



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 2024	Academic year of realisation of subject				2025/2026	
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_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			[SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment	
	[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			[SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment	
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 using 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.						

Prerequisites and co-requisites	Passed exam on Signal Processing from semester 3		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercise	51.0%	100.0%
Recommended reading	Basic literature	<p>1. Allan V. Oppenheim, Ronald W. Schaffer "Discrete-Time Signal Processing - Third Edition", Prentice-Hall Signal Processing Series, 2014</p> <p>2. T.P. Zieliński "Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań", WKŁ Warszawa 2005.</p> <p>3. Instrukcje laboratoryjne zawierające opracowania teoretyczne zagadnień.</p>	
	Supplementary literature	Presentations from Signal Processing lectures.	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<p>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).</p> <p>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).</p> <p>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).</p> <p>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 f_0 and the parameter N once so that the phenomenon of spectrum leakage does not occur and so that the phenomenon of spectrum leakage does occur. Make appropriate drawings of the signals and spectra and discuss the obtained results.</p>		
Work placement	Not applicable		