Cracow University of Technology

Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies in the academic year 2022/2023

Information on the course

Name of the course in Polish	Innowacyjne metody i algorytmy diagnostyki maszyn i urządzeń elektrycznych
Name of the course in English	Innovative methods and algorithms for diagnostics of electrical machines and devices
Number of the ECTS points	2
Language of instruction	Polish
Category of the course	Elective
Field of education	Engineering and Technology
Discipline of education	Automatic Control, Electronics and Electrical Engineering
Person responsible for the course Contact	Maciej Sułowicz, *doctor habilitatus* in Engineering, prof. of CUT maciej.sulowicz@pk.edu.pl

Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical class	Laboratory	Computer laboratory	Project class	Seminar
2, 3, 4, 5	G	15		15			

*G – graded credit, NG – non-graded credit

Course objectives

Code	Objective description
Objective 1	Presentation of selected problems of diagnosis of electrical machines and devices using innovative diagnostic methods.
Objective 2	Learning about the most common problems that occur when diagnosing electrical machines and devices.
Objective 3	Presentation of selected innovative methods for diagnosing electrical machines and devices.
Objective 4	Learning about the tools and devices used in selected innovative methods for diagnosing electrical machines and devices as well as complex mechatronic systems.
Objective 5	Introduction to the latest trends in diagnosing electrical machines and devices as well as complex mechatronic systems.

Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUT DS	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student knows and understands the subject matter of selected problems related to the diagnosis of complex electrical systems and circuits.	E_W01 E_W02	Attendance in class, test on knowledge covered in the lecture
EUW1	The doctoral student has knowledge of the means and methods of monitoring and diagnosing complex electrical systems and circuits.	E_W01 E_W02	Attendance in class, test on knowledge covered in the lecture
OUTCOMES RELATED TO SKILLS			
EUU1	The doctoral student knows how to select an appropriate method for monitoring and diagnosing selected states of complex electrical systems and circuits.	E_U01	Laboratory reports
EUU2	The doctoral student is able to perform analyses in order to develop diagnostic methods and algorithms for complex electrical systems and circuits.	E_U01	Laboratory reports
OUTCOMES RELATED TO SOCIAL COMPETENCES			
EUK1	The doctoral student is prepared to critically evaluate the solutions presented in subject-related literature for complex monitoring and diagnostic systems of electrical circuits; the student is able to plan the testing process and the launch of a diagnostic system, and is aware of the significance of expertise in scientific research.	E_K01 E_K03	Discussion

Course outline

No.	Contents	Learning outcomes for the course	No. of hours
LECTURE			
W1	Methodology for diagnosing electrical machines and devices. An overview of innovative methods for diagnosing the condition of electrical machines and devices.	EUW1, EUW2	3
W2	Diagnostics of industrial processes. An overview of methods for diagnosing industrial processes.	EUW1, EUW2	3
W3	Innovative tools and methods used in condition diagnostics of electrical machines and devices. The use of mobile devices as sensors in innovative diagnostics.	EUW2, EUU2, EUK1	3
W4	Diagnostic models used in innovative condition diagnostics for electrical machines. Field models and Multiphysics analyses applied to the development and verification of diagnostic methods.	EUW1, EUW2, EUK1	3

W5	Artificial intelligence and computational intelligence methods in innovative diagnostic methods for condition assessment of electrical machines and devices. Machine learning. Deep learning. Fusion sensor.	EUW1, EUW2, EUU2, EUK1	3
LABORATORY			
L1	Implementation of artificial intelligence methods to the problem of diagnosing the condition of selected electrical machines and devices.	EUW1, EUW2, EUU1, EUU2	3
L2	IoT sensors and systems in innovative condition diagnostics for electrical machines and devices. Selected cloud-based data processing and collection systems.	EUW1, EUW2, EUU1, EUU2, EUK1	3
L3	The use of smart devices and mobile devices in innovative condition diagnostics of electrical machines and devices.	EUW1, EUW2, EUU1, EUU2	3
L4	Advanced security features with innovative diagnostic functions in line with the Industry 4.0 philosophy.	EUW1, EUW2, EUU1, EUU2, EUK1	3
L5	Innovative diagnostics of industrial processes.	EUW1, EUW2, EUU1, EUU2, EUK1	3

