GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00053422		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2024/2025
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	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Adamowicz	
	Teachers		

Lesson types and methods of instruction

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	40.0	75

Subject objectives

The aim of the course is to provide knowledge in the field of designing electric drive systems with adjustable speed electrical drives and power electronic voltage converters.
Provide basic knowledge on calculations and methods of selecting the basic elements of drive systems: electric motor, gear and inverter, methods of selecting the basic components of the inverter: IGBT power module, diode rectifier, heat sink, DC link capacitor, motor filter and line filter. Presentation and discussion of life cycle issues, energy efficiency and energy quality in drive systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification

Subject contents

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
Laboratory	60.0%	50.0%
Test	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	Adresy na platformie eNauczanie:
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	
Work placement	Not applicable	