



Subject card

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| Subject name and code | Fundamentals of power electronics, PG_00058372 | | | | | | |
| Field of study | Hydrogen Technologies and Electromobility | | | | | | |
| 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 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 | Department of Power Electronics and Electrical Machines -> Faculty of Electrical and Control Engineering | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | prof. dr hab. inż. Ryszard Strzelecki | | | | |
| | Teachers | | dr inż. Krzysztof Iwan | | | | |
| | | | prof. dr hab. inż. Ryszard Strzelecki | | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 15.0 | 15.0 | 0.0 | 0.0 | 60 |
| | 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 | 60 | | 5.0 | | 35.0 | 100 |
| Subject objectives | introduction to principles of power electronics energy conversion, | | | | | | |
| | introduction to the structures of power electronic systems, | | | | | | |
| | introduction to converter systems design methods. | | | | | | |

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| Learning outcomes | Course outcome | Subject outcome | Method of verification |
| | [K6_K01] is aware of the need for continuous education and self-improvement in the field of the profession of an electrician and knows the possibilities of further education | The ability to assess one's own skills and knowledge in power electronics and the ability to undertake various forms of self-education and professional development. | [SK5] Assessment of ability to solve problems that arise in practice [SK4] Assessment of communication skills, including language correctness [SK2] Assessment of progress of work [SK1] Assessment of group work skills |
| | [K6_U01] Is able to obtain information from literature, databases and other sources, integrate them, interpret them and draw conclusions and formulate opinions; has the ability to self-educate m.in. in order to improve professional competences | Uses power electronics terms, can apply knowledge from other modules and subjects. | [SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment |
| | [K6_W10] knows the basics of the processing, use and rational use of electricity, including the principles of electric traction in various transport systems | Be able to use criteria for assessing the quality of electrical power, distinguish between applications of power electronics types | [SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge |
| | [K6_W03] knows the basic methods of analysis of DC and AC circuits, the basic laws of electrical engineering and the properties of elements of electrical circuits | Be able to carry out elementary analysis of power electronic circuits. Be able to determine the exposures of power electronic circuit elements. | [SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge |
| Subject contents | The meaning of power electronics within modern electrical engineering. Power electronics devices constructional features, operating principle and characteristics, thermal model. Diode rectifier operating principle, properties, interpretation the manufacturers data sheet. A multi-pulse diode rectifiers. A review of thyristors-based converters. Introduction to the fundamentals of the theory of modulation applied to power converters systems. DC-DC switched-mode converters. The single-phase voltage source inverter with square-wave output. Three-phase full-bridge inverter, the space vector modulation technique. PWM rectifiers, power factor corrections. Uninterruptible power supply solutions. Resonant-mode converters. Multilevel inverters. Electromagnetic compatibility. Practical converter design considerations: snubber circuits, drive circuits, design of magnetic components. | | |
| Prerequisites and co-requisites | General knowledge of electrical engineering, electronics, circuit theory . Ability to analyse electrical circuits in transient states. | | |
| Assessment methods and criteria | Subject passing criteria | Passing threshold | Percentage of the final grade |
| | test of accounting exercises | 60.0% | 30.0% |
| | assessment of laboratory | 60.0% | 30.0% |
| | exam | 60.0% | 40.0% |
| Recommended reading | Basic literature | <ol style="list-style-type: none"> Nowak M., Barlik R. Poradnik inżyniera energoelektronika. Tom1, Wydawnictwo WNT, Warszawa 2014, wyd. II , 400 s Nowak M., Barlik R, Rąbkowski J. Poradnik inżyniera energoelektronika. Tom 2, Wyd.WNT, Warszawa 2015, wyd.II 523 s. Guziński J, Iwan K, Łuszcz J. Musznicki P.: Laboratorium Podstaw Energoelektroniki. Wyd. Politechniki Gdańskiej, Gdańsk 2011. | |
| | Supplementary literature | <ol style="list-style-type: none"> Mohan N., Undeland T.M., Robbins W.P., Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley & Sons, Inc, 2003. Tunia H., Smirnow A., Nowak M., Barlik R.: Układy Energoelektroniczne. Warszawa: WNT 1998. Kaźmierkowski M.P., Matysik J.T., Wprowadzenie do elektroniki i energoelektroniki, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005. Dmowski A: Energoelektroniczne układy zasilania prądem stałym w telekomunikacji i energetyce. Warszawa: WNT 1998. R.W.Erickson, D. Maksimović: Fundamentals of Power Electronics, Rd.3, Springer Cham, 2020 | |

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| | eResources addresses | <p>Podstawowe</p> <p>http://pbc.gda.pl/dlibra/info?mimetype=application/pdf&sec=false&handler=browser&content_url=/Content/15235/656_energoelektronika.pdf - Laboratory of Fundamentals Power Electronics - Pomeranian Digital Library</p> <p>Adresy na platformie eNauczanie:</p> <p>ENERGOELEKTRONIKA [TWiE][2023/24] - Moodle ID: 36096 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=36096</p> |
| Example issues/ example questions/ tasks being completed | <ol style="list-style-type: none"> 1. Voltage pulse is periodically fed to the input of ideal low-pass filter. It's rms value is E_2. What is the mean of the voltage at the output of this filter? 2. Draw a circuit of a three-phase bridge diode rectifier with an output LC filter loaded with resistance R. Assuming that the loaded filter draws a smooth current of I, draw the waveforms of the currents in two diodes of one branch of the bridge and the phase current drawn from the AC source. 3. Transformerless DC-DC boost type converter is operating in continuous mode. This system is powered from 5V, average value of the input current is 0.2 A at an output voltage of 12V. In the converter is used the MOSFET transistor with $R_{DS(ON)} = 50m$. Estimate the conduction losses in the transistor assuming that the ripple current in the inductor are negligible. | |
| Work placement | Not applicable | |