



## Subject card

Subject name and code	Source and Channel Coding in Radio Communication Systems, PG_00047471						
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			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Radiocommunication Systems and Networks -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Małgorzata Gajewska					
	Teachers	dr inż. Małgorzata Gajewska dr inż. Andrzej Marczak					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	15.0	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		6.0		24.0	75
Subject objectives	The aim of the course is to familiarize students with the methods of source and channel coding.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[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	The student knows and is able to discuss basic operating methods source and channel coders.	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	Student zna metody własności sygnałów metody oraz podstawowe metody oceny jakości sygnałów mowy	[SW1] Assessment of factual knowledge
	[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.	The student knows and understands what role play individual blocks functional in encoders.	[SW1] Assessment of factual knowledge
	[K7_U07] can apply advanced methods of process and function support, specific to the field of study	The student can use acquired knowledge regarding basic coding methods source and channel to understanding of operating methods practically used encoders	[SU1] Assessment of task fulfilment
	[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	The student can perform simulation software work of channel coder.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools

Purpose and basic concepts of source coding, properties and models of the source of speech signals. Modeling of the vocal tract. Scalar linear and nonlinear quantization. Review of basic source coding methods. Fundamentals of coding type analysis by synthesis, codecs: MPLP, RPE. Fundamentals of coding analysis by synthesis, codecs: CELP, VSELP. Criteria for assessing the quality of synthesized speech signals. RPE-LTP-LPC codec in the GSM system. Short-term predictive analysis. Long-term predictive analysis. Excitation signal synthesis, APCM quantization, transmission frame forming, RPE-LTPLPC decoder. AMR-ACELP coding in the UMTS / GSM system, speech signal sending / receiving mechanisms, variable rate coding, transmission frame format. Short-term and long-term predictive analysis in the ACELP encoder, adaptive code book Algebraic code table, AMR-ACELP decoder. AMR-WB ACELP codec. Application of cyclic codes in radiocommunication systems, examples of encoders and decoders. Convolutional coding, code description using generating functions and lattice graph. Correction ability of convolutional codes, free Hamming distance. Soft and hard-coding decoding of convolutional

	<p>codes. Viterbi's algorithm. Computational complexity of the Viterbi algorithm. MAP decoding algorithm. Systematic and unsystematic convolutional codes. The use of convolutional codes in radiocommunication systems. Interleaving of code strings of convolutional codes. Excluding bits from convolutional code strings and their decoding, the impact of exclusion on correction capabilities. Turbo codes, work principle, correction abilities. Turbo codes in radiocommunication systems. Turbo code decoding. LDPC codes. Decoding LDPC codes.</p>														
Prerequisites and co-requisites															
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="451 1144 794 1178">Subject passing criteria</th> <th data-bbox="794 1144 1137 1178">Passing threshold</th> <th data-bbox="1137 1144 1487 1178">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="451 1178 794 1211">channel coding lecture</td> <td data-bbox="794 1178 1137 1211">50.0%</td> <td data-bbox="1137 1178 1487 1211">35.0%</td> </tr> <tr> <td data-bbox="451 1211 794 1245">project</td> <td data-bbox="794 1211 1137 1245">50.0%</td> <td data-bbox="1137 1211 1487 1245">30.0%</td> </tr> <tr> <td data-bbox="451 1245 794 1279">source coding lecture</td> <td data-bbox="794 1245 1137 1279">50.0%</td> <td data-bbox="1137 1245 1487 1279">35.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	channel coding lecture	50.0%	35.0%	project	50.0%	30.0%	source coding lecture	50.0%	35.0%
Subject passing criteria	Passing threshold	Percentage of the final grade													
channel coding lecture	50.0%	35.0%													
project	50.0%	30.0%													
source coding lecture	50.0%	35.0%													
Recommended reading	<p>Basic literature</p> <p>Supplementary literature</p> <p>eResources addresses</p>	<p>Goldberg R. (ed.), A Practical Handbook of Speech Coders. CRC Press LLC, 2000. Hanzo L., Somerville C., Woodard J.: Voice and Audio Compression for Wireless Communications, 2nd Edition. Wiley &amp; Sons, 2007.</p> <p>No requirements</p>													
Example issues/ example questions/ tasks being completed	<p>Discuss the operation of the CELP encoder</p> <p>Viterbi's algorithm.</p>														
Work placement	Not applicable														