

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Badanie i diagnostyka napędów przekształtnikowych**
 Name in English: **Testing and diagnostics of converter-fed drives**
 Main field of study (if applicable): **Industrial Control Engineering**
 Specialization (if applicable): **Automation of Machines, Vehicles and Apparatus**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **APR013230**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		15		
Number of hours of total student workload (CNPS):	30		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	1		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70		0.70		

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 converter-fed drives.	2
Lec 2	Measurements of basic signals and quantities characterizing performance of converter-fed drives. Basic faults of converter-fed drives with scalar and vector control.	2
Lec 3	Monitoring methods for static converters. Methods of fault detection in rectifiers and voltage inverters.	2
Lec 4	Methods of digital diagnostic signal processing used in monitoring of converter-fed drives.	2
Lec 5	Faults detection of the electrical motors operating in closed-loop systems.	2
Lec 6	Application of observers and Kalman filter in diagnostics of converter-fed drives	2
Lec 7	Application of artificial intelligence methods in diagnostics of electrical drives.	2
Lec 8	Computer monitoring and diagnostics systems (hardware and software). Final test.	1
Total hours:		15

Form of classes - laboratory		Number of hours:
Lab 1	System for automatic testing and conditions monitoring of converter-fed induction motor drive	2
Lab 2	Diagnostics of the induction motor drives with scalar control, based on stator current and vibrations measurements.	2
Lab 3	Diagnostics of the induction motor drives with DFOC control, based on state observer and Kalman filter.	2
Lab 4	Testing of the converter-fed drive using thermovision camera.	2
Lab 5	Monitoring of the converter-fed induction motor drive using Ethernet.	2
Lab 6	Application of artificial intelligence methods in diagnostics of converter-fed drives.	2
Lab 7	Fault diagnosis in PM BLDC drives	2
Lab 8	Laboratory assessment	1
Total hours:		15

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) 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
F2(W)	PEU_W01 PEU_W02 PEU_W03	Final test
P(W)	$P=0,1 \cdot F1 + 0,9 \cdot F2$	
F1(L)	PEU_U01 PEU_U02	Evaluation of preparations for the exercises
F2(L)	PEU_U01 PEU_U02	Evaluation of reports of laboratory exercises
F3(L)	PEU_U01 PEU_U02 PEU_K01	Activity in laboratory
P(L)	$P=0,4 \cdot F1 + 0,4 \cdot F2 + 0,1 \cdot F3$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

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|---|
| <p>[1] Glinka T., Badania diagnostyczne maszyn elektrycznych w przemyśle, Komel, Katowice 2000</p> <p>[2] Kowalski C.T., Diagnostyka układów napędowych z silnikiem indukcyjnym z zastosowaniem metod sztucznej inteligencji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2013</p> <p>[3] 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>[4] Orłowska- kowalska T., Blaabjerg F., Rodrigues J. (editors), Advanced and Intelligent Control in Power Electronics and Drives, Springer 2014</p> |
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SECONDARY LITERATURE:

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| <p>[1] Vas P., Parameter estimation, condition monitoring and diagnosis of electrical machines, Clarendon Press, Oxford 1993</p> |
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SUBJECT SUPERVISOR

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