

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Badanie i diagnostyka maszyn elektrycznych**  
 Name in English: **Testing and diagnostics of electrical machines**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **optional**  
 Subject code: **ELR053206**  
 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):	90		60		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	3		2		
including number of ECTS points for practical (P) classes :			2		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10		1.40		

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Has a basic knowledge on electrical machines, knows the working rules of the basic types of electric machines.
2. Has a basic knowledge on electrical drives.
3. Has a basic knowledge on digital signal processing.
4. Can correctly and effectively use knowledge on the construction and operation of electrical machines and drives.
5. Can correctly apply the mathematical methods associated with digital signal processing.
6. Can correctly realize basic measurements of electrical and mechanical quantities.

**SUBJECT OBJECTIVES**

- C1. Familiarizing students with the problems of damage of electrical machines and fundamentals of technical diagnostics.  
 C2. Familiarizing students with the basic testing of electrical machines.  
 C3. Familiarizing students with the basic methods of faults monitoring and diagnosis of electric machines and drives.  
 C4. Perfecting skills for qualitative understanding and the interpretation of results of analysis of diagnostic signals.  
 C5. Acquisition of practical knowledge regarding the measurements of electrical and mechanical quantities characterizing the operation and performance of electrical machines.  
 C6. Acquire the skills to use and assembly of circuits and systems for monitoring and diagnosis of electric machines and drives.

**SUBJECT LEARNING OUTCOMES***relating to knowledge:*

- PEU\_W01 Has knowledge of the basic methods for monitoring and diagnosis of electrical machines  
 PEU\_W02 Has knowledge of the basic methods of testing and fault detection of electrical machines and drives  
 PEU\_W03 Has matured knowledge of the measurement methods and signal processing used in the diagnosis of electrical machines

*relating to skills:*

- PEU\_U01 Has skills associated with the detection of basic faults in electrical machines and drives  
 PEU\_U02 Can choose the method and measurement equipment for testing and diagnosis of electrical machines and drives.

*relating to social competences:*

- PEU\_K01 Understands the needs for team work on finding and improving the methods of problem solving.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction to technical diagnostics and research of electrical machines	2
Lec 2	Methods of measurement of basic electrical and mechanical signals used in testing of electrical machines and drives	2
Lec 3	Methods of measurement of basic electrical and mechanical signals applied in monitoring and diagnosis of electrical machines and drives	2
Lec 4	Methods of digital diagnostic signal processing used in monitoring of electrical machines	2
Lec 5	Electrical and mechanical damage occurring in electrical machines (types, causes, symptoms)	2
Lec 6	Faults detection of the squirrel-cage rotors	2
Lec 7	Faults detection of the stator windings	2
Lec 8	Insulation testing of electrical machines	2
Lec 9	The vibrations in electric machines and drives	2
Lec 10	Detection of mechanical failures in electrical machines (eccentricity, imbalance, misalignment, bearings damages )	2
Lec 11	Thermal study of electrical machines	2
Lec 12	Thermal diagnostics of electric machines and drives	2
Lec 13	Damage occurring in the converter drives with induction motors	2
Lec 14	Computer monitoring and diagnostics systems (hardware and software).	2
Lec 15	Final test	2
Total hours:		<b>30</b>

Form of classes - laboratory		Number of hours:
Lab 1	Introduction to the lab. Modern methods of recording electrical signals using LabVIEW and data acquisition card	2
Lab 2	Computer system for automatically testing and monitoring induction motor drive	2
Lab 3	Operating diagnostics cage rotor induction motors	2
Lab 4	Diagnosis of rolling bearings operating in induction motors	2
Lab 5	Research rotor unbalance and alignment of electric drives	2
Lab 6	Operating diagnostics induction motors stator windings	2
Lab 7	Thermal diagnosis of electric drives	2
Lab 8	Laboratory assessment	1
Total hours:		<b>15</b>

TEACHING TOOLS USED
N1. Multimedia lecture with elements of traditional and problematic lectures
N2. Consultation
N3. Final test
N4. Preparation to the laboratory exercises and testing of student knowledge
N5. Implementation reports of the exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES 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)	PEU_W01 PEU_W02 PEU_W03	Participation in lectures
F1(w)	PEU_W01 PEU_W02 PEU_W03	Consultation and final test
P(w)	$P=0,3 \cdot F1 + 0,7 \cdot F2$	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Evaluation of preparations for the exercises
F1(L)	PEU_U01 PEU_U02	Activity in laboratory
F2(L)	PEU_U01 PEU_U02	Evaluation of reports of laboratory exercises
P(L)	$P=0,4 \cdot F1 + 0,4 \cdot F2 + 0,2 \cdot F3$	

<b>PRIMARY AND SECONDARY LITERATURE</b>
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<b>PRIMARY LITERATURE:</b>
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| <p>[1] Kowalski C.T., Diagnostyka układów napędowych z silnikiem indukcyjnym z zastosowaniem metod sztucznej inteligencji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2013</p> <p>[2] Kowalski C.T., Monitorowanie i diagnostyka uszkodzeń silników indukcyjnych wykorzystaniem sieci neuronowych, Prace Naukowe Instytutu Maszyn, Napędów i Pomiarów Elektrycznych, nr57, Wrocław 2005</p> <p>[3] ] Korbicz J. i inni (edytorzy), Diagnostyka procesów. Modele, metody sztucznej inteligencji, zastosowania, WNT Warszawa, 2002</p> <p>[4] Kościelny M.J., Diagnostyka zautomatyzowanych procesów przemysłowych, Akademicka Oficyna Wyd. EXIT, Warszawa 2001</p> <p>[5] Glinka T., Badania diagnostyczne maszyn elektrycznych w przemyśle, Komel, Katowice 2000</p> |
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<b>SECONDARY LITERATURE:</b>
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Vas P., Parameter estimation, condition monitoring and diagnosis of electrical machines, Clarendon Press, Oxford 1993
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<b>SUBJECT SUPERVISOR</b>
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