COURSE DESCRIPTION CARD - SYLLABUS

Course name
Control Basics [S1MNT1>G-PA]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

In mathematics: knowledge including algebra and differential equations. In terms of selected branches of ge- neral physics: the knowledge necessary to understand the basic physical phenomena occurring in automation and robotics components and systems. In the field of analogue and digital electronic systems: the knowled- ge necessary to understand analogue models of basic dynamic objects and to understand the operation of automatic control systems. Ability to use mathematical tools and methods, including numerical methods, to solve engineering problems.

Course objective

To learn about the principles of operation and methods of analysis and design of automatic control systems.

Course-related learning outcomes

Knowledge:
• knows and understands to an advanced level the terminology of mathematics and selected topics in the area of engineering sciences related to the field of study, also in a foreign language [K_W 03(P 6S_W G)];
• knows and understands to a sufficient degree issues in the field of technical sciences, including auto- mation, robotics, electrical and electronic engineering [K_W04(P6S_WG)];

• knows and understands the relationship between mathematics and modern technology [K_W 05(P 6S_WG)].

Skills:
• is able to construct an algorithm to solve a simple engineering task; to implement and test it in a selected programming environment [K_U04(P6S_UW)];
• is able to apply mathematical tools to support and develop modern technologies used in engineering sciences [K_U06(P6S_UW)];
• is able to select appropriate sources of knowledge and obtain the necessary information from them, as well as critically analyse and evaluate solutions to complex and non-standard engineering problems [K_U08(P6S_UW)];
• is able to use machines, tools etc. in accordance with general requirements and technical documentation; is able to apply the principles of safety rules at work [K_U11(P6S_UW)].

Social competences:
• is willing to critically appraise his/her level of knowledge in relation to research in science, natural sciences and engineering sciences [K_K01(P6S_KK)];
• iswillingtodeepenandbroadenhisknowledgetosolvenewlyemergingtechnicalproblems[K_K02(P6S_KK)];
• is ready to fulfil his/her social role as a graduate student in a technical university, to communicate popular scientific content and to identify and solve basic problems related to the field of study [K_K05(P6S_KR)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: students are always given a list of issues to master; written examination to check the degree of assimilation of the content taught in the lecture and the ability to solve selected problems;
Tutorials: grade on the basis of activity in class and by passing a colloquium to test the skills acquired;
Laboratory classes: grades on tests, laboratory reports and for activity.

Programme content

Theoretical foundations related to the analysis and synthesis of automatic control systems and the formation of skills for their practical application.

Course topics

Update: 19.06.2024r.
Lectures:
• basic concepts, types and examples of automatic control systems;
• laplace transform;
• modelling of dynamic objects;
• solving differential equations using the Laplace transform;
• static and dynamic linearisation;
• transformation of block diagrams and determination of equivalent transfer function;
• time and frequency characteristics of linear control objects and systems: spectral transfer function, impulse response, step response, Nyquist plot, Bode diagrams;
• characteristics and properties of basic dynamic objects;
• types of controllers and their properties, control quality factors;
• conditions and criteria for stability of linear control systems;
• control Theory: Determination of models in state space;
• relationships between state space model and transfer function matrix;
• analysis of properties of systems by state space methods: stability, controllability, observability;
• equivalence of object representations;
• diagonalization of of state space model;
• multidimensional observers and controllers.
Tutorials:
• transformation of block diagrams of control systems, simple and inverse Laplace transform, time characteristics of basic dynamic objects, frequency characteristics, graphical and analytical stability criteria for control systems, modelling of objects in state space, stability, controllability, observability,

model transformations: transfer function <-> state space model;
Laboratory classes:
• investigation of the properties of the models and control systems learned in lecture and tutorials.

Teaching methods

Lectures: multimedia presentation illustrated with examples given on the blackboard;
Tutorials: the tutor presents examples using an overhead projector or on the blackboard, then students solve tasks on the blackboard;
Laboratory classes: in the computer laboratory (Matlab-Simulink): simulation and testing of the properties of automatic control systems according to the topics covered in the lecture and exercises.

Bibliography

Basic:
• Rumatowski Karol, Podstawy automatyki. Układy liniowe o działaniu ciągłym. WPP, 2004;
• Horla Dariusz, Podstawy automatyki - ćwiczenia rachunkowe, WPP ;
• Urbaniak Andrzej, Podstawy automatyki, WPP 2004;
• Markowski Andrzej, Automatyka w pytaniach i odpowiedziach, WNT, 1985;
• Tadeusz Kaczorek, Podstawy teorii sterowania, WNT 2016;
• Władysław Pełczewski, Teoria Sterowania, WNT, Warszawa 1980.

Additional:
• Mazurek Jerzy, Podstawy automatyki, Wyd. Politechniki Warszawskiej;
• Żelazny Marek, Podstawy automatyki, PWN, Warszawa 1976;
• Brzózka Jerzy, Regulatory cyfrowe w automatyce, wyd. Mikom, Warszawa 2002;
• Findeisen Władysław, Poradnik inżyniera - automatyka;
• Bobrowski Dobiesław, Ratajczak Zbigniew, Przekształcenie Laplace'a i jego zastosowania, WPP;
• Mutambara A.: Design and analysis of automatic control, London, New York, 1999;
• Paraskevopoulos P.N.:Modern control enginneering, Marcel Dekker Inc., New York, Basel, 2002 ;
• Gerth Wilfried, Heimann Bodo, Popp Karl, Mechatronika - komponenty, metody, przykłady, PWN, Warszawa, 2001;
• Andrzej Dębowski, Automatyka Technika Regulacji, WNT 2023.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
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)	63	2,50