle of operation, properties and characteristics of permanent magnet electrical machines.

relating to skills:

- PEK_U01 Student is able to explain phenomena, construction and properties of permanent magnet electrical machines.
 PEK_U02 Student is able to measure and analyze characteristics of permanent magnet electrical machines. 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	Analysis of parameters and properties of modern permanent magnets.	2
Lec 3	Magnetic circuits of permanent magnet electrical machines.	2
Lec 4	Construction, properties, characteristics and parameters of DC permanent magnet machines.	3
Lec 5	Construction, principle of operation, supplying systems, properties and characteristics of brushless DC motors.	4
Lec 6	Permanent magnet electrical machines supplied by voltage converters.	2
Lec 7	Construction, properties, characteristics and parameters AC permanent magnet machines.	2
Lec 8	Line start permanent magnet synchronous motors. Starting and synchronization properties.	2
Lec 9	Permanent magnet synchronous generator, influence of load characteristic on the machine parameters.	2
Lec 10	Permanent magnet synchronous motor driven by non-conventional energy sources.	2
Lec 11	Permanent magnet synchronous machines with axial magnetic flux: construction, properties, characteristics and parameters.	2
Lec 12	Permanent magnet reluctance motors, stepper motors.	3
Lec 13	Application and construction of permanent magnet electrical machines: computer hardware, audio-video devices, automotive industry, non-conventional energy sources.	2
Lec 14	Crediting	1
Total hours:		30

Form of classes - laboratory		Number of hours:
Lab 1	Introduction, safety instructions.	2
Lab 2	Laboratory tests of a permanent magnet synchronous motor.	3
Lab 3	Laboratory tests of a brushless DC motor.	3
Lab 4	Laboratory tests of a three-phase permanent magnet synchronous generator.	3
Lab 5	Laboratory tests of a permanent magnet electrical motor supplied by voltage converter.	3
Lab 6	Crediting.	1
Total hours:		15

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	Examination
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02 PEK_K01	Preparation for laboratory
F2(L)	PEK_U01 PEK_U02 PEK_K01	Activity during laboratories
F3(L)	PEK_U01 PEK_U02 PEK_K01	Reports after laboratories
P(L)	$P=0,3 \cdot F1 + 0,3 \cdot F2 + 0,4 \cdot F3$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Glinka T. : Maszyny elektryczne o magnesach trwałych, Wydawnictwo Politechniki Śląskiej, Gliwice 2002
- [2] Sochocki R.: Mikromaszyny elektryczne, Wydawnictwo Politechniki Warszawskiej, 1996
- [3] Dudzikowski I.: Silniki komutatorowe o magnesach trwałych, Wydawnictwo Politechniki Wrocławskiej, 1992
- [4] Plamitzer A., Maszyny elektryczne, WNT, Warszawa 1989
- [5] Antal L., Janta T., Zieliński P.: Maszyny elektryczne. Ćwiczenia laboratoryjne. Of. Wyd. PWr, Wrocław 2001.

SECONDARY LITERATURE:

- [1] Gieras J. F., Wing M.: Permanent magnet motor technology, Marcel Dekker, Inc. New York, Basel 2002
- [2] Dąbrowski M. Projektowanie maszyn prądu przemiennego, WNT Warszawa 1994
- [3] Dąbrowski M. Konstrukcja maszyn elektrycznych, WNT W-wa 1978
- [4] 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 **ELR043105 - Permanent magnet electrical machines** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering** AND SPECIALIZATION **Industrial Electrical Engineering**

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	S2ETP_W11	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1
PEK_W02	S2ETP_W11	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14	N.1
PEK_U01	S2ETP_U09	C.1 C.2 C.3 C.4	Lab2 Lab3 Lab4 Lab5 Lab6	N.2
PEK_U02	S2ETP_U09	C.1 C.2 C.3 C.4	Lab2 Lab3 Lab4 Lab5 Lab6	N.2
PEK_K01	K2ETK_K07	C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6	N.2