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 2025	Academic year of realisation of subject	2026/2027
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 -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Turzyński	
	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_K01] is aware of the need for continuous education and self-improvement 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

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		
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		

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