COURSE DESCRIPTION CARD - SYLLABUS

Course name
Signals and dynamic systems [S1AiR1E>SiSD2]

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

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
0

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr inż. Andrzej Florek
andrzej.florek@put.poznan.pl

Lecturers

Prerequisites

The student starting this course should have basic knowledge of mathematics, statistics and the basics of signal theory. Should be able to use a computer and show willingness to learn to use various computer programs, such as Matlab. The student should be able to obtain information from the indicated sources. He should also understand the need to expand his competences. In addition, in the field of social competences, the student must present attitudes and qualities such as: honesty, responsibility.perseverance, cognitive curiosity, creative thinking, diligence, personal culture and respect for other people, care for laboratory equipment.

Course objective

Teaching students methods of generating and analyzing basic deterministic and stochastic signals in the time and frequency domain using applications in the Matlab programming language. Acquiring and consolidating the skills of spectral analysis of signals using a discrete Fourier transform - DFT or FFT and interpretation of results depending on the sampling frequency of analog signals. Understanding the properties and applications of linear convolution in signal filtration procedures.

Course-related learning outcomes

Knowledge:
The graduates has an advanced knowledge and understanding of selected facts, objects and phenomena and the methods and theories relating to them that explain the complex relationships between them; he has a basic general knowledge of mathematics including algebra, geometry, analysis, probabilistic and elements of discrete mathematics and logic, including mathematical methods and numerical methods necessary to:
▪ describe and analyse the properties of linear and basic non-linear dynamic and static systems,
▪ the description and analysis of complex numbers,
▪ the description of random processes and uncertain quantities,
▪ the description and analysis of combinatorial and sequential logic systems,
▪ description of control algorithms and stability analysis of dynamic systems,
▪ the description, analysis and methods of signal processing in the time and frequency domain,
▪ numerical simulation of dynamic systems in the continuous and discrete time domain [K1_W1 (P6S_WG)].
Knows and understands to an advanced degree signal processing methods in the time and frequency domain; has a structured knowledge of signal and information theory [K1_W5 (P6S_WG)].
Has a basic knowledge of the handling and use of IT tools for the design, rapid prototyping, simulation and visualisation of automation and robotics systems and for recording the design of mechanical constructions [K1_W10 (P6S_WG)].
Skills:
Be able to use basic methods of signal processing and analysis in the time and frequency domain and extract information from analysed signals [K1_U9 (P6S_UW)].
Social competences:
Is ready to critically assess his/her knowledge; understands the need for and knows the possibilities of continuous training - improving professional, personal and social competence, is able to inspire and organize the learning process of others [K1_K1 (P6S_KK)].
The graduate is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which the equipment and its components can operate. The graduate is ready to observe the rules of professional ethics and to demand it from others, to respect the diversity of opinions and cultures [K1_K5 (P6S_KR)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Learning outcomes presented above are verified as follows:
Assessment of laboratory exercises based on a positive final grade. The final grade results from partial grades for:
- answers to control questions during exercises,
- tasks performed during laboratory exercises,
- final test solution.

Programme content

The module program covers the following topics:
1. Methods of generating basic deterministic and random signals and their analysis in the time domain, using applications in Matlab.
2. Acquiring and consolidating the skills of spectral analysis of signals using one-dimensional discrete Fourier transform (DFT and FFT), with particular emphasis on understanding the influence of the sampling rate of analog signals and the length of their segments on the obtained discrete spectrum.
3. Basics of digital signal filtering and the use of linear convolution.

Course topics

The laboratory program covers the following topics:
1. Overview of exercises and introduction to Matlab software.
2. Determining the basic parameters of deterministic signals: average value and average power, RMS value and signal shape factor.
3. Estimation of basic quantities of random signals: probability density, expected value, power and variance.
4. Estimation of the correlation sequence of random signals and its use for distance measurement using a radar model.

5. Discrete Fourier transform (DFT) and its properties; the influence of sampling rate and length of the analysed analog signal segment on spectral resolution and spectral discrimination in a discrete spectrum.
6. Basics of digital filtering in the time and frequency domain, determining linear convolution.
7. Final test.

Teaching methods

Laboratory exercises are embedded in the Moodle platform. The necessary basic theoretical knowledge and instructions for laboratory exercises have been placed on the Moodle platform. During the laboratory, particular attention is paid to the selection of optimal functions and methods for creating applications in MATLAB, resulting in the correct, transparent and reliable operation of the application. It is also important to pay attention to the practical applications of applied methods of signal analysis and processing.

Bibliography

Basic
1. Oppenheim A.V., Willsky A.S., Nawab S.H, Signals & System, Pearson 2016, 944 pp.
2. Instructions for laboratory exercises on the PUT e-Courses platform.
3. Matlab Signal Processing Toolbox.
Additional
1. Florek A., Mazurkiewicz P., Sygnały i systemy Dynamiczne. Interpretacje - przykłady - zadania, wyd. 2, WPP, Poznań, 2015, 158 pp.
2. Zieliński T.P., Od teorii do cyfrowego przetwarzania sygnałów, WKŁ, Warszawa, 2016, 832 pp

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00