

| <b>STUDY MODULE DESCRIPTION FORM</b>   |   |  |
|--|---|--|
| Name of the module/subject<br><b>Disturbances in Electric Power Systems</b>  |   | Code<br><b>1010322221010314876</b>   |
| Field of study<br><b>Electrical Engineering</b>  | Profile of study (general academic, practical)<br><b>(brak)</b> | Year /Semester<br><b>1 / 2</b>   |
| Elective path/specialty<br><b>-</b>  | Subject offered in:<br><b>polish</b>                            | Course (compulsory, elective)<br><b>obligatory</b>   |
| Cycle of study:<br><b>Second-cycle studies</b>   | Form of study (full-time, part-time)<br><b>full-time</b>        |  |
| No. of hours<br>Lecture: <b>1</b> Classes: <b>-</b> Laboratory: <b>1</b> Project/seminars: <b>-</b>  |   | No. of credits<br><b>2</b>   |
| Status of the course in the study program (Basic, major, other)<br><b>(brak)</b>   |   | (university-wide, from another field)<br><b>(brak)</b>   |
| Education areas and fields of science and art<br><b>technical sciences</b><br><b>Technical sciences</b>  |   | ECTS distribution (number and %)<br><b>2 100%</b><br><b>2 100%</b>   |
| <b>Responsible for subject / lecturer:</b><br><br>dr inż. Krzysztof Walczak<br>email: krzysztof.walczak@put.poznan.pl<br>tel. 61 665 2797<br>Wydział Elektryczny<br>ul. Piotrowo 3A 60-965 Poznań  |   |  |
| <b>Prerequisites in terms of knowledge, skills and social competencies:</b>  |   |  |
| 1  | <b>Knowledge</b>  | Student a basic knowledge of electrical engineering, power engineering and metrology.  |
| 2  | <b>Skills</b>   | Student can assemble the measurement system, can carry out measurements of basic physical quantities. Student can elaborate results. Student is able to work in a group. |
| 3  | <b>Social competencies</b>                                      | Student understands the importance of teamwork.  |
| <b>Assumptions and objectives of the course:</b><br>Knowledge of both theoretical and practical problems associated with interference in electric power networks. Understanding the causes and effects of transients in power systems. Knowledge of standards of conduct consistent with the protection and coordination of power systems under disruptions.   |   |  |
| <b>Study outcomes and reference to the educational results for a field of study</b>  |   |  |
| <b>Knowledge:</b><br>1. Student can name and describe basic types of disturbances occurring in the power system. - [K_W15++, K_W19+++]<br>2. Student is able to characterize and evaluate the resistance against disturbance of typical devices operating in the power grid. - [K_W16++, K_W19+++]<br>3. Student can determine the rules of procedure for reducing the impact of disturbances on devices operating in the power grid. - [K_W15++, K_W16++, K_W19+++]   |   |  |
| <b>Skills:</b><br>1. Student can identify the cause of the disturbances and evaluate the risks resulting therefrom for the proper operation of the power grid. - [K_U07++, K_U14++]<br>2. Student can examine and analyze the signals generated by various types of interferences, and assess the level of resistance to interference of selected electrical equipment. - [K_U07++, K_U14++]<br>3. Student can choose elements of overvoltage protection for selected electrical devices. - [K_U13++, K_U18++] |   |  |
| <b>Social competencies:</b><br>1. Student is aware of the need to disseminate knowledge about the dangers of electric shock as a result of disruption or failure of the power system components. - [K_K02++]   |   |  |

| <b>Assessment methods of study outcomes</b>   |                      |      |
|---|----------------------|------|
| <p>Lectures:<br/>                     - assess the knowledge and skills demonstrated during written or oral tests</p> <p>Laboratory:<br/>                     - tests and rewarding knowledge necessary for the accomplishment of problems in the area of laboratory tasks,<br/>                     - continuous evaluation, on each course - rewarding skills gain in the range of use of the principles and methods have met during the course,<br/>                     - assessment of knowledge and skills related to the implementation of the exercise, the assessment of the report from performed exercise.</p>   |                      |      |
| <b>Course description</b>   |                      |      |
| <p>Lecture covers the following topics: classification of disturbance sources - intentional and unintended, the definitions, the basis of analysis of interfering signals occurring in power networks; transients, electromagnetic interferences, short-circuit disturbances, internal and external surges, resistance to disturbance exposure, overvoltage protection, coordination of power systems in terms of interferences.</p> <p>Laboratory exercises include: measurement and evaluation of disturbances levels, study of electrical devices susceptibility an levels of resistance to electromagnetic interference, ways to reduce the impact of disturbances on the power grid.</p> |                      |      |
| <b>Basic bibliography:</b>  |                      |      |
| <p>1. Boolen M. H., Gu I.: Signal Processing of Power Quality Disturbances, John Wiley &amp; Sons, 2006.<br/>                     2. Machczyński W.: Wprowadzenie do kompatybilności elektromagnetycznej, WPP, Poznań, 2004.<br/>                     3. Normy PN-EN 61000-6-1/2/3/4: Kompatybilność elektromagnetyczna (EMC) ? Wymagania dot. odporności i emisyjności.<br/>                     4. Flisowski Z.: Technika wysokich napięć, WNT, Warszawa, 2005.</p>   |                      |      |
| <b>Additional bibliography:</b>   |                      |      |
| <p>1. Charoy A.: Kompatybilność elektromagnetyczna. Zakłócenia w urządzeniach elektronicznych, t. I-IV, WNT, Warszawa, 1999.</p>  |                      |      |
| <b>Result of average student's workload</b>   |                      |      |
| Activity  | Time (working hours) |      |
| 1. Participation in lectures  | 15                   |      |
| 2. Participation in laboratory activities   | 15                   |      |
| 3. Consultation   | 3                    |      |
| 4. Preparation for laboratory activities and elaboration of the report  | 10                   |      |
| 5. Preparation for tests  | 10                   |      |
| 6. Participation in written or oral tests   | 2                    |      |
| <b>Student's workload</b>   |                      |      |
| Source of workload  | hours                | ECTS |
| Total workload  | 55                   | 2    |
| Contact hours   | 35                   | 1    |
| Practical activities  | 28                   | 1    |