# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Control of continuous and discrete processes [N1AiR2>SPCiD]

## Course

Field of study
Automatic Control and Robotics

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

## Number of hours

Lecture
20

Laboratory classes
20

Other (e.g. online)
0

Tutorials
20

Projects/seminars
0

## Number of credit points

6,00

## Coordinators

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## Lecturers

## Prerequisites

Knowledge: The student starting this course should have basic knowledge of mathematical analysis, linear algebra and physics, as well as a thorough knowledge of the subjects: Fundamentals of Automation and Theory and Signal Processing. Skills: Should demonstrate the ability to solve basic problems in the field of linear dynamical systems. He should be able to obtain information from the indicated sources, and understand the need to expand his competences. Social competencies: In addition, in the field of social competences, the student must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

## Course objective

1. Provide students with knowledge about the mathematical description and operation of discrete linear and selected nonlinear control systems. 2. Developing the ability to solve problems related to the control of discrete and selected nonlinear systems with an emphasis on formulating mathematical models of these systems. 3. Shaping in students the ability to find a mathematical description of a discrete linear control system, the selection of digital regulators, as well as the evaluation of their operation. 4. Developing the ability to formulate a mathematical description of selected continuous nonlinear control systems and their analysis.

## Course-related learning outcomes

Knowledge:
1. Has ordered advanced knowledge of the theory of linear dynamical systems, including selected modeling methods and the theory of stability; knows and understands the basic properties of linear dynamic elements in the time and frequency domain and the properties of selected nonlinear elements;
knows and understands the design techniques of linear control systems using state space description; - [K1_W14]
2. Has structured knowledge of the structures and principles of operation of analog and discrete control systems (in open and feedback systems) as well as linear and simple non-linear analog and digital regulators; - [K1_W16]
3. Knows and understands at an advanced level the basic criteria of synthesis and methods of tuning regulators, tools and techniques for automatic selection of regulator settings and identification of control objects; - [K1_W17]

Skills:
1. Can plan, prepare and simulate the operation of simple automation systems; - [K1_U10]
2. He can designate and use models of simple electromechanical systems and selected industrial processes, and also use them for the purposes of analysis and design of automation systems; - [K1_U11]
3. Can check the stability of linear and selected nonlinear objects and dynamical systems; - [K1_U12]
4. Can assess the usefulness of routine methods and tools for the design of automation systems and select and apply the appropriate method and tools; - [K1_U24]
5. Can design simple control systems for processes with one input and one output; can consciously use standard functional blocks of automation systems and shape dynamic properties of measurement paths; - [K1_U29]

Social competences:
1. Is ready to define priorities in order to accomplish the task set by himself or others; - [K1_K4]
2. Is aware of the need for a professional approach to technical issues, scrupulous familiarization with the documentation and environmental conditions in which devices and their components may function; is ready to comply with the rules of professional ethics and require it from others; - [K1_K5]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:
a) in the field of lectures:
based on answers to questions about the material discussed in previous lectures,
b) in the field of laboratories:
based on the assessment of the current progress in the implementation of tasks,

Summative assessment:
a) in the field of lectures, verification of the assumed learning outcomes is carried out by:
i. assessment of knowledge and skills demonstrated in the written review examination,
ii. discussion of the exam results during an individual interview,
b) in the field of exercises, verification of the assumed learning outcomes is carried out by:
i. assessment of the ability to solve selected problem tasks of an analytical nature,
ii. assessment of the results of two written tests on a topic representative of the material processed,
c) in the field of laboratories, verification of the assumed learning outcomes is carried out by:
i. assessment of skills related to the implementation of laboratory exercises and selected problem tasks,
ii. evaluation of the report prepared partly during the classes and partly after their completion; this assessment also includes teamwork.
Obtaining additional points for activity during classes, especially for:
i. discuss additional aspects of the issue,
ii. the effectiveness of applying the acquired knowledge while solving a given problem,
iii. the ability to cooperate as part of a team practically carrying out a detailed task in the laboratory,
iv. comments related to the improvement of teaching materials,
v. identifying students' perceptual difficulties, enabling ongoing improvement of the teaching process.

## Programme content

The lecture program covers issues related to the analysis and control of discrete and nonlinear systems. A mathematical description and operation of discrete linear and selected nonlinear control systems are presented. The selection of continuous and digital regulators is also discussed, as well as the evaluation of their operation.

## Course topics

The lecture program should cover the following topics:
Discrete control; pulse quantization and modulation. An ideal pulser and a zero-order extrapolator. Discretization of differential equations of dynamics. Discrete linear control systems, discrete transfer function. Stability of discrete systems. Discrete PID control algorithms; digital position and incremental regulators. Discrete equation of state, discretization of the continuous equation of state. Sampling theorem. Nonlinear control systems. Types of non-linearity, transforming block diagrams of nonlinear systems. Phase space method for the analysis of dynamical systems. Descriptive function and its application to the analysis of nonlinear systems. Two-position adjustment. Relay servo (three-position control) and tachometric feedback.
Auditorium classes are conducted in the form of two-hour classes, during which students solve accounting problems illustrating the content presented during the lecture.
Laboratory classes: two-person teams carry out laboratory exercises and solve selected problem tasks. Some exercises are simulation-based, while others use physical controls. Before the actual classes, an interview or test is carried out to determine the degree of students' preparation for classes.

## Teaching methods

1. Lecture: a traditional form of presentation illustrated with examples, the use of multimedia tools,
2. Auditorium exercises: solving tasks that illustrate the issues presented during the lecture,
3. Laboratory exercises: performing simulation experiments, discussion, work in a two-person team, developing a variant exercise, according to the students' idea.

## Bibliography

Basic:
1. Podstawy teorii sterowania, T. Kaczorek, A. Dzieliński, W. Dąbrowski, R. Łopatka, WNT, 2006
2. Teoria sterowania, W. Pełczewski, WNT, 1980
3. Automatyka w pytaniach i odpowiedziach, A. Markowski, J. Kostro, A. Lewandowski, WNT, 1985
4. Podstawy automatyki ćwiczenia rachunkowe cz. 1 i 2, D. Horla, Wyd. PP, 2003

Additional:
1. Modern Control Systems, R.C. Dorf, R.H. Bishop, Addison Wesley, 1999
2. Feedback Control Systems, C. Phillips, R. Harbor, Prentice Hall, 2000

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 150 | 6,00 |
| Classes requiring direct contact with the teacher | 62 | 2,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 88 | 3,50 |