POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Control Theory and Technology [S1MNT1>G-TiTS]

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. To learn about the elements and devices used in industrial automation 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_W G)].

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 control systems and the development of skills for their practical application.
Learning about the components of control systems used in industry.

Course topics

Update: 19.06.2024r.
Lectures:
• determination of models in state space for electrical, mechanical, electromechanical, hydraulic objects;
• linearisation of non-linear models;
• relationship between state space model and transmittance matrix;
• analysis of systems properties using state space methods: stability, controllability, observability;
• equivalence of object representations;
• diagonalization of state space model;
• multidimensional state observers and controllers;
• solving state equations;
• discretization of the object models;
• types of controllers and their properties;
• automation components and devices;
• construction and fundamentals of PLC industrial controller programming;
• internal combustion engine automation.
Tutorials:
• modelling of dynamic objects using state space equations, stability, controllability, observability, model transformations: transmittance ↔ state space, determination and study of properties of discrete models, design of discrete-event systems;
Laboratory classes:
• study of the properties of control models and systems learned in lecture;

• design, construction and programming of industrial control systems.

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; in the laboratory of elements and automation devices: pneumatic hardware stations and those related to the design and programming of industrial control systems.

Bibliography

Basic:
• Tadeusz Kaczorek, Podstawy teorii sterowania, WNT 2016;
• Andrzej Dębowski, Automatyka Technika Regulacji, WNT 2023;
• Tadeusz Kaczorek, Teoria sterowania, tom1, PWN, Warszawa 1977;
• Władysław Pełczewski, Teoria Sterowania, WNT, Warszawa 1980.

Additional:
• Katsuhiko Ogata, Metody przestrzeni stanów w teorii sterowania, WNT, Warszawa 1974;
• Tadeusz Kaczorek, Teoria sterowania i systemów, PWN 1993;
• Krzysztof Amborski, Andrzej Marusak, Teoria Sterowania w ćwiczeniach, PWN, Warszawa 1978;
• Jerzy Zabczyk, Zarys matematycznej teorii sterowania, PWN, Warszawa 1991;
• Mirosław Luft, Zbigniew Łukasik, Podstawy Teorii Sterowania, Politechnika Radomska 2012;
• Wilfried Gerth, Bodo Heimann, Karl Popp, Mechatronika - komponenty, metody, przykłady, PWN, Warszawa, 2001;
• Richard C. Dorf, Robert H. Bishop, Modern Control Systems (12th Edition), PrenticeHall 2011;
• Christos G. Cassandras, Stephane Lafortune, Introduction to Discrete Event Systems, 2nd ed., Springer 2008;
• G.F.Franklin, J.D.Powell, A.Emami-Naeini, Feedback Control of Dynamic Systems, Pearson Education 2014.

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