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 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.

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

1. Nowak M., Barlik R. Poradnik inżyniera energoelektronika. Tom1, Wydawnictwo WNT, Warszawa 2014, wyd. II , 400 s
2. Nowak M., Barlik R, Rąbkowski J. Poradnik inżyniera energoelektronika. Tom 2, Wyd.WNT, Warszawa 2015, wyd.II 523 s.
3. Guziński J, Iwan K, Łuszcz J. Musznicki P.: Laboratorium Podstaw Energoelektroniki. Wyd. Politechniki Gdańskiej, Gdańsk 2011.

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.: Układy Energoelektroniczne. Warszawa: WNT 1998.
3. Kaźmierkowski M.P., Matysik J.T., Wprowadzenie do elektroniki i energoelektroniki, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.
4. Dmowski A: Energoelektroniczne układy zasilania prądem stałym w telekomunikacji i energetyce. Warszawa: 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 Fundamentals Power Electronics - Pomeranian Digital Library Adresy na platformie eNauczanie: ENERGOELEKTRONIKA [TWiE][2023/24] - Moodle ID: 36096 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=36096
Example issues/ example questions/ tasks being completed	1. Voltage pulse is periodically fed to the input of ideal low-pass filter. It's rms value is E2. 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 RDS (ON) = 50m. Estimate the conduction losses in the transistor assuming that the ripple current in the inductor are negligible.	
Work placement	Not applicable	