COURSE DESCRIPTION CARD - SYLLABUS

Course name
Control basics

Course

Field of study
Automatic control and robotics

Year/Semester
2 / 3

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes

Other (e.g. online)

Tutorials
30

Projects/seminars

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
Dariusz Horla, Ph.D., D.Sc., associate professor

Responsible for the course/lecturer:

Prerequisites

Knows and understands in an advanced level - selected facts, objects and phenomena and their methods and theories explaining the complex relationships between them, constituting basic general knowledge in selected areas of general physics including thermodynamics, electricity and magnetism, optics, photonics and acoustics, and solid state physics, including the knowledge necessary to understand basic physical phenomena occurring in and around automation and robotics components and systems. The graduatee knows and understands in advanced level the methods of signal processing in the time and frequency domain. The graduate has an orderly knowledge of signal and information theory

[K1_W02 (P6S_WG), K1_W05 (P6S_WG)] Is able to obtain information from bibliography, databases and other sources; has the ability to self-educate in order to improve and update professional competences.

[K1_U01 (P6S_UU)] The graduatee is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for decisions taken. The graduate is ready to take care of the achievements and traditions of the profession

[K1_K02 (P6S_KR)]

Course objective

The aim of the course is to teach students to analyze control systems and present basic knowledge concerning continuous-time systems.

Course-related learning outcomes

Knowledge

1. Knows and understands in an advanced level selected facts, objects and phenomena, as well as methods and theories explaining the complex relations between them, constituting basic general knowledge of mathematics including algebra, geometry, analysis, probabilistic and elements of discrete mathematics and logic, including mathematical methods and numerical methods necessary for: * description and analysis of linear and basic non-linear dynamic and static systems * description and analysis of complex quantities * description of random processes and uncertain quantities * description and analysis of combination and sequence logical systems * description of control algorithms and stability analysis of dynamic systems * description, analysis and methods of signal processing in the time and frequency domain * numerical simulation of dynamic systems in the domain of continuous time and discrete time.[K1_W01 (P6S_WG)]

2. Knows and understands to an advanced level the theory and methods of structures and operating principles of analogue and discrete control systems (open and feedback systems) as well as linear and simple, non-linear analog and digital controllers. [K1_W16 (P6S_WG)]

Skills

1. Is able to check the stability of linear and selected non-linear objects and dynamic systems. [K1_U07 (P6S_UW)]

2. The graduatee can use selected tools for rapid prototyping of automation and robotics systems [K1_U12 (P6S_UW)]

3. Can plan, prepare and simulate the operation of simple automation and robotics systems [K1_U21 (P6S_UO)]

Social competences

The graduatee is ready to critically evaluate his or her knowledge. The graduate understands the need for and knows the possibilities of continuous learning - improving professional, personal and social competences, the graduate is able to inspire and organize the learning process of others. [K1_K01 (P6S_KK)]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Exercises: verifying the ability to analytically solve control problems; periodic tests performer to assess the learning process, assessment of students' abilities when solving the problems by the blackboard. Pass rate at 60% of maximum number of points.

Programme content

LECTURE:

Introduction to control. Dynamical models. Laplace transform. Properties of the Laplace transform. Transfer function. Inverse Laplace transform. Block diagrams. Time analysis of LTI systems. Sinusoidal transfer function. Frequency response. Analytical stability tests. Time delay. Nyquist and Nichols plots. Nyquist stability criterion. Stability margins. Root locus method. Correction of control systems. Linear controllers. Impact of controller parameters on control performance. Frequency response-based synthesis of controllers. State-space description.

EXERCISES:

Laplace transform. Inverse Laplace transform. Time and frequency reponses. Block diagrams. Analytical and graphical stability criteria. Stability margins. Root locus method. State-space description. 2020 update: examples.

Teaching methods

a) lecture

- pdf slides (figures, photos), with additional information written on the blackboard,

- lectures accompanied by self-studying handouts via Moodle,

- theory presented with reference to current knowledge of students,

- new subjects preceded by recalling subjects connected or known from other lectures.

b) exercises

- sample problems solved on the blackboard,

- commented solutions of the solved problems by the tutor and discussing solutions.

Bibliography

Basic

1. Horla D., Control Basics. Exercises. Part 1, Poznań, Wydawnictwo Politechniki Poznańskiej 2016

2. Horla D., Control Basics. Exercises. Part 2, Poznań, Wydawnictwo Politechniki Poznańskiej 2017

3. Horla D., Control Basics. Laboratory exercises. Poznań, Wydawnictwo Politechniki Poznańskiej 2016

Additional

1. Franklin F.G., Powell J.D., Emami-Naeini A., Feedback Control of Dynamic Systems, 4th ed, New Jersey, Prentice Hall 2002

2. Giernacki W., Horla D., Sadalla T., Mathematical Models Database (MMD ver. 1.0) Non-commercial proposal for researchers, 21st International Conference on Methods and Models in Automation & Robotics (MMAR 2016): IEEE, 2016, pp. 555-558

3. Ogata K., Discrete-time Control Systems, 2nd ed, Prentice Hall International 1995.

4. Ogata K., Modern Control Engineering, 4th ed, Prentice Hall 2002.

5. Shinners S.M., Modern Control System Theory and Design, 3rd ed, New York, John Wiley & Sons, 1992.

6. Slotine J.-J.E, Li W., Applied Nonlinear Control, New Jersey, Prentice Hall 1991.

7. Ryniecki A., Wawrzyniak J., Gulewicz P., Horla D., Nowak D., Bioprocess feedback control. A case study of the fed-batch biomass cultivation bioprocess, Przemysł Spożywczy, vol. 72, no 8, pp. 34-39, 2018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	120	4,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam) [1]	60	2,0

[1] delete or add other activities as appropriate