GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Dynamic Signals and Systems, PG_00058787		
Field of study	Electrical Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Zakład Przekształtników i Magazynowania Energii -> Department of Power Electronics and Electrical Machines -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Bartosz Puchalski	
	Teachers	dr inż. Bartosz Puchalski dr inż. Tomasz Rutkowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

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	45	3.0	27.0	75

Subject objectives: The objective of the course is for the student to acquire adequate knowledge and skills in the signal analysis and processing.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W08	Student understands sampling and the sampling theorem. Understands fundamental properties of frequency analysis of continuous-time and discretetime signals, periodic or nonperiodic. Explains the relationship between the spectra of sampled signals and their continuous-time originals. Formulates mathematical description of continuous-time and discrete-time dynamic systems in the time and frequency domain. Explains the relationship between the impulse response, the transfer function and the frequency response of a dynamic system. Explains and uses basic methods of digital filter design. Explains the relationship between the spectra of analog reconstructions and their discrete-time originals. Understands the basic properties of the phase-locked loop (PLL).	[SW1] Assessment of factual knowledge
K6_U04	Uses discrete Fourier transform (DFT) for the analysis of discrete-time and sampled continuous-time signals (notably for the analysis of power line currents and voltages). Implements and uses simple digital filters and the phase-locked loop.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents	LECTURE Continuous-time and discrete-time signals. Sampling. Frequency of discrete-time signals. Sampling theorem. Complex exponential signal. Fourier series of continuous-time signals. Fourier series of discrete-time signals. Fourier transform of continuous-time and discrete-time signals. Discrete Fourier transform. Z transform. Basic properties of systems. Representing linear dynamic systems: differential and difference equations, transfer function, frequency response, discrete convolution. Transmission of signals through linear systems. Basic structures of digital filters. Digital filter design by analog prototyping. Reconstruction of analog signals. Downsampling and upsampling. LABORATORY Fourier series. Implementation of discrete Fourier transform (DFT). Using sampling and DFT for the analysis of selected continuous-time signals (square wave, sawtooth etc.). Spectral analysis of distorted signals in three-phase systems. Computing the total harmonic distortion (THD) of these waveforms. Design, implementation and testing of selected digital filters. Implementation and analysis of the phase-locked loop (PLL) algorithm.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Test of lecture-related knowledge	50.0%	50.0%
	Reports and tests related to laboratory exercises	50.0%	50.0%
Recommended reading	Basic literature	1. Śleszyński W.: Sygnały i systemy dynamiczne. Politechnika Gdańska, Wydział Elektrotechniki i Automatyki, Gdańsk 2010. 2. Wojciechowski J. M.: Sygnały i systemy. WKŁ, Warszawa 2008. 3. Zieliński T.P.: Cyfrowe przetwarzanie sygnałów. WKŁ, Warszawa 2007. 4. Oppenheim A. V., Willsky A. S., Nawab S. H.: Signal and Systems. Prentice-Hall, 1997 5. Chen C.-T.: System and Signal Analysis. Saunders College Publishing, 1994	
	Supplementary literature	1. Szabatin J.: Podstawy teorii sygnałów. WKŁ, Warszawa 2000. 2. Izydorczyk J., Płonka G., Tyma G.: Teoria sygnałów. Helion, Gliwice 1999. 3. Gabel R., Roberts R. A.: Sygnały i systemy liniowe. WNT, Warszawa 1978 4. Lyons R.G.: Wprowadzenie do cyfrowego przetwarzania sygnałów. Warszawa: WKŁ 2000. 5. Oppenheim A. V., Schafer R.W.: Cyfrowe przetwarzanie sygnałów. WKŁ, Warszawa 1979 6. Franklin G.F., Workman M.L., Powell D.: Digital Control of Dynamic Systems. Addison-Wesley, 1998.	
	eResources addresses	Adresy na platformie eNauczanie: SYGNAŁY I SYSTEMY DYNAMICZNE [2023/24] - Moodle ID: 32141 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32141	

Example issues/ example questions/ tasks being completed	1. A periodic sequence of period N is made of the following samples (per period): 4, 2, 0, 3, 0, -3, 2, 0. Find the Fourier series coefficient c2. 2. Draw a block schematic of the discrete-time system defined by a given transfer function. 3. Find the difference equation of the dynamic system defined by a given transfer function. Compute the first 6 samples of the response of the system to a given input sequence. 4. Find the difference equation an transfer function of the filter defined by a given block schematic. Compute the filter gain for selected frequencies. 5. Using the "Euler backward" method (s = (1 - 1/z) / T), digitize the PI controller with the following transmittance: R(s) = Kp + Ki / s. Give the differential equation of the controller. Calculate the steady-state value of the impulse response and the starting value of the step response.
Work placement	Not applicable