STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Diagnostics of electrical power devices	**1010341761010319415**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics in Technology	**general academic**	**3 / 6**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Device diagnostics	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies **(Polish Qualifications Framework level six)**	**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)
other	**university-wide**

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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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student knows basic theorems and transforms of mathematical analysis and linear algebra. the student has theoretical knowledge in the field of technical sciences, including electrical engineering. Student has a basic knowledge of the properties and applications of electroinsulating materials. [K_W01 (P6S_WG), K_W04 (P6S_WG), K_W10 (P6S_WG)]
2	**Skills**	Student is able to carry out detailed research using experimental methods, interpret the results obtained and draw conclusions. Student has the ability to use IT tools to process measurement data. [K_U05 (P6S_UW), K_U03 (P6S_UW)]
3	**Social competencies**	Student is able to work and cooperate within the team and is aware of the need to expand his competence in the area of solving technical problems. [K_K01 (P6S_KK), K_K03 (P6S_KO)]

Assumptions and objectives of the course:

Knowledge of electric power equipment design. Learning the parameters and physical quantities useful for diagnostic methods of electric power equipments. Practical ability to apply the chosen measurement technique for diagnostic and comprehensive evaluation of the technical condition of equipments. Practical ability to processing and proper interpretation of measuring data used for evaluation of the technical condition of electric power equipments. Ability to prepare professional reports from the research.

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

Knowledge:

1. Student has knowledge of electric power equipment design. - [K_W08 (P6S_WG)]
2. Student has knowledge of physical phenomena in insulation system of electric power devices. - [K_W05 (P6S_WG)]
3. Student has knowledge of diagnosis and operation of electric power equipments. - [K_W07 (P6S_WG)]

Skills:

1. Student can choose and use the proper measurement method for evaluation of the technical condition of equipments. - [K_U07 (P6S_UW), K_U09 (P6S_UW)]
2. Student is able to process and correctly interpret the obtained results and present them in the form of a report. - [K_U12 (P6S_UK)]

Social competencies:

Student understands the need for continuous training in the field of modern diagnostics of power devices - [K_K02 (P6S_KK)]

Assessment methods of study outcomes

Lectures:

- assess the knowledge and skills indicated in a written or oral exams

Laboratory classes:

- tests of the knowledge necessary for the accomplishment of the problems in the area of laboratory tasks,
- continuous assessment for each laboratory class
- rating the knowledge and skills related to realization of laboratory task; assessment of the written measurement report
- assess the knowledge and skills indicated in a written or oral test.

Course description

Design of equipments and high voltage (HV) insulation systems used in power electrical engineering. Parameters and physical quantities used for condition assessment of HV insulation systems. Diagnostic methods of power electrical equipments: conventional and unconventional partial discharge detection and localization methods, physical and chemical methods for evaluation of moisture and aging process of insulation system, polarization methods for estimation of the moisture concentration in oil-paper insulation system (RVM, FDS, PDC), diagnostics of transformer winding deformation, infrared electrical inspection, spectrophotometry. Digital signal processing of measurement signals (frequency and joint time-frequency methods: FFT/STFT transform, continuous and discrete wavelet transform, statistical analysis, automatic signal classification techniques).

Update 2018:

Mathematical modelling of partial discharge sensors and transducers.

Basic bibliography:

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 bibliography:

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

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in laboratory classes	30
3. Participation in consultation related to realization of learning process	7
4. Preparation of reports from laboratory classes	6
5. Preparation for classes/ laboratory classes	15
6. Preparation to the exam and attendance at exam	12

Student’s workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	69	3
Practical activities	31	1