FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Systemy monitorowania i diagnostyki w przemyśle**
Name in English:	**Monitoring and diagnostic systems in industry**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**optional**
Subject code:	**APR013210**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		30		
Number of hours of total student workload (CNPS):	90		60		
Form of crediting:	examination		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 machine construction, knows principles of operation 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 with basic issues of technical diagnostics of industrial objects
C2. Familiarizing with basic methods for monitoring and diagnosis of electric machines and drives
C3. Perfecting skills for qualitative understanding and the interpretation of results of analysis of diagnostic signals
C4. Acquisition of practical knowledge regarding the construction, operation and completion systems for monitoring and diagnosis of industrial plants, in particular – complex drive systems

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Has knowledge on the basic methods for monitoring and diagnosis of industrial objects
PEU_W02 Has knowledge on the basic methods of faults detecting in electrical machines and drives
PEU_W03 Has matured knowledge of signal processing methods applied in diagnostics

relating to skills:

PEU_U01 Has skills relating to the detection of basic faults in electrical machines and drives
PEU_U02 Can choose the method and measuring equipment to monitor industrial plants

relating to social competences:

PEU_K01 Active attitude to teamwork

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction to technical diagnostics	2
Lec 2	Diagnostic signals and symptoms (classification, characteristics, techniques of digital estimation, filtration)	2
Lec 3	Characteristics of diagnostic signals	2
Lec 4	Signal analysis - basic diagnostic method	2
Lec 5	Overview of the basic failures of electric drives	2
Lec 6	Monitoring and diagnostic of electrical drives faults	2
Lec 7	Methods for fault detection and location of industrial processes	2
Lec 8	Thermal diagnostics of industrial objects (temperature, heat testing, thermovision testing)	2
Lec 9	Mathematical models in the diagnosis of the process	2
Lec 10	Estimators of state variables and parameters in the diagnostic	2
Lec 11	Artificial intelligence methods in diagnostics	2
Lec 12	Monitoring and diagnostic computer systems (hardware and software)	2
Lec 13	Sensors in monitoring and diagnostics systems. Review of technical solutions	2
Lec 14	Monitoring systems of SCADA type for industrial processes. Overview of solutions	2
Lec 15	Systems to detect mechanical failures in electric drives (damage to bearings, misalignment)	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction to the lab	2
Lab 2	Modern methods of recording electrical signals using LabVIEW and data acquisition card	2
Lab 3	Monitoring the dynamic states of the induction motor drive	2
Lab 4	Monitoring of the converter drive with squirrel-cage induction motor	2
Lab 5	Operating diagnostics cage rotor induction motors based on an analysis of the stator current and stator current space vector	2
Lab 6	Diagnosis of rolling bearings operating in induction motors	2
Lab 7	Alignment of electric drives using a laser system OPTALGIN	2
Lab 8	Monitoring the rotor unbalance in induction motors	2
Lab 9	Computer systems for monitoring and diagnosis electrical and mechanical faults	2
Lab 10	Monitoring the status of an induction motor stator windings based on an analysis of the stator current	2
Lab 11	Monitoring the status of an induction motor stator windings based on the analysis of mechanical vibrations and axial flux	2
Lab 12	Automation of thermal testing of electrical machines	2
Lab 13	Thermal diagnosis of electric drives	2
Lab 14	Monitoring underwater pump	2
Lab 15	Laboratory assessment	2
	Total hours:	**30**

TEACHING TOOLS USED
N1. Multimedia lecture with elements of traditional and problematic lectures
N2. consultations and final exam
N3. Laboratory exercises in student groups; testing of student knowledge with short test before laboratory exercises.
N4. Assessment of the laboratory exercises by reports.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**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 exam
P(W)	P=0,1*F1+0,9*F2	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Activity during laboratory exercises (includings grades obtaining during short tests)
F2(L)	PEU_U01 PEU_U02 PEU_K01	Preparation of the report
P(L)	P=0,3*F1+0,7*F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kowalski C.T.,Diagnostyka układów napędowych z silnikiem indukcyjnym z zastosowaniem metod sztucznej inteligencji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2013
[2] Kowalski C.T., Monitorowanie i diagnostyka uszkodzeń silników indukcyjnych wykorzystaniem sieci neuronowych, Prace Naukowe Instytutu Maszyn, Napędów i Pomiarów Elektrycznych, nr57, Wrocław 2005
[3]] Korbicz J. i inni (edytorzy), Diagnostyka procesów. Modele, metody sztucznej inteligencji, zastosowania, WNT Warszawa, 2002
[4] Kościelny M.J., Diagnostyka zautomatyzowanych procesów przemysłowych, Akademicka Oficyna Wyd. EXIT, Warszawa 2001
[5] Glinka T., Badania diagnostyczne maszyn elektrycznych w przemyśle, Komel, Katowice 2000

SECONDARY LITERATURE:

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

SUBJECT SUPERVISOR

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