COURSE DESCRIPTION CARD - SYLLABUS

Course name

Podstawy automatyki

Course

Field of study

Automatyka i robotyka

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

2/3

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

30

Other (e.g. online)

0

Tutorials

30

Projects/seminars

0

Number of credit points

7

Lecturers

Responsible for the course/lecturer:

Dariusz Horla Ph.D., D.Sc. (Eng.), associate professor

Responsible for the course/lecturer:

Prerequisites

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.

Methods of signal processing in the time and frequency domain. Orderly knowledge of signal and information theory. [K1_W02, K1_W05]

Ability to obtain information from bibliography, databases and other sources; ability to self-educate in order to improve and update professional competences. [K1_U01]

Awareness 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. [K1_K02]

Course objective

Passing on to students basic knowledge concerning control basics, related esp. to linear control systems to prepare them to understand issues related to modeling, analysis and synthesis of control systems. Developing capabilities to solve problems concerning description of control systems, their stability and control quality, useful in future engineer role.

Course-related learning outcomes

Knowledge

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]

The graduate 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.

Knows and understands to an advanced level the theory of linear dynamic systems, including selected methods of modelling and stability theory; knows and understands the basic properties of linear dynamic elements in the time and frequency domain and the properties of selected non-linear elements; knows and understands the design techniques of linear control systems using the description in state space. [K01_W06]

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]

Skills

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

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

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

Social competences

The graduate 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]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written exam, pass level at 60% to verify the knowledge. Exam-related issues are available at eKursy platform at the beginning of the semester. Exercises: verification of abilities to solve control problems analytically, periodic tests, and on-going verification of knowledge during the exercises. Laboratory exercises: entry tests, written reports.

Programme content

Lecture: Introduction to control basics. Model of dynamics. Laplace transform. Properties of Laplace transform. Transfer function. Inverse Laplace transform. Block diagram algebra. Time analysis of linear systems. Sinusoidal transfer function. Frequency response. Analytical stability tests. Time delay. Nyquist and Nichols plots. Nyquist stability criterion. Stability margin. Root locus method. Compensation of linear control systems. Linear controllers. Impact of controller gains on control performance. Frequency-based design of control systems. State-space description of control systems.

Exercises: Laplace transform. Inverse Laplace transform. Time and frequency responses of linear models. Block diagram algebra. Steady-state error. Analytical and graphical stability criteria. Stability margins. Root locus method. State-space description.

Laboratory exercises: Introduction to Matlab and Simulink. Modeling of dynamics. Time and frequency response of linear systems. Transport delay. Stability of linear systems. Linear controllers. Servo system. Tracking system. Kessler methods. Hardware exercises to depict issues related to time and frequency responses, stability and control quality topics.

Teaching methods

Lecture: multimedia presentation (figures, photos), accompanied by blackboard examples; self-study handouts available through eKursy; theory presented in relation to current knowledge of the students; new topics preceded by presentation of issues related to them, known from other fields.

Exercises: solving tasks by the blackboard; in-depth analysis of solutions and discussion.

Laboratory exercises: simulation and hardware exercises.

Bibliography

Basic

[1] Amborski K., Marusak A., Teoria sterowania w ćwiczeniach, Warszawa, Państwowe Wydawnictwo Naukowe 1978.

[2] Poradnik inżyniera. Automatyka, eds. W. Findeisen, 2nd ed., Warszawa, Wydawnictwa Naukowo-Techniczne 1973.

[3] Findeisen W., Technika regulacji automatycznej, 3rd ed., Warszawa, Państwowe Wydawnictwa Naukowe 1978.

[4] Horla D., Podstawy automatyki. Ćwiczenia rachunkowe. Część I, Poznań, Wydawnictwo Politechniki Poznańskiej, 6th ed., 2019.

[5] Horla D., Podstawy automatyki. Ćwiczenia laboratoryjne, Poznań, Wydawnictwo Politechniki Poznańskiej, 4th ed., 2015.

[6] Kaczorek T., Teoria sterowania i systemów, 2nd ed., Warszawa, Państwowe Wydawnictwo Naukowe 1996.

[7] Kostro J., Elementy, urządzenia i układy automatyki, 5th ed., Warszawa, Wydawnictwa Szkolne i Pedagogiczne 1998.

[8] Markowski A., Kostro J., Lewandowski A., Automatyka w pytaniach i odpowiedziach, 2nd ed., Warszawa, Wydawnictwa Naukowo-Techniczne 1985.

[9] Pułaczewski J., Szacka K.,Manitius A., Zasady automatyki, Warszawa, Wydawnictwa Naukowo-Techniczne 1974.

[10] Rumatowski K., Podstawy automatyki. Cześć I. Układy liniowe o działaniu ciągłym, Poznań, Wydawnictwo Politechniki Poznańskiej, 2004.

[11] Rumatowski K., Podstawy automatyki, Poznań, Wydawnictwo Politechniki Poznańskiej, 2008.

[12] Żelazny M., Podstawy regulacji automatycznej, Warszawa, Państwowe Wydawnictwo Naukowe 1996.

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

4. Shinners S.M., Modern Control System Theory and Design, 3rd ed., Nowy Jork, John Wiley & Sons, 1992.

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

6. 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(8), pp. 34-39, 2018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	210	7,0
Classes requiring direct contact with the teacher	90	3,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam) [1]	120	4,0

[1] delete or add other activities as appropriate