



Subject card

Subject name and code	Signal analysis, PG_00060218						
Field of study	Technical Physics						
Date of commencement of studies	October 2026	Academic year of realisation of subject				2027/2028	
Education level	first-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	2	Language of instruction				Polish	
Semester of study	3	ECTS credits				3.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Department of Theoretical Physics and Quantum Computing -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Marek Czachor					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	15.0	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		5.0		25.0	75
Subject objectives	Introduction to Fourier and wavelet analysis						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W04] has advanced knowledge of the principles of experimental design, experimental methods, measurement techniques and scientific equipment used in physics and related sciences, including their life cycle.	The ability to select measurement techniques related to the analysis of acoustic or visual data.			[SW2] Assessment of knowledge contained in presentation		
	[K6_U07] is able to solve problems within a team, including interdisciplinary teams, appropriately planning its work.	The ability to apply theoretical principles to prepare simple illustrations of sound and image analysis.			[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		
	[K6_U08] communicates effectively using specialist terminology in physics and related disciplines, enabling the preparation of reports, publications or presentations, as well as participation in discussion and expression of opinions.	The ability to prepare a written thesis that meets the requirements of a diploma thesis or scientific publication.			[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools		
[K6_W05] has knowledge of programming methodologies and techniques, as well as the use of selected IT tools in physics and engineering.	Ability to apply modern programming techniques, in particular using artificial intelligence.			[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects			

Subject contents	Course content – lecture Lecture		
	<ol style="list-style-type: none"> 1. Signal as a vector, signal analysis as a change of basis, scalar products and unitarity, resolutions of unity 2. Discrete Fourier transforms: complex, fast, cosine 3. Consequences of unitarity: Parseval's and Plancherel's theorems 4. Fourier transform on an interval and a line 5. Shannon's sampling theorem; Shannon's wavelet 6. Windowed Fourier transform; bases and frames 7. Fast Haar transform 8. Subband coding; downsampling and upsampling 9. Lowpass and highpass filters 10. Bi-orthogonality 11. From filters to wavelets 12. Compression 		
	Course content – seminar		
	<ol style="list-style-type: none"> 1. Application of discrete Fourier transform to sound analysis 2. Two-dimensional Fourier transform applied to image compression 3. 2-dimensional Haar transform applied to image compression 4. Gibbs phenomenon and its minimization applied to a selected discontinuous signal 5. Sound analysis using windowed transform 		
Prerequisites and co-requisites	Knowledge of elementary theory of Hilbert spaces and complex analysis		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	lecture	60.0%	50.0%
	seminar	50.0%	50.0%
Recommended reading	Basic literature	J. T. Białasiewicz, Falki i aproksymacje, WNT, Warszawa 2000 P. Wojtaszczyk, Teoria falek, PWN, Warszawa, 2000 G.Kaiser, A Friendly Guide to Wavelets, Birkhauser, Boston, 1995	
	Supplementary literature	No requirements	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Types of discrete Fourier transforms Scheme of multiresolution analysis Prove Shannon's sampling theorem		
Practical activities within the subject	Not applicable		

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