GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	DSP Applications in Metrology, PG_00047449						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	February 2022		Academic year of realisation of subject	2022/2023			
Education level	second-cycle studies		Subject group	Optional subject group 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	1		Language of instruction	English			
Semester of study	2		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Marcin Strąkowski				
	Teachers		dr inż. Marcin Strąkowski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	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	30		4.0	16.0		50
Subject objectives	Teaching students of basic parameters and characteristics of measured signals and teaching methods,procedures and algorithms of digital processing measured signals						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_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	implements the data processing and filtering system, reduces noise	[SW1] Assessment of factual knowledge
[K7_U03] can design, according to required specifications, and make a complex 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	implements a system of conditioning, acquisition and processing of measurement data in the hardware and software forms	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K7_U06] can analyse the operation of components, circuits and systems related to the field of study; measure their parameters; examine technical specifications; interpret obtained results and draw conclusions	diagnoses systems, analyzes metrological properties of signals, introduces adequate improvements in the existing system	[SU2] Assessment of ability to analyse information
[K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum.	knows the uses the discrete Fourier transform and the power spectrum density of digital signals, understands the aliasing phenomenon, knows the methods of averaging periodograms	[SW1] Assessment of factual knowledge

Subject contents

Acquisition and preliminary data processing. Classification and characterization of deterministic and random measurement signals. Uniform sampling of band-limited signals; interpolation and decimation procedures. Autocorrelation function and power spectraL density (PSD) of digital random signals. Parameters and characteristics of digital random signals, accuracy of their measurement dependent on data acquisition parameters. Parameters and characteristics of a measurement channel; digital measurement procedures and errors of their estimation. Measurement of PSD: DFT, mean value and variance of periodogram; time and spectral windows; examples of PSD estimation. Bartletts and Welchs method of periodogram averaging. High-resolution spectra. Gibbs effect; examples. DFT applications; circular convolution. Wiener and Kalman filter applications in metrology. Designing of FIR and IIR (recursive) filters. Multirate sampling. Transient signal detection. Influence of quantization and round off noise on filter kernels in DSP applications. Detection of a signal buried in noise; basic techniques of noise reduction. Removal of transient and noise pulse distortions. DSP in diagnostics of objects quality.

Prerequisites and co-requisites

Teaching students of basic parameters and characteristics of measured signals and teaching methods, procedures and algorithms of digital processing measured signals

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	50.0%	50.0%
Laboratory projects	50.0%	50.0%

Recommended reading

Basic literature	1. Bendat J., Piersol A.: Engineering applications of correlation and spectral analysis. . Wiley, New York 1993. 2. Clark C.L.: LabVIEW Digital Signal Processing and Digital Communications. McGraw-Hill 2005. 3. Lyons R. G.: Wprowadzenie do cyfrowego przetwarzania sygnałów. WKiŁ, Warszawa 1999. 4. Stranneby Dag: Digital Signal Processing: DSP and Applications. Oxford 2001.
Supplementary literature	1. Manolakis G.D., Ingle V.K.: Applied Digital Signal Processing. Theory and Practice. Cambridge University Press 2011. 2. The digital signal processing handbook (Electrical engineering handbook series). Editors Madisetti Vijay K., Williams Douglas B.. CRC Press & IEEE Press, Florida 1998. 3. Vaseghi S.V.: Advanced Digital Signal Processing and Noise Reduction, 2nd ed. Wiley 2000.
eResources addresses	

Example issues/ example questions/ tasks being completed	Parameters and characteristics of digital random signals, accuracy of their measurement. Autocorrelation function and power spectra density (PSD) of digital random signals; errors in statistical analysis of processed random signals. Measurement procedures and errors of estimation. Measurement of PSD: DFT, mean value and variance of periodogram; role of time windows. Examples of PSD estimation. Bartletts and Welchs method of periodogram averaging. DFT applications; circular convolution. Influence of quantization and round off noise on filter kernels in DSP applications. Detection of signal in noise background techniques of noise reduction.
Work placement	Not applicable