COURSE DESCRIPTION CARD - SYLLABUS

Course name
High voltage technology [N1Eltech2>TWN]

Course

Field of study
Electrical Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
10

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student possesses knowledge of electrical materials science and understands the basic laws of electrical circuit theory. They can construct a simple electrical circuit and measure basic electrical quantities. They can work and collaborate in a team.

Course objective

The aim of the course is to familiarize students with: phenomena occurring in the insulating systems of high-voltage devices, issues related to the electric strength of solid, liquid and gaseous dielectrics, methods of measuring the properties of dielectrics related to their electric strength and basic methods of generating and measuring high voltages.

Course-related learning outcomes

Knowledge:
1. Has advanced knowledge of physics necessary to understand the basic physical phenomena occurring in the insulation systems of high-voltage equipment.
2. Has knowledge of the properties and applications of dielectrics.
3. Has knowledge of the operation of high-voltage testing equipment.

4. Knows the basic health and safety regulations for working with high-voltage equipment and the hazards associated with high voltage.

Skills:
1. Is able to set up and operate a typical high-voltage test stand.
2. Is able to diagnose high-voltage insulation systems.
3. Is able to plan and conduct high-voltage measurements and measurements of quantities describing electrical insulating materials used in high-voltage technology.

Social competences:
1. Is aware of the responsibility for his/her own work and is ready to comply with the principles of teamwork and take responsibility for jointly implemented tasks in the field of high voltage engineering.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
1) Knowledge and skills related to the topics covered during the lecture are assessed in a final test. A passing grade on the test requires a score of at least 50%.
Laboratory classes:
1) Assessment of laboratory reports.
2) Continuous assessment of preparedness for the exercises and recognition of knowledge necessary to solve the problems posed in a given laboratory area.

Programme content

This course covers issues related to the generation and measurement of high voltages. It also addresses issues related to the electrical strength of dielectrics and methods for measuring their properties.

Course topics

The lectures cover the following topics:
1) Application of high-voltage technology in industry
2) Generation of high voltages
3) Basics of high-voltage measurement using direct and indirect methods
4) Electric strength of gases - corona phenomenon, flashover, the effect of field inhomogeneity on the electric strength of air, Paschen's law, the effect of space charge on the electric strength of air at DC voltage
5) Electric strength of insulating liquids, breakdown mechanisms, factors affecting the electric strength of liquids, properties of insulating liquids - resistivity, dielectric loss factor, other physicochemical properties
6) Electric strength of solid dielectrics, dielectric polarizations, breakdown mechanisms, properties of solid dielectrics - dielectric loss factor (Schering bridge), volume and surface resistivity
The laboratory classes covers the following topics:
1) Testing of air spark gaps - sphere to sphere and point to point systems
2) Voltage distribution across an insulator string
3) Measurement of low frequency AC high voltage
4) Influence of space charge on air strength at direct voltage
5) Measurement of dielectric loss factor of HV insulation system
6) Testing of electro-insulating liquid
7) Testing of air spark-gaps - parallel plates and cylindrical system
8) Investigation of the corona phenomenon
9) Influence of pressure on electric strength of air
10) Sliding discharge on surface of solid dielectrics in air
11) Recovery voltage in a high-voltage insulating system
12) Development of a discharge bridge in insulating oil

Teaching methods

The theory presented during lectures is closely linked to practice. A discussion is initiated during the lecture. The lecture includes a multimedia presentation (including drawings, photos, and videos)

supplemented with information provided on the board. The laboratory classes are team-based. Laboratory reports are reviewed by the instructor and discussed in the presence of the author.

Bibliography

Basic:
1. Flisowski Z., Technika wysokich napięć, Wydawnictwo Naukowo-Techniczne, Warszawa 2017
2. Florkowska B., Kuniewski M., Florkowski M., Włodek R., Wysokie napięcie w elektroenergetyce. Wybrane zagadnienia i obliczenia., Wydawnictwa AGH, Kraków 2020
3. Florkowska B., Furgał J., Technika wysokich napięć - Podstawy teoretyczne i laboratorium, Wydawnictwo AGH, Kraków 2017
4. Mościcka-Grzesiak H., Ćwiczenia laboratoryjne z materiałoznawstwa elektrotechnicznego i techniki wysokich napięć, Wydawnictwo Politechniki Poznańskiej, Poznań 2002
5. Gielniak J., Ćwiczenia laboratoryjne z inżynierii materiałowej w elektrotechnice, Wydawnictwo Politechniki Poznańskiej, Poznań 2009

Additional:
1. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom I - 1996
2. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom II - 1999
3. Gacek Z., Wysokonapięciowa technika izolacyjna, Wydawnictwo Politechniki Śląskiej, Gliwice 2006
4. Celiński Z., Materiałoznawstwo elektrotechniczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
5. Przybylek P. and Gielniak J., "Analysis of Gas Generated in Mineral Oil, Synthetic Ester, and Natural Ester as a Consequence of Thermal Faults," in IEEE Access, vol. 7, pp. 65040 -65051, 2019, doi: 10.1109/ACCESS.2019.2917761

Breakdown of average student's workload

	Hours	ECTS
Total workload	58	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	28	1,00