GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | High Voltage Engineering, PG_00038442 | | |
| Field of study | Electrical Engineering | | |
| Date of commencement of studies | October 2022 | Academic year of realisation of subject | 2023/2024 |
| Education level | first-cycle studies | Subject group | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 2 | Language of instruction | Polish |
| Semester of study | 4 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Faculty of Electrical and Control Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Marek Olesz | |
| | Teachers | dr inż. Daniel Kowalak<br>dr hab. inż. Marek Olesz | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 15.0 | 0.0 | 0.0 | 45 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 45 | 7.0 | 48.0 | 100 |

**Subject objectives**

Understanding of phenomena in high voltage insulation systems

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| K6_K01 | Student appreciates the importance of self-expanding knowledge in the field of high voltage engineering | [SK5] Assessment of ability to solve problems that arise in practice<br>[SK2] Assessment of progress of work |
| K6_U05 | The student is able to perform basic measurements confirming the electrical strength of the insulation system. The student is able to estimate safe separating distances. | [SU1] Assessment of task fulfilment<br>[SU3] Assessment of ability to use knowledge gained from the subject |
| K6_W02 | The student understands the conditions determining the occurrence of electrical discharges in gas, solid and liquid insulation, the mechanism of discharge development, the mechanisms of insulation degradation. The student understands the basics of overvoltage protection, the requirements for basic elements and insulation systems, the principles of their operation, taking into account the influence of the surrounding environment, allowing interpretation of regulations and standards. | [SW1] Assessment of factual knowledge |

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| Subject contents | LECTURE Dielectrics, ionisation processes in gases, forms of dischargs, corona, impuls air strength, effect of field distribution, polarity, symmetry, dimensions, time and frequency on electric strength of gases. Compressed gases. Liquid dielectrics, effect of pressure, temperature, humidity, time and frequency, field distribution and electrode dimension on electric strength, applications. Solid dielectrics, mechanisms of breakdown, partial discharges, degradation, dielectric strength of composed insulation systems, surface and gliding discharges. Insulators, application, design, effect of field distribution, pollution and humidity, design of HV power cables and terminations. Lightning, basic parameters, overvoltages, propagation of waves in power lines and windings, principles and methods of lightning protection, co-ordination of insulation. Principles of diagnostics of insulation. LABORATORY Measurement of AC, DC and impuls high voltages. Effect of voltage distribution on discharge form in air at AC, DC and impuls voltages. Effect of ambient conditions on electric strength of air. Insulator testing in dry conditions and under rain. Oil evaluation, Model investigations of wave phenomena in long lines. |
| Prerequisites and co-requisites | acquaintance with principles of differencial ordinary and partial equations, integral calculus, theory of electric fields, kinetic-molecular theory of gases, principles of thermodynamics, and structure of atom |

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Laboratory passing test | 60.0% | 40.0% |
| Written exam | 60.0% | 60.0% |

**Recommended reading**

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| Basic literature | 1. Z. Flisowski: "Technika Wysokich Napięć" (HV engineering), PWN Warszawa 2017.<br>2. Z. Gacek: "Wysokonapięciowa technika izolacyjna" (HV insulation technique), Wydawnictwo Politechniki Gliwickiej, Gliwice 2006<br>3. H. Boryń, A. Rynkowski, S. Wojtas: Laboratorium Techniki Wysokich Napięć. Wydawnictwo Politechniki Gdańskiej, 2007.<br>4. S. Szpor i inni, "Technika wysokich napięć" ( HV engineering) WNT, Warszawa, 1978,<br>5. Ravindra Arora and Wolfgang Mosch, High Voltage and Electrical Insulation Engineering IEEE Press , 2011 |
| Supplementary literature | 1. H. Mo cicka-Grzesiak: Inżynieria wysokich napięć w elektroenergetyce, tom I, Wydawnictwo Politechniki Poznańskiej, Poznań 1996.<br>2. S. Szpor: Ochrona odgromowa. WNT 1978 |
| eResources addresses | Adresy na platformie eNauczanie:<br>TECHNIKA WYSOKICH NAPIĘĆ [ET][2023/24] - Moodle ID: 36064<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=36064 |

**Example issues/ example questions/ tasks being completed**

The streamer mechanism of spark

Dielectric loss coefficient

Breakdown mechanism of solid materials

Breakdown mechanism of liquid dielectrics

Measurement of DC high voltages

Measurement of AC high voltages

Measurement of impulse high voltages

The lightning protection of buildings

Principles of overvoltage protection for power systems and devices

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| Work placement | Not applicable |