# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | | Code |
|---|---|---|
| **High voltage engineering** | | **1010314471010311585** |
| Field of study: **Power Engineering** | Profile of study (general academic, practical): **(brak)** | Year /Semester: **4 / 7** |
| Elective path/specialty: **-** | Subject offered in: **Polish** | Course (compulsory, elective): **obligatory** |
| Cycle of study: **First-cycle studies** | Form of study (full-time,part-time): **part-time** | |
| No. of hours: Lecture: **15** Classes: **-** Laboratory: **15** Project/seminars: **-** | | No. of credits: **3** |
| Status of the course in the study program (Basic, major, other): **(brak)** | (university-wide, from another field): **(brak)** | |
| Education areas and fields of science and art: **technical sciences** **Technical sciences** | | ECTS distribution (number and %): **3 100%** **3 100%** |

## Responsible for subject / lecturer:

dr eng. Piotr Przybyłek
email: piotr.przybylek@put.poznan.pl
tel. 616652018
Faculty of Electrical Engineering
Piotrowo 3A Str., 60-965 Poznan

## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | He/she has fundamental knowledge in the frame of electrical engineering material science, and knows fundamental principles of theory of electrical circuits. |
| 2 | **Skills** | He/she can build simple electrical setup and conduct the measurements of basic physical quantities. |
| 3 | **Social competencies** | He/she can work and cooperate in group. |

## Assumptions and objectives of the course:

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.

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

### 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. - [K_W02++]
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. - [K_W05++]
3. He/she has knowledge in the frame of fundamentals of high voltage insulating systems used in electric power. - [K_W11+]
4. He/she knows and understands methods of measurements of fundamental properties describing high voltage insulation systems. - [K_W19++]
5. He/she has elementary knowledge about life cycle of high voltage insulating systems used in electric power devices. - [K_W24+]

### 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. - [K_U01++]

2. He/she can work individually and in a team; can estimate the time needed to complete the task. - [K_U02++]

3. He/she can use proper methods and devices to measure fundamental parameters describing high voltage insulation systems. - [K_U10+++]

4. He/she can plan and measure high voltage and fundamental properties describing materials used in high voltage engineering. - [K_U11++]

**Social competencies:**

1. He/she understands role of their own work, work in team, and responsibility of team tasks in frame of high voltage engineering. - [K_K04++]

## Assessment methods of study outcomes

Lectures:

1) Assessment of knowledge and skills proved on written exam,

Laboratories:

1) Tests and preemie of knowledge which is necessary to realize fundamental tasks in some fields of laboratory,

2) Continuous assessment on each laboratory - preemie of knowledge increase,

3) Assessment of knowledge and skills connected to realization of laboratory tasks, assessment of report.

## Course description

Updated: 2017

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.

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.

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.

Laboratory classes are done in teams. Laboratory reports are reviewed by the instructor and discussed in the presence of the author.

## Basic bibliography:

1. Flisowski Z., Technika wysokich napięć, Wydawnictwo Naukowo-Techniczne, Warszawa 2005

2. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom I - 1996, tom II - 1999

3. Mościcka-Grzesiak H., Ćwiczenia laboratoryjne z materiałoznawstwa elektrotechnicznego i techniki wysokich napięć, Wydawnictwo Politechniki Poznańskiej, Poznań 2002

4. Gielniak J., Ćwiczenia laboratoryjne z inżynierii materiałowej w elektrotechnice, Wydawnictwo Politechniki Poznańskiej, Poznań 2009

## Additional bibliography:

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., Siodła K., Application of capacitive sensor for measuring water content in electro-insulating liquids, Eksploatacja i Niezawodnosc - Maintenance and Reliability, Vol. 18, No. 2, 181-185, 2016

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|

| | |
|---|---|
| 1. Participation in lectures | 15 |
| 2. Participation in laboratory classes | 15 |
| 3. Participation in exam | 2 |
| 4. Preparation for the exam | 18 |
| 5. Consultation | 2 |
| 6. Preparation for the laboratory classes | 18 |
| 7. Preparation of laboratory reports | 10 |

| **Student's workload** | | |
|---|---|---|
| **Source of workload** | **hours** | **ECTS** |
| Total workload | 80 | 3 |
| Contact hours | 34 | 1 |
| Practical activities | 43 | 2 |