COURSE DESCRIPTION CARD - SYLLABUS

Course name
High voltage engineering [S1Energ1>TWN]

Course

Field of study
Power Engineering

Year/Semester
3/5

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
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Student starting this course: 1) has knowledge in the frame of construction of electric al machines and their insulation systems and materials used for their construction 2) has knowladge concerning the laws regarding the theory of electrical circuits 3) can build simple electrical setup and conduct the measurements of basic physical quantities 4) is aware of the need to broaden his/her competence in the field of electrical engineer"s work 5) is aware of the responsibility related to work within the team.

Course objective

The aim of the course is getting knowledge about: materials used in insulating systems of electrical power devices and properties of these materials; fundamental issues regarding to high voltage engineering; sources of test voltage, the methods of measurements of typical properties for high voltage engineering. Moreover, the course is aimed at develop skills related to safe work with high voltage equipment and the ability to use in practice selected methods of evaluating the condition of insulating systems.

Course-related learning outcomes

Knowledge:
1. he/she has knowledge in the frame of physics, necessary to understand fundamental phenomena

occurring in high voltage insulating systems used in electric power.
2. he/she has fundamental knowledge in the frame of materials passing constructive and loading needs of high voltage insulation systems used in electric power.
3. he/she has knowledge in the frame of fundamentals of high voltage insulating systems used in electric power. he/she knows and understands phenomena occurring in high voltage insulation systems
4. he/she has knowledge in the field of diagnostics of high-voltage electrical equipment insulation systems and in the measurement of basic quantities characterizing high-voltage insulation systems
5. he/she has elementary knowledge about life cycle of high voltage insulating systems used in electric power devices.

Skills:
1. he/she can collect information from literature, data base, and other sources; can integrate collected information, can explain, and can make conclusions and opinions about high voltage engineering.
2. he/she can work individually and in a team; can estimate the time needed to complete the task.
3. he/she can use proper methods and devices to measure fundamental parameters describing high voltage insulation systems.
4. he/she can plan and measure high voltage and fundamental properties describing materials used in high voltage engineering.

Social competences:
1. he/she understands role of their own work, work in team, and responsibility of team tasks in frame of high voltage engineering.

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:
1) Assessment of knowledge and skills proved on written exam,
Laboratories:
1) Assessment of knowledge and skills related to performed laboratory classes - assessment of laboratory report
2) Continuous checking of the preparation for the laboratory classes

Programme content

In the frame of lectures the following topics are presented:
Solid, liquid and gas electrical insulating materials used in high voltage devices. Electrical (dielectric strength, bulk and surface resistivity, electric permittivity, dissipation factor) physical and chemical properties of electro-insulating materials and the methods of investigations of these properties. Evaluation of the condition of insulating systems of high voltage equipment on the basis of investigations of insulating materials properties. Methods of measurement of high voltage. Sources of AC, DC and pulse test voltage.
In the frame of laboratory lessons the following exercise are realized:
Dielectric strength of the air in spherical, plate, and needle spark gaps. Tests of transformer mineral oil. Methods of measurement of high voltlage. The influence of spatial electric load on the dielectric strength of the air at DC voltage. The investigations of resistivity of solid and liquid dielectrics. The measurement of dissipation factor of high voltage insulating system. The part of laboratory classes are performed using high voltage up to 75 kV.

Teaching methods

The theory presented during lectures is closely related to practice. During the lecture a discussion is initiated. Lectures with multimedia presentation (including: figures, photos, videos) complemented by the information on the board.
Laboratory classes are done in teams. 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. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom I – 1996
3. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom II – 1999
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. Gacek Z., Wysokonapięciowa technika izolacyjna, Wydawnictwo Politechniki Śląskiej, Gliwice 2006
2. Celiński Z., Materiałoznawstwo elektrotechniczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
3. Lisowski M., Pomiary rezystywności i przenikalności elektrycznej dielektryków stałych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004
4. Przybyłek P., Water saturation limit of insulating liquids and hygroscopicity of cellulose in aspect of moisture determination in oil-paper insulation, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 23, Issue 3, 2016, 1886-1893, DOI: 10.1109/TDEI.2016.005627
5. Dombek G., Nadolny Z., Influence of paper type and liquid insulation on heat transfer in transformers, EEE Transactions on Dielectrics and Electrical Insulation, Vol. 25, Issue 5, 2018, 1863-1870, DOI: 10.1109/TDEI.2018.007227

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	70	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00