GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fundamentals of power electronics, PG_00058372						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2024/2025		
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						
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	Getting acquainted with the principles of power electronic energy conversion. Getting acquainted with the structures of power electronic systems. Getting acquainted with the methods of designing converter systems.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W03] knows the methods of analysis of DC and AC circuits, the laws of electrical engineering and the properties of elements of electrical circuits	Can make an elementary analysis of power electronic circuits. Can identify 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
[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	He uses terms from the area of power electronics, is able to use knowledge from other modules and subjects.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[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 evaluate one's skills and knowledge of power electronics and the ability to various forms of self-education and professional development.	[SK1] Assessment of group work skills [SK2] Assessment of progress of work [SK4] Assessment of communication skills, including language correctness [SK5] Assessment of ability to solve problems that arise in practice
[K6_W10] knows the principles of the processing, use and rational use of electricity, including the principles of electric traction in various transport systems	He is competent to use the criteria to evaluate the quality of electricity, distinguishes the applications of types of power electronic systems	[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 relevance of power electronics in modern electrical engineering. Power electronic switches - overview of technology, principles of operation and characteristics. Power electronic passive components, Thermal models-cooling of components. Diode rectifier operation, properties, use of data specifications. Theory of m-pulse diode rectifiers. Overview of thyristor circuits. Power factor of converters. Overview of modulation theory as applied to converter systems. Switch-mode DC-DC converters. Single-phase inverter with square output voltage and PWM control. Three-phase bridge inverter. Active rectifiers and PFC systems, power factor correction. Fundamentals of resonant converters and multilevel converters. Overview of electromagnetic compatibility problems of power electronic systems. Selected issues of converter design, protective circuits, control systems.

Prerequisites and co-requisites

Overall knowledge of the topics of electrical engineering, electronics , circuit theory including an understanding of the principles of commutation. Ability to analyze electrical circuits in steady state and transient states.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	60.0%	40.0%
credit colloquium	60.0%	30.0%
lab credit	60.0%	30.0%

Recommended reading

Basic literature

1. Nowak M., Barlik R. Handbook of a power electronics engineer. Volume1, WNT Publishing House, Warsaw 2014, 2nd edition , 400 p
2. Nowak M., Barlik R, Rąbkowski J. Handbook of a power electronics engineer. Volume 2, WNT Publishing House, Warsaw 2015, 523 p
3. Guziński J, Iwan K, Łuszcz J. Musznicki P.: Laboratory of power electronics fundamentals. Gdansk University of Technology Publishing House, Gdansk

	Supplementary literature	1. Mohan N., Undeland T.M., Robbins W.P., Power Electronics: Converters, Applications and Design, 3rd Edition, John Willey & Sons, Inc, 2003. 2. Tunia H., Smirnow A., Nowak M., Barlik R.: Systems. Power electronics. Warsaw: WNT 1998. 3. Kaźmierkowski M.P., Matysik J.T., Introduction to electronics and Power Electronics, Publishing House of the Warsaw University of Technology, Warsaw 2005. 4. Dmowski A: Power electronic systems of direct current power supply in telecommunications and power engineering. Warsaw: WNT 1998. 5. R.W.Erickson, D. Maksimović: Fundamentals of Power Electronics, Rd.3, Springer Cham, 2020
	eResources addresses	Podstawowe http://pbc.gda.pl/dlibra/info?mimetype=application/pdf&sec=false&handler=browser&content_url=/Content/15235/656_energoelektronika.pdf - Laboratory of Power Electronics Fundamentals - Pomeranian Digital Library Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. At the input of an ideal low-pass filter is periodically applied a voltage pulse with such a filling that its rms value is E/2. What is the average value of the voltage at the output of this filter? 2. Draw a diagram 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 both diodes of one of the bridge branches and the phase current of the AC supply. 3. The transformerless DC-DC boost converter operates with a continuous current in the inductance (in continuous mode). This circuit is supplied with 5V and is loaded with an average current of 0.2A at an output voltage of 12V. The circuit uses a MOSFET transistor with $r_{DS(ON)}$=50m. Estimate the conduction loss in this transistor assuming that the current ripple in the inductance is negligible.	
Work placement	Not applicable	