GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Signal Processing, PG_00047780		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2021/2022
Education level	first-cycle studies	Subject group	Obligatory subject group 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	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Teleinformation Networks -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Blok	
	Teachers	dr hab. inż. Marek Blok dr inż. Maciej Sac	

Lesson types and methods of instruction

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

E-learning hours included: 0.0

Przetwarzanie sygnałów - zima 2021/22 - Moodle ID: 14087
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=14087

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	2.0	53.0	100

Subject objectives

Student uses basic analog and discrete-time signal processing algorithms and tools. Student analyzes signals and systems in the time and frequency domains. Student designs elementary discrete-time systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study	The student uses basic tools of discrete signals analysis and is able to design and analyze a simple digital signal processing system.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_W04] Knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	The student knows and describes basic tools and algorithms of analog and discrete-time and digital signal processing methods. The student is familiar with the basic methods of signals and systems analysis in the time and frequency domain. The student knows the structures and design methods of basic discrete-time signal processing systems.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents	1. Classification of signals. 2. Representation of continuous-time signals in the frequency domain. Continuous Fourier transformation. 3. Properties of continuous Fourier transformation. Analogue signal spectrum. 4. Discrete-time Fourier transformation (DTFT). 5. Properties of the DTFT. Discrete-time signal spectrum. 6. Processing of a discrete-time signal by a linear system. 7. Discrete-time complex signal - instantaneous amplitude, phase and angular frequency. 8. Hilbert transformation of a discrete-time signal. Applications. 9. Complex envelope of a discrete-time band-pass signal. 10. Analog to digital conversion 11. Digital to analog conversion. 12. Quantization noise and its additive model. 13. Estimating the signal to quantization noise power ratio. 14. Difference equations for discrete-time linear systems having finite (FIR) and infinite (IIR) impulse responses. 15. Block schemes of discrete-time systems. 16. The Z transformation. 17. Transfer function of a discrete-time system. 18. Discrete-time systems of finite impulse response. 19. Discrete-time systems of infinite impulse response. 20. Realizability of dicrete-time systems in real time versus causality. 21. Stability. Minimum-phase discrete-time systems. 22. Introduction to digital FIR and IIR filtering. 23. Examples of designing elementary digital filters. 24. Discrete Fourier transformation (DFT). 25. Fast Fourier transformation (FFT). Applications. 26. Relationships between: DTFT, DFT and Z transformations. 27. Discrete linear convolution. 28. Circular convolution. Applications. 29. Introduction to interpolation and decimation. 30. Applications of interpolation and decimation.
Prerequisites and co-requisites	
Assessment methods and criteria	see table below

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	50.0%
Midterm colloquium	50.0%	50.0%

Recommended reading

Basic literature	A.V. Oppenheim, R.W. Schafer with J. R. Buck: Discrete-Time Signal Processing. Prentice Hall International, 1999.
Supplementary literature	S.W.Smith: The scientist and engineer's guide to digital signal processing, California Technical Pub,1997
eResources addresses	

Example issues/ example questions/ tasks being completed	Practically used operator of averaging over two neighboring samples is given in the form of its impulse response. Find and write down the formula for its difference equation and its frequency responses: complex response, amplitude response, phase response and group delay response. Draw these characteristics as functions of variable omega. Also draw the structure of this operator as a filter. Is this FIR or IIR filter? How do you recognizable that? Using DFT and IDFT find and write down the output of digital FIR filter of given impulse response on given input signal. Draw the spectra of signals at input and output of the filter in carthesian form and the transfer function of the filter based on estimated DFT-s, while the spectra and transfer function are the complex sequences of 4-point length. On the examination sheet each student will find matrix formulas needed for evaluation of 4-point DFT and IDFT.
Work placement	Not applicable