COURSE DESCRIPTION CARD - SYLLABUS

Course name
High voltage engineering

Course

Field of study
Electrical Engineering

Year/Semester
1/2

Area of study (specialization)

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
10	10	
Tutorials	Projects/seminars	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Student has basic knowledge about physical phenomena occurring in insulating materials and typical construction of high voltage equipments and apparatus. Student has the ability to design the basic high-voltage insulation systems and to conduct basic diagnostic tests on high-voltage equipments and apparatus. Student has the ability to work and collaborate in groups.

Course objective

Construction of high-voltage equipment and insulation systems. The methods for proper selection of high-voltage insulation materials. The parameters and physical phenomena in diagnostics of high-voltage equipment. The review of modern diagnostic techniques and assessment of the insulation condition of high-voltage equipment. The digital processing and proper interpretation of measurement data for assessment of high-voltage equipment condition.

Course-related learning outcomes

Knowledge

1. Student has knowledge about physical phenomena occurring in high-voltage insulation systems.
2. Student has knowledge about design of high-voltage insulation systems .
3. Student has detailed knowledge about high voltage equipment diagnostics; Student has knowledge in the area of elaborating of experiment results.
4. Student has extended knowledge about construction and functioning of high-voltage equipment insulating systems.

Skills

1. Student can process and properly interpret measurement data to evaluate technical condition of high-voltage equipment.
2. can apply an adequate diagnostic method to evaluate condition of high-voltage equipment insulation system.
3. Student can gain information based on literature and other sources related to construction and diagnostic methods of high-voltage equipment.

Social competences

1. Student is aware of the role of high-voltage equipment diagnostics in assuring continuity of energy supply for industry and population.
2. Student is aware of threats scale and influence of high-voltage equipment breakdown results on natural environment naturalne.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:

- evaluation of knowledge and skills proven on written or oral examinations during examination session

Laboratory classes:

- tests and rewarding knowledge necessary to realise basic problems in the given laboratory task field,
- continuous evaluation, on each class - rewarding improvement of ability to use the known rules and methods,
- evaluation of knowledge and skills related to realisation of laboratory task, evaluation of report on task carried out,
- evaluation of knowledge and skills proven on written or oral test.

Programme content

Lectures:

- Construction of high voltage equipment and systems
- Ageing processes occurring in high-voltage insulation systems
- Problems of partial discharges occurring in high voltage insulation systems
- Problems of moisture of paper-oil insulation
- Methods of high-voltage equipment diagnostics:

a) methods of partial discharges detection (electromagnetic HF/UHF, AE, conventional IEC 60270),
b) methods of moisture content evaluation (Karl-Fischer, capacitive probes),
c) detection methods of power transformer windings deformation (FRA/SFRA),
d) dissolved gas analysis (DGA),
e) partial discharge localization techniques (trilateration, standard auscultatory technique SAT).

Laboratory:
1. Detection and location of partial discharges using acoustic emission method (AE).
2. Measurement of partial discharges using conventional electric method (PN-EN 60270).
3. Detection of partial discharges registered in HF/UHF frequency band.
4. Detection of power transformer insulation system defects basing on analysis of gases dissolved in insulation oil.
5. Evaluation of moisture content insulation system using physicochemical methods (Karl-Fischer, capacitive probe).
6. Detection of power transformer windings deformation using FRA/SFRA method.

Teaching methods

Lecture: multimedia presentation (including drawings, photos, animations) supplemented with examples given on the board, taking into account various aspects of the issues presented, including: economic, ecological, legal and social issues, presenting a new topic preceded by a reminder of related content known to students in other subjects .

Laboratory: detailed review of reports, demonstrations, teamwork.

Bibliography

Basic

1.Kaźmierski M., Olech W., Diagnostyka techniczna i monitoring transformatorów, ZPBE ENERGOPOMIAR - ELEKTRYKA Sp. z o.o. Gliwice; wyd. 2013r.
2. Florkowska B., Diagnostyka wysokonapięciowych układów izolacyjnych urządzeń elektroenergetycznych, Wydawnictwo AGH Kraków, 2009
3. Gulski E., Diagnozowanie wyładowań niezupełnych w urządzeniach wysokiego napięcia w eksploatacji, Prace Naukowe Politechniki Warszawskiej, 2003
4. Flisowski Z., Technika wysokich napięć, WNT Warszawa, 2009
5. Gacek Z., Wysokonapięciowa technika izolacyjna, Wydawnictwo Politechniki Śląskiej, Gliwice, 2006
6. Mościcka-Grzesiak H., pod red., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom I, 1996, tom II, 1999
7. Fleszyński J., pod red., Laboratorium wysokonapięciowe w dydaktyce i elektroenergetyce, Oficyna Wydawnicza Politechniki Wrocławskiej, 1999

Additional

1. Sivaji Chakravorti,Debangshu Dey,Biswendu Chatterjee , Recent Trends in the Condition Monitoring of Transformers, Spinger-Verlag, 2013
2. S.V. Kulkarni,S.A. Khaparde, Transformer Engineering: Design, Technology, and Diagnostics, Second

Edition, CRC Press, 2013
3. Sikorski W., Acoustic emission, InTech, 2012
4. Sikorski W, Acoustic emission: research and applications, InTech 2013
5. Sikorski W., Ultraczułe przetworniki emisji akustycznej zoptymalizowane do monitoringu wyładowań niezupełnych w transformatorach, Przegląd Elektrotechniczny, Tom 92, Wydanie 10, str. 11-16, 2016
6. Szymczak C., Sikorski W., Projektowanie i optymalizacja anten UHF do monitoringu wyładowań niezupełnych w transformatorze energetycznym, Przegląd Elektrotechniczny, Tom 92, Wydanie 10, str. 75-79, 2016

Breakdown of average student's workload

	Hours	ECTS
Total workload	52	2,0
Classes requiring direct contact with the teacher	24	1,0
Student's own work (literature studies, preparation for laboratory classes, preparation for exam, reports preparation) [1]	28	1,0

[1] delete or add other activities as appropriate