GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Power Electronics Systems, PG_00050045						
Field of study	Electrical Engineering						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group				
Mode of study	Part-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	3.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Power Converters and Energy Storage Group -> Department of Power Electronics and Electrical Machines -> Faculty of Electrical and Control Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Paweł Szczepankowski				
	Teachers						

Lesson types							
	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	20.0	0.0	20.0	0.0	0.0	40
	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	40	4.0	31.0	75

Subject objectives	
	The subject aims to provide the student with knowledge of the construction and control of power electronics systems. The student will learn the principles of designing such devices, the building and functions of high-current parts, and control and measurement in voltage inverters, network converters, and DC/DC converters.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W07] has an in-depth, theoretically grounded knowledge of electromechanical systems and their electromechanical systems and their design, electrotraction systems power supply and electrical energy storage devices	The student selects and determines the main parameters for grid converters with energy storage devices.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W06] has in-depth knowledge of industrial electronics, microprocessor control systems, programmable logic systems and printed circuit design and prototyping computer-aided prototyping	Designs a microprocessor system, TMS320F283XX DSP processors, software logic, and analog-to-digital converters.	[SW3] Assessment of knowledge contained in written work and projects
[K7_K03] can interact and work in a group assuming various roles and identify priorities for the achievement of a specific task	Determines the needs of a power electronics application, selects power electronics system components and performs its simulation and analysis. In addition, it defines priorities for design activities.	[SK1] Assessment of group work skills
[K7_U07] is able to analyse, calculate, design, program and test converters, drive systems, control systems and state observers	Knows the PLECS program and can design a simulation circuit diagram for a given type of power electronics system topology.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_U06] is able to analyse, model, simulate and design electrical systems	Calculates and selects electrical parameters of the high-current components of the device using computer programs, especially simulators.	[SU1] Assessment of task fulfilment
[K7_K04] correctly identifies and resolves dilemmas associated with the exercise of the profession, in particular relating to responsibility for his own safety and the safety of others	Identifies threats and selects solutions to increase power electronics systems' safety and reliability.	[SK5] Assessment of ability to solve problems that arise in practice

Subject contents

Course content – lecture

LECTURE:Construction, operating principle and control of three-phase DC/AC voltage inverters - two-level three-branch, two-level four-branch, three-level NPC. Construction, operating principle and control of a network converter. Digital signal processing algorithms used in power electronics: phase synchronization, DSOGI filters, powers, harmonic analysis and transformations. Control system of a network converter with PI controllers and resonant controllers. Types and construction of DC voltage and current converters. Alarm states and practical protections in control systems of power electronics systems.

Course content – laboratory

LABORATORY:Design, analysis and simulation of a network converter in the PLECS program. Design and launch of a three-phase inverter using an evaluation board with a TMS320F28379D processor.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	60.0%	50.0%
Labs	60.0%	50.0%

Recommended reading

Basic literature

1. Power Electronics: Converters, Applications, and Design 3rd Edition, by Ned Mohan, Tore M. Undeland, William P. Robbins

2. Principles of Power Electronics 2nd Edition, by John G. Kassakian, David J. Perreault, George C. Verghese

	Supplementary literature	Fundamentals of Power Electronics Third Edition 2020, by Robert W. Erickson, Dragan Maksimović
	eResources addresses	Basic https://dev.ti.com/tirex/explore - Information about the C2000 family of processors, including the LAUNCHXL-F28379D board used in the lab.
Example issues/ example questions/ tasks being completed	Draw a diagram of the high-current part of a network converter with a two-level four-branch inverter.Draw a diagram of the high-current part of a three-level inverter with clamping diodes.Draw a diagram of the high-current part of a matrix converter with three inputs and five outputs.Draw and describe the block diagram of the control of a network converter in a dq system with PI controllers.Give the formula for the maximum amplitude of the voltage generated by a 6T inverter with udc voltage in the intermediate circuit.Explain the concepts of power invariance, amplitude invariance.Describe the principle of operation of any phase synchronization system.Describe the practical implementation of DFT and FFT algorithms in DSP processors and provide differences, advantages and disadvantages.Provide algorithms for extracting quadrature signals from sinusoidal signals.Give the formula for the transfer power of a phase shift controlled DC/DC converter.Park and Clarke transformation give formulas and applications.	
Practical activites within the subject	Visiting ELMECH-ASE in Pruszcz Gdański to familiarize yourself with the production of power electronics systems and listen to a presentation on energy storage. The visit will take place after the department authorities have formally approved it.	

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