

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>High voltage engineering</b>		Code <b>1010325321010311585</b>
Field of study <b>Electrical Engineering</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>1 / 2</b>
Elective path/specialty <b>-</b>	Subject offered in: <b>Polish</b>	Course (compulsory, elective) <b>obligatory</b>
Cycle of study: <b>Second-cycle studies</b>	Form of study (full-time, part-time) <b>part-time</b>	
No. of hours Lecture: <b>10</b> Classes: <b>-</b> Laboratory: <b>10</b> Project/seminars: <b>-</b>		No. of credits <b>2</b>
Status of the course in the study program (Basic, major, other) <b>major</b>		(university-wide, from another field) <b>university-wide</b>
Education areas and fields of science and art		ECTS distribution (number and %)
<b>Responsible for subject / lecturer:</b>		
dr inż. Wojciech Sikorski email: wojciech.sikorski@put.poznan.pl tel. (61) 665 20 35 Wydział Elektryczny ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Student has basic knowledge about physical phenomena occurring in insulating materials Student has knowledge about typical construction of high voltage equipments and apparatus
2	<b>Skills</b>	Student has the ability to design the basic high-voltage insulation systems Student has the ability to conduct basic diagnostic tests on high-voltage equipments and apparatus
3	<b>Social competencies</b>	Student has the ability to work and collaborate in groups
<b>Assumptions and objectives of the course:</b>		
Construction of high-voltage equipment and insulation systems. The methods for proper selection of high-voltage insulation materials. The parameters and physical phenomena in diagnostics of high-voltage equipment. The review of modern diagnostic techniques and assessment of the insulation condition of high-voltage equipment. The digital processing and proper interpretation of measurement data for assessment of high-voltage equipment condition.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. Student has knowledge about physical phenomena occurring in high-voltage insulation systems - [K_W03++] 2. Student has knowledge about design of high-voltage insulation systems - [K_W05+++] 3. Student has detailed knowledge about high voltage equipment diagnostics; Student has knowledge in the area of elaborating of experiment results - [K_W11+++] 4. Student has extended knowledge about construction and functioning of high-voltage equipment insulating systems - [K_W15+++]		
<b>Skills:</b>		
1. Student can process and properly interpret measurement data to evaluate technical condition of high-voltage equipment - [K_U03+++] 2. can apply an adequate diagnostic method to evaluate condition of high-voltage equipment insulation system - [K_U09++] 3. Student can gain information based on literature and other sources related to construction and diagnostic methods of high-voltage equipment - [K_U01++]		
<b>Social competencies:</b>		
1. Student is aware of the role of high-voltage equipment diagnostics in assuring continuity of energy supply for industry and population - [K_K02++] 2. Student is aware of threats scale and influence of high-voltage equipment breakdown results on natural environment naturalne - [K_K02++]		

<b>Assessment methods of study outcomes</b>	
<p>Lectures:</p> <ul style="list-style-type: none"> <li>- evaluation of knowledge and skills proven on written or oral examinations during examination session</li> </ul> <p>Laboratory classes:</p> <ul style="list-style-type: none"> <li>- tests and rewarding knowledge necessary to realise basic problems in the given laboratory task field</li> <li>- continuous evaluation, on each class - rewarding improvement of ability to use the known rules and methods,</li> <li>- evaluation of knowledge and skills related to realisation of laboratory task, evaluation of report on task carried out</li> <li>- evaluation of knowledge and skills proven on written or oral test</li> </ul>	
<b>Course description</b>	
<p>LECTURE:</p> <ul style="list-style-type: none"> <li>- Construction of high voltage equipment and systems</li> <li>- Ageing processes occurring in high-voltage insulation systems</li> <li>- Problems of partial discharges occurring in high voltage insulation systems</li> <li>- Problems of moisture of paper-oil insulation</li> <li>- Methods of high-voltage equipment diagnostics:               <ol style="list-style-type: none"> <li>a) methods of partial discharges detection (HF, UHF, EA, conventional),</li> <li>b) evaluation methods of insulation system moisture content (Karl-Fischer, FDS, PDC, RVM, capacitive probe),</li> <li>c) detection methods of power transformer windings deformation (FRA/SFRA),</li> <li>d) methods</li> </ol> </li> </ul> <p>LABOARTORY:</p> <ol style="list-style-type: none"> <li>1. Detection and location of partial discharges using acoustic emission method (EA)</li> <li>2. Measurement of partial discharges using conventional electric method (PN-EN 60270)</li> <li>3. Detection of partial discharges registered in HF/UHF frequency band</li> <li>4. Detection of power transformer insulation system defects basing on analysis of gases dissolved in insulation oil</li> <li>5. Evaluation of moisture content insulation system using physicochemical methods (Karl-Fischer, capacitive probe)</li> <li>6. Evaluation of moisture content insulation system using physicochemical methods (FDS/PDC/RVM)</li> <li>7. Detection of power transformer windings deformation using FRA/SFRA method</li> </ol>	
<p><b>Basic bibliography:</b></p> <ol style="list-style-type: none"> <li>1. Florkowska B., Diagnostyka wysokonapięciowych układów izolacyjnych urządzeń elektroenergetycznych, Wydawnictwo AGH Kraków, 2009</li> <li>2. Gulski E., Diagnostowanie wyladowań niezupełnych w urządzeniach wysokiego napięcia w eksploatacji, Prace Naukowe Politechniki Warszawskiej, 2003</li> <li>3. Flisowski Z., Technika wysokich napięć, WNT Warszawa, 2009</li> <li>4. Gacek Z., Wysokonapięciowa technika izolacyjna, Wydawnictwo Politechniki Śląskiej, Gliwice, 2006</li> <li>5. Mościcka-Grzesiak H., pod red., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom I ? 1996, tom II ? 1999</li> <li>6. Fleszyński J., pod red., Laboratorium wysokonapięciowe w dydaktyce i elektroenergetyce, Oficyna Wydawnicza Politechniki Wrocławskiej, 1999</li> </ol>	
<p><b>Additional bibliography:</b></p> <ol style="list-style-type: none"> <li>1. Kuffel E., Zaengl W., Kuffel J., High Voltage Engineering. Fundamentals, Butterworth-Heineman, 2001</li> </ol>	
<b>Result of average student's workload</b>	
Activity	Time (working hours)
1. Participation in lecture classes	10
2. Participation in laboratory classes	10
3. Consultations	5
4. Preparation for examination	10
5. Preparation for laboratory classes	7
6. Preparation of reports	10
7. Participation in examinations	3

<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	55	3
Contact hours	28	1
Practical activities	40	2