STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
High voltage engineering fundamentals	**1010341741010319412**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics in Technology	**(brak)**	**2 / 4**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**4 100%**
Technical sciences	**4 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has a basic knowledge of physics, chemistry, fundamental rights of electrical engineering and materials science. Student has a basic knowledge of mathematics necessary to analyze the results of measurements (arithmetic mean, standard deviation of the arithmetic mean, t-distribution, complete differential).
2	**Skills**	Student can build a simple electric circuit to carry out measurements of basic physical quantities of electrical materials and carry out statistical analysis of the results of measurements, and has the ability to use some methods of linear algebra, differential and integral calculus.
3	**Social competencies**	Student is aware of the need to broaden their skills and competences. He is able to work independently and cooperate in a group.

Assumptions and objectives of the course:

-Knowledge of basic issues related to the high voltage technique. Understanding the test sources of high voltages. Understanding the measurement techniques of typical high voltage parameters. Understanding the physical phenomena occurring in insulating systems under high voltage.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Knowledge about systems to generate of high DC, AC and surge. - [K_W14, K_W17]
2. Basic knowledge about the construction of high voltage insulation systems and electrical values which characterize them. - [K_W14, K_W16, K_W18]

Skills:

1. Student can carry out measurements of physical quantities characteristic for insulation systems. - [K_U22, K_U32]
2. Student can perform high voltage measurements by several methods. - [K_U22, K_U26, K_U27]

Social competencies:

1. Student is aware of the impact of the technical aspects on the environment. Student can act in a resourceful way. - [K_K03, K_K04]

Assessment methods of study outcomes

Lecture: assessment of knowledge and skills shown at the written exam,

Laboratory exercises:

- test and rewarding knowledge necessary for the accomplishment of the problems in the area of laboratory tasks,

- continuous assessment, for each classes - rewarding gain skills they met the principles and methods,

- assessment of knowledge and skills related to the implementation of the tasks of exercises, evaluation of the reports from classes.

Course description

Direct current (DC) test sources (rectifier circuits), alternate current (AC) test sources (high voltage test transformer), surge voltage test sources (Marx generator).

Methods of measurement of high voltage electrical parameters, such as electrical strength (flat spark gap, sphere-sphere spark gap, cylindrical spark gap, edge spark gap), volume resistance and surface capacitance (Schering bridge), partial discharges, dielectric loss factor tan(delta) (Schering bridge).

Statistical analysis of the measurements results.

In the laboratory, will be performed the following topics: measurement of electrical strength of the flat, sphere-sphere, cylindrical and edge spark gaps; analysis of the corona phenomenon; dependence of electrical strength of air pressure; the effect of the space charge on the strength of the air; slide discharges; voltage distribution in chain of insulators; high voltage measurement techniques; development of conductive bridges in the oil; investigation of transformer oil.

Update 2017: Electrical and magnetic fields: professional and environmental exposure.

Basic bibliography:

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.

4. Glorkowska B., Wytrzymałość elektryczna gazowych układów izolacyjnych wysokiego napięcia, Uczelniane Wydawnictwo Naukowo-Dydaktyczne, Kraków, 2003.

Additional bibliography:

1. Gacek Z., Wysokonapięciowa technika izolacyjna, Wydawnictwo Politechniki Śląskiej, Gliwice, 2006.

2. Gacek Z., Kształtowanie wysokonapięciowych układów izolacyjnych stosowanych w elektroenergetyce, Wydawnictwo Politechniki Śląskiej, Gliwice, 2002.

3. Florkowska B. i inni, Mechanizmy, pomiary i analiza wyładowań niezupełnych w diagnostyce układów izolacyjnych wysokiego napięcia, Uczelniane Wydawnictwo Naukowo-Dydaktyczne AGH, Kraków, 2001.

4. PN-EN 60270:2003 Wysokonapięciowa technika probiercza - Pomiary wyładowań niezupełnych

5. 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

6. 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

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures classes	30
2. Participation in laboratory classes	30
3. Participation in the consultations related to the implementation of the education process, especially laboratory classes	2
4. Finishing (as part of own work) reports on laboratory exercises	6
5. Preparing for laboratory exercises	15
6. Preparing to pass the lecture and participate in it	17

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	64	2
Practical activities	53	2