COURSE DESCRIPTION CARD - SYLLABUS

Course name
Servo drives in automation

Course

Field of study
Automatic Control and Robotics
Area of study (specialization)
-
Level of study
First-cycle studies
Form of study
full-time

Year/Semester
3/6
Profile of study
practical
Course offered in
Polish
Requirements
elective

Number of hours

Lecture
15
Laboratory classes
30
Other (e.g. online)
0
Tutorials
0
Projects/seminars
0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr inz. Piotr Sauer

email: Piotr.Sauer@put.poznan.pl

phone: 61 665 2117

Faculty of Control, Robotics and Electrical Engineering

ul. Piotrowo 3a, 60-965 Poznań

Responsible for the course/lecturer:
mgr inż. Tomasz Jedwabny

email: Tomasz.Jedwabny@put.poznan.pl

phone: 61 665 2757

Faculty of Control, Robotics and Electrical Engineering

ul. Piotrowo 3a, 60-965 Poznań

Prerequisites

The student starting this subject should have a basic knowledge of the basics of automation, executive elements of automation, metrology and electronics. Should have the ability to solve basic problems in the design of control systems with drive components and the ability to obtain information from the indicated sources. He should also understand the need to expand his competences. The student should demonstrate the ability to work in a team. In addition, in terms of social competences, students must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

Providing students with basic knowledge in the field of drive system control systems with particular emphasis on servo drives in the field of automation. Developing students' skills to solve design problems related to control of propulsion systems. Developing students' teamwork skills

Course-related learning outcomes

Knowledge

1. has structured knowledge in the field of construction, application and control of propulsion systems used in automation systems - [K1_W18]

2. knows and understands the principles of selection of drive systems, servo drives, frequency converters and measurement converters - [K1_W20]

3. has elementary knowledge of the life cycle of propulsion systems and selected security systems used in automation - [K1_W22]

Skills

1. is able to obtain information from technical documentation - [K1_U1]

2. is able to use models of DC and AC drives and use them for the purposes of analysis and design of automation systems - [K1_U11]

3. able to integrate the control system (programmable controller) with a DC or AC drive using properly selected measuring systems, power amplifiers and / or frequency converters, peripheral and communication systems (RS-485, CAN) - [K1_U22].

Social competences

1. is aware of the responsibility for own work and willingness to comply with the principles of teamwork and taking responsibility for jointly implemented tasks - [K1_K3]

2. is aware of the need for a professional approach to technical issues, meticulous reading of technical documentation, compliance with professional ethics - [K1_K5].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during lectures is verified by a written exam. The exam consists of 10-15 questions

(test and open), variously scored with the possibility of obtaining 20 points. Passing threshold: 50% of points. The final issue on the basis of which questions are prepared will be sent to students by e-mail.

Skills acquired as part of the laboratory classes are verified on the basis of a final test, consisting of 7-10 tasks with various points depending on their level of difficulty and based on the evaluation of laboratory reports. Passing threshold: 50% of points. During the implementation of laboratory exercises, there is the possibility of obtaining additional points for preparation for classes (oral answer) and / or activity during classes.

Programme content

The lecture program includes the following topics:

1. Basic information about servo drives such as block diagram, components of servos, their properties and the selection of its elements. The power amplifiers used in propulsion systems (transistor, thyristor, electrohydraulic amplifiers) will be discussed.

2. Drive systems with induction motors: induction motor (modeling), methods of starting and controlling drives with an induction motor, methods of braking an induction motor.

3. Drive systems with DC motors: mathematical model and parameters of the DC motor, structure of the control system.

4. Drive systems with synchronous motors: types of synchronous motor, drive system modeling methods, advanced control methods.

5. Machine safety (requirements, safety levels, defining and determining risk), ways of securing propulsion systems.

6. Feedback in servo drives: positioning systems with open and closed loop (resistance, capacitive, inductive sensors, optical-impulse transducers, selsyn link), spatial positioning systems (axis synchronization) and force control systems (force and moment sensors), spatial positioning.

7. Pneumatic drive systems: elements and construction of pneumatic systems, methods of analysis and design of penumatic systems, examples of pneumatic systems.

8. Master servo drive control systems, methods of tuning controllers, examples of servos (servos with a transformer encoder link for remote position transfer, servos with a measuring system with an output signal in the form of phase shift, digital servos, CNC controllers), modern TRACK transport systems.

Laboratory classes are conducted in the form of 2-hour exercises that take place in the laboratory, preceded by a 2-hour instructional session at the beginning of the semester. Exercises are carried out by teams of 2.3 students (depending on the number of student groups). The laboratory program includes the following issues:

1. Pneumatic cylinder control system using programmable controllers from B&R and the Automation Studio environment: implementation of cylinder control algorithms that perform specific tasks described by the cyclogram.

2. AC motor control system: presentation of various three-phase motor control systems implemented with the use of a contactor-relay system or including a programmable relay, reversing motor operation, time control, positioning the drive using an optical-pulse sensor, designing control systems, and then combining them in a specially prepared position.

3. Application of a frequency converter to control an AC motor: discussion of the SIEMENS frequency converter parameterization and its use to control a three-phase asynchronous motor, testing various functions of the converter, familiarization with the characteristics and structure of the drive control, use of the frequency converter to build a simple servo drive system.

4. Testing the ACOPOS servo drive: configuration and commissioning of the ACOPOS servo drive in the Automation Studio environment, familiarizing with its functions and their use in practice, controlling the synchronous motor through a program written in the Automation Studio environment, testing the impact of regulator settings (speed and position) on the quality of control.

5. Linear drive positioning system: construction of a linear drive implemented by means of a stepper motor, drive control using a PLC program written in Automation Studio.

6. Servomechanism with three-position controller and asynchronous motor: design of three-position controller (programmable pulse counter), configuration of three-position controller, familiarization with various types of asynchronous motor braking.

7. Drive system with a DC motor: determining the basic parameters of a DC motor, designing a servo drive system, implementing and starting control using the miControl driver.

8. Acopos Track drive simulator, drive configuration and implementation using the Automation Studio environment.

Teaching methods

1. lecture: multimedia presentation,

2. laboratory exercises: practical exercises, discussion, teamwork.

Bibliography

Basic

1. K. Krykowski, Silniki PM BLDC, właściwości, sterowanie, aplikacje, BTC 2015

2. K. Zawirski, J. Deskur, T. Kaczmarek, Automatyka napędu elektrycznego, Politechnika Poznańska 2012

3. K. Zawirski, Sterowanie silnikiem synchronicznym o magnesach trwałych, Politechnika Poznańska, 2005.

4. W. Szejnach, Napęd i sterowanie pneumatyczne, WNT 1997

Additional

1. W. Drury, Control Techniques Drives and Control Handbook

2. E. Goźlińska, Maszyny elektryczne

3. J. Przepiórkowski, Silniki elektryczne w praktyce elektronika, BTC 2007

4. J. Kostro Elementy. Urządzenia i układy automatyki, WSziP 2012

5. Wł. Findeisen, Poradnik inżyniera automatyka, WNT

6. Technical documentation of drives and software used in the laboratory

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for exam) [1]	30	1,0

[1] delete or add other activities as appropriate