GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	DRIVE SYSTEMS AND POWER CONVERTERS DESIGN , PG_00053439		
Field of study	Electrical Engineering		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	4	Language of instruction	Polish
Semester of study	7	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Electric Drives and Energy Conversion -> Faculty of Electrical and Control Engineering -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Adamowicz	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30

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	30	5.0	65.0	100

Subject objectives

The aim of the course is to provide the student with knowledge on the design of drive systems and converter systems. The student will learn the principles of design, calculation methods and methods for selecting basic drive system components: motor, gear and inverter, as well as the principles of design, calculation methods and methods for selecting basic inverter components: transistor module and diode rectifier, radiator, DC link capacitor, motor filter and network filter. In addition, the student will learn the skills of presenting and discussing energy efficiency and energy quality issues in drive systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_K01	Student reads technical literature and updates knowledge of changing standards and emerging new technical solutions in the design and construction of power converter systems and electrical drives.	[SK5] Assessment of ability to solve problems that arise in practice [SK3] Assessment of ability to organize work
K6_U09	Student calculates long-term load currents, transient load currents and short-circuit conditions and selects electrical power equipment.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
K6_U10	Student designs simple low-voltage electrical networks and installations. Performs calculations and selects components taking into account current regulations and standards.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
K6_W10	Student designs electrical energy conversion systems, selects components, calculates energy conversion efficiency.	[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects

Subject contents	Course content – lecture Lecture: 1) Calculations of drive systems - introduction. 2) Selection of electric motors for industrial drives, incl. fans, conveyor belts, cranes, etc. 3) Designing special propulsion systems: electric cars and electric bicycles, electric boats and electric planes. 4) Selection of auxiliary elements: clutches, brakes, speed sensors, torque sensors. 5) Energy-saving hybrid construction crane driving system. 6) Electric-combustion drives for power backup generators. 7) Selection of a mechanical transmission. 8) Selection of regulator settings in electric drive automatics systems. Laboratory: 1) Selection and analysis of fan drive system components, incl. using the Motor System Tool and Drivesize environment. 2) Selection and thermal analysis as well as loss analysis of the IGBT transistor module, diode bridge and heat sink, incl. using the IPOSIM environment. 3) Selection and analysis of DC intermediate circuit components: capacitor, braking resistor and pre-charge circuit. 4) Designing inverter filters. Design and analysis of the line filter and engine filter using the FEMM environment. 6) Analysis of the designed drive system in terms of energy quality. Simulation tests of the designed drive system using the LTSpice environment.
Prerequisites and co-requisites	Knowledge of the subjects of electric machines, basics of automatics, power electronics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	60.0%	50.0%
Laboratory	60.0%	50.0%

Recommended reading

Basic literature

[1] NOWAK M., BARLIK R., OLEKSIAK L., Poradnik inżyniera energoelektronika. Wydawnictwa Naukowo-Techniczne, Warszawa 2014.

[2] Allen Bradley Drives Engineering Handbook. Rockwell Automation. E-book PDF.

[3] Volke a., Hornkamp M., IGBT Modules. Technologies, Driver and Application. Infineon Technologies AG, Munich 2012. www.infineon.com

[4] TUNIA H., KAŹMIERKOWSKI M. P., *Automatyka napędu przekształtnikowego*. Panstwowe Wydawnictwo Naukowe, Warszawa 1987.

[5] Grunwald Z., Napęd Elektryczny, WNT, Warszawa1987.

[6] PIRÓG S., Energoelektronika: Układy o komutacji sieciowej i o komutacji twardej. AGH. Uczelniane Wydawnictwa Naukowo-Dydaktyczne, 2006.

[7] Sieklucki G., Bisztyga B., Zdrojewski A., Orzechowski T., Sykulski R., Modele i zasady sterowania napędami elektrycznymi. Wydawnictwa AGH, Kraków 2014.

[8] KRYKOWSKI K., *Energoelektronika*. Wydawnictwo Politechniki Śląskiej, 2007.

	Supplementary literature	[1] AN2011-05 Industrial IGBT Modules. Explanation of Technical Information. Application Note PDF. Infineon 2015. www.infineon.com [2] AND9140/D Thermal Calculations for[1]IGBTs. Application Note PDF. ON Semiconductor 2014. http://onsemi.com [3] Output Filters Design Guide. E-book PDF. Danfoss 2011. www.danfoss.com/drives [4] LC Sine Wave Filter for Motor Drives. Application Note PDF. Schaffner Group 2018. www.schaffner.com [5] FUJI IGBT MODULES APPLICATION MANUAL. Ebook PDF. Fuji Electric Device Technology 2004. www.fujielectric.com [6] Dimensioning program IPOSIM for loss and thermal calculation of Infineon IGBT modules. Application Note PDF. www.infineon.com
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Analysis of fan characteristics, selection of components and analysis of fan drive operation 2. Selection, thermal calculations and loss analysis of the IGBT power module 3. Selection, thermal calculations and loss analysis of the diode bridge and the IGBT chopper circuit 4. Design and analysis of the motor filter and mains filter operation 5. Analysis and simulation tests of the impact of the designed drive system on the power supply network	
Practical activites within the subject	Not applicable	

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