COURSE DESCRIPTION CARD - SYLLABUS

Course name
Systems Engineering [S1MiKC1E>IS]

Course

Field of study
Microelectronics and Digital Communication

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
16

Laboratory classes
18

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student should have a structured knowledge of mathematical analysis and algebra. They should possess an organized and mathematically grounded understanding of one-dimensional signal theory, essential for comprehending the representation and analysis of signals in the time and frequency domains. Additionally, they should be able to solve fundamental problems in electronics and telecommunications using mathematical tools from mathematical analysis and algebra.

Course objective

The aim of the course is to present the theory of continuous linear systems and their description in the domains of the Fourier transform, Laplace transform, and state-space representation. The course covers system stability based on selected criteria, as well as issues related to automatic control systems. Additionally, aspects of nonlinear systems are discussed.

Course-related learning outcomes

Knowledge:
The student knows the basic principles of analysis and modeling of linear and nonlinear systems, including state-space representations, stability analysis, and automatic control theory. [K1_W02]

Skills:
The student is able to analyze automatic control systems and evaluate the effectiveness of different controllers based on stability criteria and system response quality. [K1_U08]
The student can apply mathematical models for the analysis and synthesis of control systems and interpret the results of computer simulations. [K1_U19]

Social competences:
The student understands the role of systems engineering in modern technologies and can assess its impact on the technical efficiency and economic effectiveness of processes. [K1_K05]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Lecture
Assessment in the form of a written and/or oral exam. The exam consists of several to a dozen questions (depending on the type of questions) and covers the content presented during the lectures. The exact nature of the exam questions will be communicated to students during one of the final lectures. Passing threshold: 50% of points.
The passing threshold is 50% of the points. In the case of written and oral credit, the points are summed. Grading scale: <50% - 2.0 (ndst); 50% to 59% - 3.0 (dst); 60% to 69% - 3.5 (dst+) ; 70% to 79% - 4.0 (db); 80% to 89% - 4.5 (db+); 90% to 100% - 5.0 (bdb).
2. Laboratory
Knowledge is assessed during exercises through oral and written evaluations, as well as written reports on the course of laboratory exercises and tests conducted after exercise series. Passing requirements: completion of all exercises, submission of positively evaluated reports, and a positive assessment of students' knowledge during laboratory sessions.
The skills achieved in the laboratory are determined on the basis of reports (reports) from the laboratory exercises (OL) and the final credit (ZK) in the form of an independently carried out exercise or project. Social competence (KS) is assessed on the basis of evaluation of the ability to listen actively, the ability to cooperate and participate effectively in team discussions, and the level of involvement in problem-solving processes . A weighted average is determined: OK = 0.5 x OL + 0.3 x ZK + 0.2 x KS and grades are given:
5.0 for OK > 4.75;
4.5 for 4.75 > OK > 4.25;
4.0 for 4.25 > OK > 3.75;
3.5 for 3.75 > OK > 3.25;
3.0 for 3.25 > OK > 2.75;
2.0 for OK < 2.75.

Programme content

Fundamentals of dynamic system theory - linear and nonlinear systems. Stability analysis of systems - stability criteria. System description in state-space representation - basics of modeling. Signal flow graphs and their application in system analysis. Automatic control systems. Discrete signals and systems - fundamental differences compared to continuous systems. Introduction to filter design - approximations of frequency characteristics. Deterministic chaos - the impact of nonlinearity on system behavior.

Course topics

Lecture:
• Fundamentals of continuous linear system theory, system stability analysis.
• System description in state-space representation, relationship between state-space and system transfer function.
• Signal flow graphs, system description using graphs.
• Automatic control systems, evaluation of the performance of selected types of controllers.

• Discrete signals and systems.
• Introduction to filter design, selected approximations of frequency characteristics, fundamental aspects of filter synthesis.
• Nonlinear systems, key differences in the behavior of linear and nonlinear systems.
• Deterministic chaos.
Laboratory:
• Transfer function and frequency characteristics of systems. Zeros and poles of the transfer function. Influence of pole location on the system's impulse response.
• Stable systems.
• Automatic control systems.
• State-space representation.
• Discrete signals and systems.
• Filters, selected approximations of frequency characteristics.
• Deterministic chaos.

Teaching methods

1. Lecture
Classes include elements of both traditional lectures and problem-based lectures (discussion with students on specific problems), depending on the content being presented. The lecture topics are introduced along with examples of their application. Selected lecture content is presented using a multimedia projector or a whiteboard. The discussion of topics is accompanied by information on their practical applications.
2. Laboratory
The exercises involve conducting simulation studies using the Python programming language. Before each exercise, a presentation is given to explain the theoretical and practical context of the current topic. Instructional materials are provided. Tasks are introduced and explained, with part of the Python code presented (students complete the remaining code themselves).

Bibliography

Basic:
1. T. Kaczorek: Teoria sterowania i systemów, PWN, Warszawa 1993.
2. Papoulis, Obwody i układy, WKiŁ, Warszawa 1988.
3. Jacek Wojciechowski, Sygnały i Systemy, WKiŁ, Warszawa, 2008.
4. K. Snopek, J. Wojciechowski, Sygnały i systemy - zbiór zadań, Wyd. Politechniki Warszawskiej, 2010

Additional:
1. J. Klamka, Z. Ogonowski: Teoria systemów liniowych, Wyd. Politechniki Śląskiej 1999.
2. J. Kudrewicz, Fraktale i chaos, WNT, Warszawa 1993.
3. J. Izydorczyk, J. Konopacki, Filtry analogowe i cyfrowe, Polska Akademia Nauk, Oddział w Katowicach, Katowice 2003.
4. Praca zbiorowa pod redakcja G.C.Temesa i S.K. Mitry, Teoria i projektowanie filtrów, WNT, Warszawa 1978.

Breakdown of average student's workload

	Hours	ECTS
Total workload	52	2,00
Classes requiring direct contact with the teacher	27	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00