GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Fundamentals of Power Electronics, PG_00055956 | | |
| Field of study | Power Engineering, Power Engineering, Power Engineering | | |
| Date of commencement of studies | October 2021 | Academic year of realisation of subject | 2023/2024 |
| Education level | first-cycle studies | Subject group | Optional subject group<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 | 3 | Language of instruction | Polish |
| Semester of study | 5 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Power Electronics and Electrical Machines -> Faculty of Electrical and Control Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Piotr Musznicki | |
| | Teachers | dr hab. inż. Piotr Musznicki | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 15.0 | 0.0 | 15.0 | 0.0 | 0.0 | 30 |

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 | 30 | 2.0 | 18.0 | 50 |

**Subject objectives**

The aim of the course is to familiarize students with the basic systems of power electronic converters, including their construction, control methods, use and problems of their use in modern power engineering. The classic topologies of converter systems, their applications in modern power engineering and selected latest solutions for controlling electrical machines and renewable energy sources will be presented.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W05] has structured knowledge in the field of electrical engineering and electronics, necessary to understand the basics of operation and selection of electrical machines, electricity transmission systems and power electronic devices | Fundamentals of Power Electronics are aimed at presenting the importance of modern power electronic systems in practice energy engineer. Students will learn about the basic elements and power electronic systems and with problems that may arise when using them. As a result, students will become familiar with the most commonly used ones system topologies, the possibilities of their application and control, and understand the phenomena and physical processes occurring in switches and systems power electronics. | [SW1] Assessment of factual knowledge |
| [K6_W03] knows the basics of automation and automatic regulation, knows the principles of the selection of electrical devices, drive systems and their control | Students are able to choose a power electronic converter to cooperate with the system electromechanical. | [SW1] Assessment of factual knowledge |

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| Subject contents | Lectures: 1. The importance of power electronics in modern electricity. Basic power electronic switches 2/3 AC/DC systems - rectifiers 4/5. Elementary low power converters - DC/DC, 6/7 Elementary DC/AC converters (inverters). 8. Outline of modulation theory applied to converter systems. 9. Elementary AC/AC converters. 10 Resonant converters. 11. Power converter control systems. 12/13 Energy aspect in converter systems, high-speed circuit breakers, power quality, uninterruptible power supply systems, active filters. 14/15. Selected issues of power electronic systems: network distortions, protection circuits, interferences.<br><br>Laboratory: 1. Single-phase diode rectifier 2. Power transistors (IGBT) 3. Thyristors 4. Single-phase voltage inverter 5. AC controller 6. Isolated DC-DC converters |
| Prerequisites and co-requisites | Knowledge of the theoretical basis and methods of analysis of electrical circuits. |

Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| Laboratory | 50.0% | 50.0% |
| Tests during the semester | 50.0% | 30.0% |
| Final test | 60.0% | 20.0% |

Recommended reading

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| Basic literature | • Mohan N., Undeland T.M., Robbins W.P., Power Electronics: Converters, Applications and Design, 3rd Edition, John Willey & Sons, Inc, 2003.<br>• Williams, Barry W, Principles and Elements of Power Electronics, B. W. Williams, 2006<br>• Rashid, Muhammad H. Power Electronics Handbook: Devices, Circuits, and Applications.Burlington, MA: Academic, 2006. |
| Supplementary literature | • Bose, Bimal K. Modern Power Electronics and AC Drives. New Delhi: PHI Learning, 2012.<br>• Piotr Musznicki The conducted EMI in DC-DC converters Walter de Gruyter GmbH & Co KG, 2018 |
| eResources addresses | Adresy na platformie eNauczanie:<br>Podstawy Energoelektroniki [2023/24] - Moodle ID: 32583<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32583 |

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| Example issues/ example questions/ tasks being completed | • Compare IGBTs and MOSFETs, give basic parameters, characteristics andmethod of application.<br>• Describe the sub-periods of operation of a single-phase voltage inverter.<br>• What is the method of tracking the optimal working point (MPPT) in converter systemsfor photovoltaic energy sources |
| Work placement | Not applicable |