GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Electric drives, PG_00058351		
Field of study	Hydrogen Technologies and Electromobility		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
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	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department Of Electric Drives And Energy Conversion -> Faculty Of Electrical And Control Engineering -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Jarosław Guziński	
	Teachers	prof. dr hab. inż. Jarosław Guziński dr hab. inż. Marek Adamowicz dr hab. inż. Arkadiusz Lewicki	

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	6.0	39.0	75

Subject objectives

The aim of the programme is tis to get knowledge regarding electric drives. The student will learn the drive properties and methods of controlling various types of electric machines. In addition, the student will acquire the skills of selecting, starting and performing measurements in electric drives.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U07] can build and analyze models of systems and systems in the field related to hydrogen devices and installations as well as control and automation systems	Is able to select and configure an electrical drives for operation in electrrical power plants.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task
[K6_W06] knows the construction and operation of transformers, electrical machines, low and high temperature electrolysers, electrical drive systems, their modeling and industrial applications	Defines work regimes of electrical machines, distinguishes kinds of load, defines machine loads, explains equations of machine dynamics, principles of motion control, determines machine models, defines structures of drive systems with AC and DC machines, explains principles of energy recovery, explains basic principles of vector control.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Lectures. Theory of electromechanical energy conversion. The general form of the equations of motion drive. Converting the torque to the motor shaft. Mechanical characteristics of electric motors and load machines. Drives with DC machines: output characteristics; power converters - choppers, rectifiers, control system, dual-area of drive operation, the sellection and tunning of the controllers. Classification of power converters for AC electric motors AC: frequency converters. Drives with induction motors: characteristics, start-up, speed control and braking; mechanical characteristics in case of inverter voltage and current type supply. Phenomena related to power a converter motors, dV / dt, bearing currents, motor filters. Induction motor control methods: control V / f = const. (scalar), field-oriented (vector) control to direct torque control (DTC), non-linear control (multiscalar). Sensorless control of induction motors. Drives with double fed induction machines: constant torqe cascade, hydroelectric power generators and wind turbines. Synchronous motor drives: properties, accelerating, braking, speed control. Drive systems with motors permanent magnet synchronous (PMSM). Drive systems of brushless DC motors (BLDCM). The properties and control of switched reluctance motor drives. The properties and control of switched reluctance motor drives.stepper motors. Transient analysis: start-up, change of speed and load. Concurrency of electric motors. Speed and shaft position sensors. mechanical coupling and gearboxes, motoreducers. Types of electric motors. Selection of electric motors for drive systems: heating, power calculation, supply cables, and protection. Cooling of electrical machines. Selection and configuration of frequency converters. Industrial drive systems: drives for pumps, fans, centrifuges, compressors, cranes. Electric drives vehicles. Fundamentals of computer simulation of electric drives.
Laboratory. DC drive with controlled rectifier. Scalar U/f control of induction motor. Electric drive with voltage inverter and induction motor - field oriented control (FOC). Programming of LS-iC5 frequency converter for operation in vehicle drive. Nonlinear (multiscalar) control od induction motor.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basic knowleage on electrical machines, electrical engineering and control theory</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Midterm colloquium</td><td>60.0%</td><td>50.0%</td></tr>
<tr><td>Laboratory exercises</td><td>60.0%</td><td>50.0%</td></tr>
</table>
</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. Koczara W.: Wprowadzenie do napędu elektrycznego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2012.
2. Sieklucki G., Bisztyga B., Zdrojewski A., Orzechowski T., Sykulski R.: Modele i zasady sterowania napędami elektrycznymi. Wydawnictwa AGF, Kraków 2014.
3. Zawirski K., Deskur J., Kaczmarek T.: Automatyka napędu elektrycznego, Wydawnictwo Politechniki Poznańskiej, Poznań 2012.
4. Grunwald Z. (red): Napęd Elektryczny. Warszawa, WNT 1987.
5. Szklarski L., Dziadecki A., Strycharz J., Jaracz K.: Automatyka napędu elektrycznego. Wyd. AGH, Kraków 1996.</td></tr>
<tr><td>Supplementary literature</td><td>1. Tunia H., Kaźmierkowski M. Automatyka napędu przekształtnikowego.PWN 1987.
2. Orłowska-Kowalska T: Bezczujnikowe układy napędowe z silnikami indukcyjnymi. Wrocław, Oficyna Wydawnicza PW 2003.
3. Krzemiński Z. Cyfrowe sterowanie maszynami asynchronicznymi.Gdańsk, Wyd. PG 2001.
4. Guzinski J.: "Układy napędowe z silnikami indukcyjnymi i filtramiwyjściowymi falowników napięcia. Zagadnienia wybrane".Seria Monografie nr 115, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2011.
5. Abu-Rub H., Iqbal A., Guzinski J.: "High Performance Control of AC Drives with Matlab / Simulink Models". A John Wiley & Sons (2012).</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
NAPĘD ELEKTRYCZNY [TWiE][2024/25] - Moodle ID: 43351
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=43351</td></tr>
</table>
</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Motion equation for electrical drive with constant inertia.
2. Motor selection for cyclic variable load.
3. Measurement of electrical machines mechanical speed.
4. Properties of the rolling mill electric drives.
5. Mechanical characteristics of the DC motor with permanent magnets and the possibility of forming it.
6. Compare scalar control and vector control of induction motor.
7. Field oriented control of induction motor - principle, vectors, DC motor analogy, control scheme.
8. Principle of operation of an electronic commutator of BLDC motor.
9. Electric drive with swithced reluctance motor.
10. How to select the electric motor for cyclic loading.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.