The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH THE ACADEMIC TEACHER	
Hours allotted in the syllabus	30
Consultations	3
Examination / course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF THE ACADEMIC TEACHER	
Independent study of the course contents	10
Preparation of a paper, report, project, presentation, discussion	15
ECTS POINTS STATEMENT	
Total number of hours	60
The ECTS points number	2

Preliminary requirements

No.	Requirements
1	Structured knowledge of the fundamentals of electrical engineering, electrical machines, devices and electromechanical systems, as well as mechatronic systems.
2	Knowledge of the principles of digital signal processing and analysis.
3	Ability to use application software supporting data collection, processing and analysis (MATLAB, LabVIEW), OPC servers, SCADA systems.

Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	

1	Attendance in class, passing a test on knowledge covered in the lecture, successful completion of the laboratory class
METHOD OF THE FINAL GRADE CALCULATION	
The final grade is a weighted average of the grade on the test of knowledge covered in the lecture (weight 2) and the final grade in the laboratory class (weight 1)	

Additional information

None

The course reading list

1	Korbicz J., Kościelny J.M., Kowalczuk Z., Cholewa W — Diagnostyka Procesów. Modele. Metody sztucznej inteligencji. Zastosowania., Warszawa, 2002, WNT
2	Kowalski C.T. — Diagnostyka układów napędowych z silnikiem indukcyjnym z zastosowaniem metod sztucznej inteligencji, Wrocław, 2013, OW Politechnika Wrocławska
3	Dwojak J., Szymaniec S. — Diagnostyka eksploatacyjna zespołów maszynowych w energetyce, Opole, 2013, OW Politechnika Opolska
4	Szymaniec S. — Badania, eksploatacja i diagnostyka zespołów maszynowych z silnikami indukcyjnymi klatkowymi, Opole, 2013, OW Politechnika Opolska
5	Swędrowski L. — Pomiary w diagnostyce silników indukcyjnych klatkowych, Gdańsk, 2013, Wydawnictwo Politechniki Gdańskiej
6	Białasiewicz J. — Falki i aproksymacje, Warszawa, 2009, WNT
7	Sułowicz M. — Diagnostyka silników indukcyjnych metodami sztucznej inteligencji, Kraków, 2005, Rozprawa doktorska
8	Zielinski T. P. — Cyfrowe przetwarzanie sygnałów, Warszawa, 2007, WKŁ
9	Tumanski S. — Technika pomiarowa, Warszawa, 2013, WNT
10	P. Rodriguez et al. — Stator circulating currents as media of fault detection in synchronous motors, Valencia, 2013, 2013 9th IEEE International Symposium on Diagnostics for Electric Machines, Power Electronics and Drives (SDEMPED)
11	Sahoo S., Rodriguez P., Sulowicz M. — Evaluation of different monitoring parameters for synchronous machine fault diagnostics, Berlin, 2017, Electrical Engineering, June 2017, Volume 99, Issue 2, pp. 551560
12	Glinka T.—Maszyny elektryczne i transformatory. podstawy teoretyczne, eksploatacja i diagnostyka, Katowice, 2015, Wydawnictwo KOMEL
13	Rzeszucinski P, Orman M., Pinto C. T., Tkaczyk A., Sulowicz M. — Bearing Health Diagnosed with a Mobile Phone: Acoustic Signal Measurements Can be Used to Test for Structural Faults in Motors, New Jork, 2018, IEEE Industry Applications Magazine
14	Mielnik R., Sulowicz M., Ludwinek K., Jaskiewicz M. — The Reliability of Critical Systems in Railway Transport Based on the Track Rail Circuit, Cham, 2018, In: Mazur D., Gołebiowski M., Korkosz M. (eds) Analysis and Simulation of Electrical and Computer Systems. Lecture Notes in Electrical Engineering, vol. 452. Springer, Cham, 2018