GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Signal Processing - laboratory, PG_00047521		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Multimedia Systems -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Daniel Węsierski	
	Teachers	dr inż. Daniel Węsierski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	15.0	0.0	0.0	15

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	15	1.0	9.0	25

Subject objectives

Student uses MATLAB tools for implementation of discrete-time signal processing algorithms, and their application to the analysis of signals and systems in the time and frequency domains (FFT), and to designing elementary discrete-time systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] can design, according to required specifications, and make a simple device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	- student uses MATLAB tools to implement discrete-time signal processing algorithms - student analyzes signals and systems in the domains of time and frequency (FFT) - student designs algorithms for basic discrete-time signal processing systems	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task
[K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn	- student uses MATLAB tools to implement discrete-time signal processing algorithms - student analyzes signals and systems in the domains of time and frequency (FFT) - student designs algorithms for basic discrete-time signal processing systems	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task

Subject contents

Visualization of typical signals, including modulated signals, and listening them in on ear-phones. Spectrogram. Sampling and reconstruction of signals. DTFT, DFT and FFT, and their properties. Spectral analysis usig the FFT and windows. Quantization of continuous-time (analogue) signals. Linear and circular convolutions, and their application to obtaining the linear discrete-time system response for given excitation. Basic discrete-time systems, their characteristics and examples of applications. Zeros and poles of digital filter transfer function. Shaping the frequency response based on zeros and poles.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Passed exam on Signal Processing from semester 3</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Practical exercise</td><td>51.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Allan V. Oppenheim, Ronald W. Schafer "Discrete-Time Signal Processing - Third Ediction", Prentice-Hall Signal Processing Series, 2014

2. T.P. Zieliński "Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań", WKŁ Warszawa 2005.

3. Instrukcje laboratoryjne zawierające opracowania teoretyczne zagadnień.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">Presentations from Signal Processing lectures.</td></tr>
<tr><td>eResources addresses</td><td colspan="2">Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1. Select any DLS differential equation with non-zero initial conditions and causal stimulation (similar to the one in the corresponding examples section, it can be e.g. an equation from a task exam or test). Analyze the time domain system as in the examples section (block diagram, computational complexity of the algorithm, system responses).

2. Select a bi-harmonic signal (or with more than two components) satisfying assumptions about the sampling theorem as in the examples section. Write down this signal by the formula. Compare,discuss the results of tests for three reconstructors (use and graphical interface of PROREK, draw signals and the spectrum).

3. Select a system with known transmittance and impulse response. Conduct your research choosing the right input signals and discuss the results as in the examples section (frequency and time characteristics, distribution of zeros and poles, stability, response as convolution).

4. Investigate the phenomenon of spectral leakage similar to example from the examples section. Select the real or complex sine wave for testing. Adjust the frequency f0 and the parameter N once so that the phenomenon of spectrum leakage does not occurr and so that the phenomenon of spectrum leakage does occurr. Make appropriate drawings of the signals and spectra and discuss theobtained results.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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