COURSE DESCRIPTION CARD - SYLLABUS

Course name
High voltage engineering [S1Eltech1>TWN1]

Course

Field of study
Electrical Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Student has knowledge in frame of electric engineering material science, and knows fundamental principles of theory of electrical circuits. He/she can build simple electrical system. He/she can work and cooperate in group.

Course objective

To know simple tasks connected to high voltage engineering. To know sources of test Voltage. To know methods of measurements of typical properties for high voltage engineering. To know fundamental definitions regarding to overvoltage protection.

Course-related learning outcomes

Knowledge:
1. Student has structured and theoretically founded knowledge about the construction, principles of operation and operation of transformers, electrical machines and technical systems, knows the processes occurring in their life cycle.
2. He/She has basic knowledge necessary to understand social, ethical, economic, legal and other non-technical conditions of engineering activities, knows the basic principles of ergonomics, health and

safety and hazards occurring in the industry related to the awarded qualification.
3. He/She knows and understands the physical phenomena occurring in high-voltage insulation systems, systems for generating high voltage and surge protection, has basic knowledge about the life cycle of this type of systems.

Skills:
1.Student is able to plan and carry out simulations and measurements of basic quantities characteristic for electrical systems; can present the results in numerical and graphical form, make their interpretations and draw the right conclusions.
2. He/She is able to design and perform, in accordance with the specification and using the right methods, techniques, tools and materials, typical electrical systems designed for different applications.
3. He/She is able to use his knowledge in the selection of measuring apparatus for the measurement and acquisition of basic measurable quantities characteristic of electrical engineering, in typical and atypical conditions (not fully predictable).

Social competences:
1. Student is aware of the necessity to initiate activities for the public interest, understands various aspects and effects of the electrical engineer"s activity, including the impact on the environment, and the related responsibility for decisions.
2. He/She correctly identifies and resolves dilemmas related to the profession.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lectures:
- assessment of knowledge and skills proved on tests,
Laboratories:
- tests and preemie of knowledge which is necessary to realize fundamental tasks in some fields of laboratory,
- continuous assessment on each laboratory ? preemie of knowledge increase,
- assessment of knowledge and skills connected to realization of laboratory tasks, assessment of report.

Programme content

The lecture presents knowledge about the sources of DC, AC and pulse test voltages, methods of measurements of electrical properties describing high voltage engineering. In addition, the lecture provides knowledge about statistical analysis, measurement results and electric and magnetic fields.
In frame of laboratory are realized subjects connected to high voltage techniques.

Course topics

The lecture presents knowledge about sources of AC (high voltage test and power transformer), DC test voltage (Van de Graff generator, rectifiers and rectifier systems), and pulse test voltage (Marx generator). Method of measurements of electrical properties, describing high voltage engineering, such as electrical strength (plate spark gap, spherical spark gap, cylindrical spark gap, sharp spark gar), resistance (Schering bridge), surfacial resistance, capacity (Schering bridge), partial discharge, dielectric losses factor (Schering bridge). Overvoltage protection (overvoltage factor, source of overvoltage, spares, attenuation of overvoltage waveform, overvoltage installations, touch voltage). Electrical and magnetic fields: professional and environmental exposure.
In addition, the classes provide basic knowledge about the statistical analysis of measurement results.
In frame of laboratory, following subjects are realized: measurements of electrical strength of plate spark gap, spherical spark gap, cylindrical spark gap, needle spark gap, tests of volume and surface resistance of insulation partial discharges measurements (including corona discharges), determination of the dielectric loss coefficient tg(delta) using a Schering bridge, influence of space charge on electrical strength of air, analysis of transformer oil, analysis of voltage distribution on HV line insulator.

Teaching methods

LECTURE - lecture with multimedia presentation (including drawings, photos, animations) supported with the content given on the board, taking into account various aspects of the issues presented,

including: economic, ecological, legal and social, presenting a new topic preceded by a reminder of related content known to students from other items.
LABORATORY - detailed review of reports by the laboratory leader and discussions on comments, demonstrations, teamwork.

Bibliography

Basic
1. Flisowski Z., Technika wysokich napięć, Wydawnictwo WNT, Warszawa, 2015.
2. Ćwiczenia laboratoryjne z materiałoznawstwa elektrotechnicznego i techniki wysokich napięć, pod redakcją H. Mościckiej-Grzesiak, skrypt, Wydawnictwo Politechniki Poznańskiej, Poznań, 2002.
3. Florkowska B., Wytrzymałość elektryczna gazowych układów izolacyjnych wysokiego napięcia, Uczelniane Wydawnictwo Naukowo-Dydaktyczne AGH, Kraków, 2003.
Additional
1. Florkowska B. i inni, Mechanizmy, pomiary i analiza wyładowań niezupełnych w diagnostyce układów izolacyjnych wysokiego napięcia, Uczelniane Wydawnictwo Naukowo-Dydaktyczne AGH, Kraków, 2001.
2. PN-EN 60270:2003 Wysokonapięciowa technika probiercza - Pomiary wyładowań niezupełnych
3. Sikorski W., Morańda H., Lokalizacja źródeł wyładowań niezupełnych w transformatorach energetycznych metodą emisji akustycznej i konwencjonalną metodą elektryczną, Pomiary Automatyka Kontrola, 2017, T. 57, ss. 356-359
4. Nadolny Z., Grzybowski A., Kasprzak W., Ludwikowski K., Lopatkiewicz R., Moranda H., Przybylek P., Sikorski W., Siodla K., Analysis of electric and magnetic field intensity generated by overhead power distribution lines of high voltage in Poznan, Przegląd Elektrotechniczny, T. 86, Wyd. 11b, 2010/11, ss. 254-257

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	35	1,00