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):	**Control Engineering and Robotics**
Specialization (if applicable):	**Automation of Machines, Vehicles and Apparatus**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**ARR043230**
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 EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Has knowledge of the basic methods for monitoring and diagnosis of electrical machines
PEK_W02	Has knowledge of the basic methods of testing and fault detection of electrical machines and drives
PEK_W03	Has matured knowledge of the measurement methods and signal processing used in the diagnosis of electrical machines

relating to skills:

PEK_U01	Has skills associated with the detection of basic faults in electrical machines and drives
PEK_U02	Can choose the method and measurement equipment for testing and diagnosis of electrical machines and drives.

relating to social competences:

PEK_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 EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02 PEK_W03	Participation in lectures
F2(W)	PEK_W01 PEK_W02 PEK_W03	Final test
P(W)	P=0,1*F1+0,9*F2	
F1(L)	PEK_U01 PEK_U02	Evaluation of preparations for the exercises
F2(L)	PEK_U01 PEK_U02	Evalution of reports of laboratory exercises
F3(L)	PEK_U01 PEK_U02 PEK_K01	Activity in laboratory
P(L)	P=0,4*F1+0,4*F2+0,1*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Glinka T., Badania diagnostyczne maszyn elektrycznych w przemyśle, Komel, Katowice 2000
[2] Kowalski C.T.,Diagnostyka układów napędowych z silnikiem indukcyjnym z zastosowaniem metod sztucznej inteligencji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2013
[3] Kowalski C.T., Monitorowanie i diagnostyka uszkodzeń silników indukcyjnych wykorzystaniem sieci neuronowych, Prace Naukowe Instytutu Maszyn, Napędów i Pomiarów Elektrycznych, nr57, Wrocław 2005
[4] Orlowska- kowalska T.. Blaabjerg F., Rodrigues J. (editors), Advanced and Intelligent Control in Power Electronics and Drives, Springer 2014

SECONDARY LITERATURE:

[1] Vas P., Parameter estimation, condition monitoring and diagnosis of electrical machines, Clarendon Press, Oxford 1993

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR043230 - Testing and diagnostics of converter-fed drives
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**
AND SPECIALIZATION **Automation of Machines, Vehicles and Apparatus**

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	S2AMPU_W13	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_W02	S2AMPU_W13	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_W03	S2AMPU_W13	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_U01	S2AMPU_U12	C.4 C.5 C.6	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.4 N.5
PEK_U02	S2AMPU_U12	C.4 C.5 C.6	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.4 N.5
PEK_K01	K2AiR_K07	C.4 C.5 C.6	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.4 N.5