



Subject card

Subject name and code	Advanced Processing of Telecommunications Signals, PG_00048355						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	February 2024	Academic year of realisation of subject			2024/2025		
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			Polish		
Semester of study	2	ECTS credits			2.0		
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					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	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	Familiarize students with selected advanced digital signal processing techniques encountered in digital telecommunications.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[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.		Describes the modulation and channel access techniques used in digital telecommunications. Explains the operation of basic multirate algorithms. Describes the classical sampling rate conversion algorithms. Draws and describes the schemes of polyphase interpolator and decimator. Explains the principle of the interpolated FIR filter. Describes the basic techniques of spread spectrum. Describes selected techniques of all-optical signal processing used in OTN networks.			[SW1] Assessment of factual knowledge	
	[K7_W01] Knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study.		Determines the signal parameters based on the eyediagram. Draws and describes diagrams of a quadrature modulator with interpolation and a quadrature demodulator with decimation and determines changes in signals and their spectra at subsequent processing stages. Determines a specification of the interpolation and decimation filter.			[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge	

Subject contents	<ol style="list-style-type: none"> 1. Classification of contemporary telecommunications signals – speech and data transmission. Channel capacity. 2. Modulation techniques used in data transmission: ITU-T standards – from telephone modem to OTN. 3. Multiple access techniques for data transmission channel. 4. Modulation techniques in digital transmission. 5. Introduction to multirate signal processing. Fundamental building blocks of multirate algorithms and their properties. 6. Equivalent structures in multirate processing. Transposition rules for multirate structures. 7. Classic sample rate conversion algorithm and its polyphase implementations. 8. Aliasing in polyphase structures. Computational complexity of polyphase structures. 9. Digital signal processing for VoIP. 10. Multirate ADC and DAC converters. Principles and operation of vocoder. Subband coding. Estimation of speech parameters. 11. Digital filters in data transmission – theory and design. Hilbert transformer and complex Hilbert filter. Shaping and receiving filters. 12. Quadrature mirror filters. 13. Cascade and multistage filter structures. I-FIR filters. Multistage CIC filters. 14. Multistage sample rate conversion. 15. Modulation based on quadrature modulator with interpolation (QMI). Demodulation based on quadrature demodulator with decimation (QDD). 16. Multichannel QDD and QMI. 17. Digital implementation of resonators and narrowband filters. 18. Carrier and symbol timing recovery in digital receiver. 19. Delaying digital signals. 20. Variable fractional delay filters and their application in symbol synchronizations. 21. FFT as multirate DFT implementation. Arbitrary length FFT. Fast convolution. 22. Analysis and synthesis filter banks - implementation based on DFT. 23. Multicarrier modulations: FMT, DMT and OFDM. 24. Multicarrier transmission in multipath environment. 25. Spectrum spreading in data transmission - FHSS, DSSS. 26. UWB technology. UWB signal. UWB receiver. 27. Propagation of data transmission signals: distortions and countermeasures. 28. Channel parameters estimation and equalization. 29. Review of optical signal processing methods. 30/ Selected techniques for all digital optical signal processing used in OTN networks. 		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Written exam	50.0%	90.0%
	Activity	0.0%	10.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Fredric J. Harris: Multirate Signal Processing for Communication Systems, Prentice Hall, 2004 2. John G. Proakis, Dimitris K. Manolakis: Digital Signal Processing, Prentice Hall, 2006 3. Andrea Goldsmith: Wireless Communications, Stanford University, California, 2005 	
	Supplementary literature	<ol style="list-style-type: none"> 1. P. P. Vaidyanathan: Multirate Systems And Filter Banks, Prentice Hall, 1992 2. Ronald E. Crochiere, Lawrence R. Rabiner: Multirate Digital Signal Processing, Prentice Hall, 1983 3. M. Ibnkahla Ed., Signal Processing for Mobile Communications Handbook, CRC Press, 2004 	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		