GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Actuators in in Automatic Control, PG_00067425		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
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	3	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Signals and Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Jan Schmidt	
	Teachers	dr inż. Jan Schmidt	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15	1.0	9.0	25

Subject objectives	The aim is to familiarize the student with the principles of operation, purpose, and properties of executive elements commonly used in automatic control systems. The knowledge acquired prepares the student for later work in an industrial environment. The knowledge acquired also prepares the student for taking up Msc studies.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W10] knows and understands, to an advanced extent, the parameters, functions, and methods of analysis, design, and optimization of electronic circuits and systems, the definitions of error and measurement uncertainty, measurement methods, including time, frequency, and phase measurements, the properties of converters, and methods of digital signal processing, as well as the basic processes occurring in the life cycle of technical devices, objects, and systems, and methods of supporting processes and functions, specific to the field of study	The student has the ability to optimally design automatic control systems.	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge
	[K6_W03] knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Thanks to the acquired theoretical knowledge on the executive elements of automation, in particular controllers, actuators and power amplifiers, the student has acquired knowledge on the construction and principles of operation of components used in the implementation of automatic control systems.	[SW2] Assessment of knowledge contained in presentation
	[K6_W21] knows and understands the basic methods of decision making as well as methods and techniques of design and operation of automatic regulation and control systems, computer applications for controlling and monitoring dynamic systems.	The student knows the methods of design and operation of automation systems using actuators.	[SW1] Assessment of factual knowledge
	[K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	The student understands and knows which physical phenomena are used in the functioning of executive elements. The student knows the operating principles of actuators.	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture

Lectures:

1. Functions of actuators in automation systems: concepts of actuator, servomotor and power amplifier
2. Types, matching and sample actuator designs
3. Division of actuators in relation to the type of energy used
4. Sample design solutions for pneumatic and hydraulic actuators. Groups and types of electric actuators. Power amplifiers for actuators
5. Method of operation and types of electric motors
6. Brush DC motors. Disc motors
7. Brushless DC motors (BLDC)
8. Characteristics of DC motors
9. Losses occurring in DC motors
10. Rotating magnetic field of three-phase motors. Three-Phase AC Induction Motors Operation
11. Types and Characteristics of Three-Phase AC Induction Motors
12. Synchronous AC Motors
13. Starting Methods and Properties of Single-Phase Motors
14. Stepper Motors Characteristics and Classification
15. Reluctance Rotor Stepper Motors
16. Permanent Magnet and Hybrid Stepper Motors
17. Stepper Motor Voltage Excitation Methods
18. Dynamic Characteristics of Stepper Motors
19. DC Motor Controllers, Direction of Rotation and Torque Control Methods
20. Converter Topologies in DC Motor Controllers
21. Brushless DC Motor Controllers
22. Open Stepper Motor Control System and Closed Stepper Motor Control System
23. Microstepping control
Laboratories:
1. Methodology of measuring characteristics describing electric motors.
2. Study of dynamic characteristics of an actuator with a DC electric motor.
3. Study and interpretation of the basic properties of electromechanical and contactless switching devices.
4. Checking the characteristics of discrete drive parameters with a stepper motor (controllers, full-step and microstep operation).
5. Testing and evaluation of the rotational speed control system using an electric motor.
6. Testing the parameters and characteristics of signal amplifiers.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></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>100.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>1. Ryszard Białek, Andrzej Budziłowicz "Elektrotechnika i elektronika okrętowa"
2. Austin Hughes, Bill Drury "Electric Motors and Drivers-Fundamentals, Types, and Applications"
3. Sang-Hoon Kim "Electric Motor Control DC, AC, BLDC Motors"</td></tr><tr><td>Supplementary literature</td><td>1. Takashi Kenjo, "Electric Motors and Their Control : An Introduction"
2. Jacek Przepiórkowski "Silniki Elektryczne w praktyce elektronika"
3. Krzysztof Krykowski "Silniki PM BLDC właściwości, sterowanie, aplikacje"</td></tr><tr><td>eResources addresses</td><td></td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Types, rules of selection and exemplary constructions of the controllers.
2. Classification of the actuators according to the kind of used energy and examples of construction solutions.
3. Types of DC motors and their characteristics.
4. Construction, principle of operation and properties of the disc-armature motor.
5. The construction and operation of the brushless DC motor.
6. Principle of operation, types and characteristics of three-phase induction motors.
7. Methods for start-up and properties of the single-phase motors.
8. The main differences in the construction, principle of operation and properties between induction and synchronous AC motors.
9. The construction and principle of operation of the variable reluctance stepping motor.
10. The essential differences in the construction of rotors for VR, PM and HB stepping motors. What are magnetic properties of materials that are used for these rotors?
11. Give the waveforms of currents in the monofilar-wound three-phase VR motor for single-phase and two-phase excitation.
12. The main construction features of the typical two-phase 1.8 ° hybrid motor.
13. Differences between unipolar and bipolar exciting drivers.
14. What is the half-step excitation, and how it is achieved in the 2-phase, and as a 5-phase hybrid motors?
15. What are the differences: single-phase and two-phase excitation operation of the stepper motor?
16. Purpose of microstep operation and features of the driver for this mode.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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