



Subject card

Subject name and code	Actuators in in Automatic Control, PG_00047564						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
Education level	first-cycle studies	Subject group			Obligatory subject group 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			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Marine Electronic Systems -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Jan Schmidt				
	Teachers		dr inż. Jan Schmidt				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	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		3.0		42.0	75
Subject objectives	The aim is to education specialists in the field of actuators in control systems, as well as preparing them for industrial jobs. The aim is also to prepare to take up studies on the second stage.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[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	The student knows the structure and operation principles of actuators.	[SW1] Assessment of factual knowledge
	[K6_W05] Knows and understands, to an advanced extent, methods of supporting processes and functions, specific to the field of study	The student knows the methods of designing 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 knows the operating principles of actuators.	[SW1] Assessment of factual knowledge
	[K6_W06] Knows and understands the basic processes occurring in the life cycle of devices, facilities and systems specific to a given field of study.	The student knows the operating principles of actuators.	[SW1] Assessment of factual knowledge
[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	
Subject contents	<ol style="list-style-type: none"> 1. Functions of actuating devices in automatic control systems: notions of controller, actuator and power amplifier 2. Types, selection and exemplary constructions of controllers 3. Classification of actuators according to the kind of used energy 4. Exemplary construction solutions of pneumatic and hydraulic actuators. Types and properties of electric actuators. Power amplifiers for actuators 5. Principle of operation and classification of electric motors 6. Brushed direct current (DC) motors. Disc-armature "printed" motor 7. Brushless DC motors 8. Characteristics of self-excited DC motors 9. Losses in DC motors 10. Equivalent circuit diagram of the DC motor 11. Three-phase rotating field. Operating principle of three-phase alternative current (AC) induction motors 12. Classification and characteristics of three-phase AC induction motors 13. Synchronous AC motors 14. Methods of start-up and features of single-phase induction motors 15. Stepping motors – properties and classification 16. Variable-reluctance stepping motors 17. Permanent magnet and hybrid stepping motors 18. Modes of excitation of stepping motors 19. Dynamic characteristics of stepping motors 20. Power electronics elements (power field effect transistors – HEXFETs, IGBT transistors) 21. Specialized circuits for driving power MOSFETs and IGBT transistors 22. Continuous and bistate steering of electric energy flux 23. Electromagnetic relays and reed-relays. Drivers for relays and electromagnets 24. DC and AC solid-state (semiconductor) relays 25. DC motors drives - control of rotation direction and torque 26. Converter topologies for DC motor drives 27. Brushless DC motors drive systems 28. Open-loop control of stepping motor 29. Closed-loop control of stepping motor 30. Microstepping drive 31. Inverters - fundamentals of operation 32. Asynchronous motors control 		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	60.0%	100.0%

Recommended reading	Basic literature	1. Jerzy Kostro, "Elementy, urządzenia i układy automatyki" - Czytelnia na Wydziale ETI 2. Zbigniew Zajda, Ludwik Żebrowski, "Urządzenia i układy automatyki" - Czytelnia na Wydziale ETI 3. Takashi Kenjo, "Electric Motors and Their Control : An Introduction" - Czytelnia na Wydziale Elektrotechniki i Automatyki
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie: Elementy Wykonawcze Automatyki 2023/2024 Zima - Moodle ID: 30762 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30762
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 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, functions and properties of the power amplifiers in actuating devices. 4. Structural diagram and transfer functions of the direct current (DC) motor. 5. Types of DC motors and their characteristics. 6. Construction, principle of operation and properties of the disc-armature motor. 7. The construction and operation of the brushless DC motor. 8. Principle of operation, types and characteristics of three-phase induction motors. 9. Methods for start-up and properties of the single-phase motors. 10. The main differences in the construction, principle of operation and properties between induction and synchronous AC motors. 11. The construction and principle of operation of the variable reluctance stepping motor. 12. 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? 13. Give the waveforms of currents in the monofilar-wound three-phase VR motor for single-phase and two-phase excitation. 14. The main construction features of the typical two-phase 1.8 ° hybrid motor. 15. Differences between unipolar and bipolar exciting drivers. 16. What is the half-step excitation, and how it is achieved in the 2-phase, and as a 5-phase hybrid motors? 17. What are the differences: single-phase and two-phase excitation operation of the stepper motor? 18. Purpose of microstep operation and features of the driver for this mode. 19. Purpose and way of realization of PWM modulation in bipolar drivers. 	
Work placement	Not applicable	