GDAŃSK UNIVERSITY OF TECHNOLOGY

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 2023 | | Academic year of realisation of subject | 2024/2025 | | | |
| 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_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_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_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_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_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 |

## Subject contents

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 alterna-tive 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<br>2. Zbigniew Zajda, Ludwik Żebrowski, "Urządzenia i układy automatyki" - Czytelnia na Wydziale ETI<br>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: |
| Example issues/ example questions/ tasks being completed | 1. Types, rules of selection and exemplary constructions of the controllers.<br>2. Classification of the actuators according to the kind of used energy and examples of construction solutions.<br>3. Types, functions and properties of the power amplifiers in actuating devices.<br>4. Structural diagram and transfer functions of the direct current (DC) motor.<br>5. Types of DC motors and their characteristics.<br>6. Construction, principle of operation and properties of the disc-armature motor.<br>7. The construction and operation of the brushless DC motor.<br>8. Principle of operation, types and characteristics of three-phase induction motors.<br>9. Methods for start-up and properties of the single-phase motors.<br>10. The main differences in the construction, principle of operation and properties between induction and synchronous AC motors.<br>11. The construction and principle of operation of the variable reluctance stepping motor.<br>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?<br>13. Give the waveforms of currents in the monofilar-wound three-phase VR motor for single-phase and two-phase excitation.<br>14. The main construction features of the typical two-phase 1.8 ° hybrid motor.<br>15. Differences between unipolar and bipolar exciting drivers.<br>16. What is the half-step excitation, and how it is achieved in the 2-phase, and as a 5-phase hybrid motors?<br>17. What are the differences: single-phase and two-phase excitation operation of the stepper motor?<br>18. Purpose of microstep operation and features of the driver for this mode.<br>19. Purpose and way of realization of PWM modulation in bipolar drivers. | |
| Work placement | Not applicable | |