POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Diagnostics of Electrical Power Devices [S2Elenerg1>DUE]

Course

Field of study
Electrical Power Engineering

Year/Semester
1/2

Area of study (specialization)
Smart Grids

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Extended knowledge in the field of measurement and assessment of measurement uncertainty, mathematics (discrete and applied mathematics, probability, differential calculus, numerical optimization methods). Knowledge of the analysis of electrical circuits. Skills to evaluate the usefulness and selection of computational methods or software to solve a given problem.

Course objective

Getting to know the types and scope of tests of electrical power devices. Acquiring the ability to select appropriate diagnostic methods, both for new and operated devices. Getting to know the theoretical and practical basics of testing and monitoring the condition of electrical power devices. Mastering the skills to diagnose and formulate recommendations for the further use of devices.

Course-related learning outcomes

Knowledge:
1. student knows the maintenance strategies of electrical power devices
2. student has an advanced knowledge of testing and monitoring power transformers, insulators, cables, capacitors, stations and gas insulated power transmission lines

Skills:
1. student is able to choose the appropriate diagnostic methods of electrical power devices, taking into account the maintenance strategies, their importance in the system and technical condition
2. student is able to perform measurements of quantities characterizing the technical condition of electrical power devices
3. student is able to diagnose the technical condition of the device, give recommendations for further use and prepare a professional test report
4. student is able to measure the intensity of electromagnetic field and analyze the distribution of this field
5. student is able to use his knowledge to design the devices and diagnostic systems

Social competences:
1. student understands the contemporary problems of power supply safety and the importance of properly conducted diagnostics in terms of the reliability of the power system operation

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lectures:
1. Assessment of the knowledge and skills by means of written exam. Assessment of the exam on the basis of a point system, 50% of the maximum number of points required.
Laboratory classes:
1. Assessment of knowledge and skills related to performed laboratory classes - assessment of laboratory report.
2. Checking of the preparation for the laboratory classes during introductory conversation for classes.
3. Short tests to check the preparation for laboratory classes.

Programme content

Lectures:
1. Maintenance strategies of electrical power devices
2. Types of diagnostic tests
3. Diagnostic methods of transformers: dielectric spectroscopy methods (RVM, FDS, PDC), partial discharges measurement method (electric, acoustic, radio UHF), winding deformation measurement method, thermal imaging method, Karl Fischer method, vibroacoustics
4. Diagnostic methods of cables: reflected wave method, cable insulation measurement method, dielectric loss factor measurement
5. Capacitor diagnostic methods: thermal imaging method, capacitance measurement method, insulation resistance test
6. Diagnostic methods of insulators: thermal imaging method, partial discharges measurement method
7. Diagnostic methods of GIS stations: partial discharges (UHF) measurement methods
8. Detection and location of faults and methods of monitoring electrical power devices
9. Physicochemical methods for the assessment of the insulation condition (DGA method, infrared spectroscopy method, polymerization degree testing, acid number testing, standard testing of insulating liquids)
Laboratory classes:
1. Detection of deformation of transformer windings using the frequency response
2. Testing the moisture content of paper insulation using RVM method
3. Testing the moisture content of paper insulation using FDS method
4. The method of polarization and depolarization currents in tests of moisture content in solid insulation
5. Testing of partial discharges in transformer insulation by electric method
6. Partial discharge source localization using trilateration technique
7. Detection of partial discharge with the use of electromagnetic methods HF/VHF/UHF
8. Vibroacoustic tests of the transformer core
9. Methods of measuring moisture in insulating liquids - KFT method, capacitive sensor
10. Analysis of gases dissolved in oil - DGA method
11. Measurement of particles content in insulating liquid
12. Measurement of the electric field intensity around the medium voltage insulator

Teaching methods

Lectures:
lecture with multimedia presentation (including: drawings, photos) supplemented with examples given on the blackboard. Theory presented in close connection with practices
Laboratory classes:
laboratory exercises carried out in teams of several people, compiling measuring systems in practice, dividing tasks between cooperating persons, performing measurements and analyzing the results in terms of assessing the condition of the tested devices

Bibliography

Basic
1. Florkowska B., Diagnostyka wysokonapięciowych układów izolacyjnych urządzeń elektroenergetycznych, Wydawnictwa AGH, Kraków 2016
2. Kaźmierski M., Olech W., Diagnostyka techniczna i monitoring transformatorów, Zakład Pomiarowo-Badawczy Energetyki ENERGOPOMIAR-ELEKTRYKA, Gliwice, 2013
3. Flisowski Z., Technika wysokich napięć, WNT, Warszawa, 2017
4. Gacek Z., Wysokonapięciowa technika izolacyjna we wspóczesnej elektroenergetyce, Wydawnictwo Politechniki Śląskiej, Gliwice 2016
Additional
1. Gielniak J., Zawilgocenie izolacji papierowo-olejowej transformatorów wysokiego napięcia, Wydawnictwo Politechniki Poznańskiej, Poznań 2012
2. Florkowska B., Wytrzymałość elektryczna gazowych układów izolacyjnych wysokiego napięcia, Wydawnictwo AGH, Kraków, 2003
3. Gielniak J., Przybyłek P., Mościcka-Grzesiak H.,Wytrzymałość elektryczna nanomodyfikowanych dielektryków ciekłych, Przegląd Elektrotechniczny, ISSN 0033-2097, R. 91 NR 2/2015
4. Gielniak J., Dombek G., Wróblewski R., Fire Safety and Electrical Properties of Mineral Oil/Synthetic Ester Mixtures, 8th International Symposium on Electrical Insulating Materials, September 12-15, 2017, Toyohashi Chamber of Commerce &Industry, Toyohashi City, Japan, Conference Proceedings of ISEIM 2017, V1-10, p. 227-230

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50