



Subject card

Subject name and code	DRIVES SUPPLIED BY POWER CONVERTERS II, PG_00022579						
Field of study	Electrical Engineering						
Date of commencement of studies	October 2024	Academic year of realisation of subject			2025/2026		
Education level	second-cycle studies	Subject group			Specialty subject group Subject group related to scientific research in the field of study		
Mode of study	Part-time studies	Mode of delivery			at the university		
Year of study	2	Language of instruction			Polish		
Semester of study	3	ECTS credits			2.0		
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		prof. dr hab. inż. Jarosław Guziński				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	10.0	0.0	10.0	0.0	0.0	20
	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	20		4.0		26.0	50
Subject objectives	The aim of the course is to get knowledge on advanced topics in the field of electrical drives operating with power electronics converters.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[K7_K03] can interact and work in a group assuming various roles and identify priorities for the achievement of a specific task						
	[K7_W06] has in-depth knowledge of industrial electronics, microprocessor control systems, programmable logic systems and printed circuit design and prototyping computer-aided prototyping						
[K7_U07] is able to analyse, calculate, design, program and test converters, drive systems, control systems and state observers		Student can design a converter drive system of a squirrel-cage induction motor with the use of LC filter			[SU1] Assessment of task fulfilment		

Subject contents	<p>Lecture Introduction to advanced topics of electrical drives with converter type supply. Simulation models of induction machines and permanent magnet synchronous (PMSM). Power electronic converters in electric drives systems: classification, pulse width modulation, three-phase voltage inverter, multilevel inverters, Z inverters, quasi-Z inverters, the dead time. Current source PWM inverters. Field oriented control (FOC) of induction motors. PMSM motor control. The direct torque control (DTC) of induction machines: base structure, modifications. DTC control of PMSM. Nonlinear control of induction machines. Electric drives with multi-phase machines (> 3 phase). Sensorless control. Selected topics on electric drives with voltage inverter output filters. Electric drives with medium voltage and high power machines. The use of new semiconductor materials in converter drive systems: silicon carbide SiC, gallium arsenide GaAs.</p> <p>Laboratory</p> <ol style="list-style-type: none"> 1. Circuit models of electrical machines. 2. Power electronics converters and control methods. 3. Electric drives with induction motor, inverter and output filter (Control methods V/f and FOC). 4. Electric drive with induction motor, inverter and output filter (Control method DTC-SVM). 5. Investigations of effects related to leakage currents and inverter output voltage filtering. 6. Investigations of matrix converter with output voltage and input power factor control. 7. Transistorized current source inverter with PWM. 														
Prerequisites and co-requisites	<p>General knowledge on electrical machines, power converters and electric drives based on the field of Electrical Machines, Power Electronics and Electric Drives courses for I cycle engineering studies. Additionality is advisable to complete course Electric Drives with Power Electronics Supply I for II cycle of engineering studies.</p>														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="453 732 794 763">Subject passing criteria</th> <th data-bbox="799 732 1141 763">Passing threshold</th> <th data-bbox="1145 732 1492 763">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 770 794 801">Project</td> <td data-bbox="799 770 1141 801">60.0%</td> <td data-bbox="1145 770 1492 801">35.0%</td> </tr> <tr> <td data-bbox="453 808 794 840">Practical exercises at laboratory</td> <td data-bbox="799 808 1141 840">60.0%</td> <td data-bbox="1145 808 1492 840">25.0%</td> </tr> <tr> <td data-bbox="453 846 794 878">Midterm exams</td> <td data-bbox="799 846 1141 878">60.0%</td> <td data-bbox="1145 846 1492 878">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Project	60.0%	35.0%	Practical exercises at laboratory	60.0%	25.0%	Midterm exams	60.0%	40.0%
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Practical exercises at laboratory	60.0%	25.0%													
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Recommended reading	<p>Basic literature</p> <p>Supplementary literature</p> <p>eResources addresses</p>	<ol style="list-style-type: none"> 1. Lecturer teaching materials accessed on web page. 2. Abu-Rub H., Iqbal A., Guzinski J.: High Performance Control of AC Drives with MATLAB/Simulink Models. Wiley, United Kingdom 2012. 1. Zawirski K., Deskur J., Kaczmarek T.: Automatyka napędu elektrycznego. Wyd. Politechniki Poznańskiej, Poznań 2012. 2. Nowak M., Barlik R.: Poradnik inżyniera - energoelektronika. WNT, Warszawa 1998. 3. Guzinski J.: Układy napędowe z silnikami indukcyjnymi i filtrami wyjściowymi falowników napięcia - zagadnienia wybrane. Wydawnictwo Politechniki Gdańskiej, Gdańsk 2011. 4. Drury B.: Control Techniques Drives and Controls Handbook. The Institution of Electrical Engineering. London 2001. 5. Wu B.: High-Power Converters and AC Drives. John Wiley & Sons 2006. <p>Adresy na platformie eNauczanie:</p>													
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. Multilevel converters: structure, principle of operation, the output voltage waveform. 2. High power and medium voltage drives: problems, requirements, application, the topologies. 3. Semiconductor switches in medium voltage drive systems. 4. Commercial converter topologies for medium voltage. 5. Problems in the medium voltage drive systems. 6. Problems in the electric drives with converter power supply. 7. Bearing currents: the causes and mechanism of occurrence. 8. Elimination of bearing currents. 9. Wave reflections in the electric drives with inverters and long cable connection: the mechanism of the phenomenon, effects, elimination. 10. Common mode choke: structure, purpose and method of use. 11. Sinusoidal-wave filter: the purpose of the application, the topology, the method of elements selection. 12. Construction of electric machines for limiting the bearing currents. 13. Installation requirements for reduction of bearing currents. 14. Shaft grounding rings: structure, purpose and method of use. 15. Bearing currents reduction by changes in pulse width modulation algorithms. 16. Multi-phase drives: advantages, purpose of use, topologies. 														
Work placement	Not applicable														

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