GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Source and Channel Coding in Radio Communication Systems, PG_00048370
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	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 source and channel coding methods.

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.	The student knows and understands the role of individual functional blocks in encoders.	[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	The student is able to perform software simulating the work of channel coders.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
	[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	The student knows the methods of the method's signal's properties and the basic methods of assessing the quality of speech signals.	[SW1] Assessment of factual knowledge
	[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 the methods of operation of basic source and channel encoders.	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_U07] can apply advanced methods of process and function support, specific to the field of study	The student is able to use the acquired knowledge of the basic methods of source and channel coding to understand the methods of operation of practically used coders.	[SU1] Assessment of task fulfilment

Subject contents	The target and fundamentals of source coding. Characteristics and models of voice signals sources, statistical characteristics.
	Vocal tract modelling.
	Scalar and vector; uniform and non-uniform quantization.
	Basic source coding methods review.
	Fundamentals of analysis by synthesis coding methods. Codecs: MPLP, RPE.
	Fundamentals of analysis by synthesis coding methods. Codecs: CELP, VSELP.
	Criteria of synthesized voice signals quality.
	RPE-LTP-LPC codec in GSM system.
	Short-term prediction analysis.
	Long-term prediction analysis.
	Synthesis of excitation signal, APCM quantization, transmission frame format, RPE-LTP-LPC decoder.
	AMR-ACELP coding in UMTS/GSM system, mechanisms of voice signals transmission and reception, variable transmission rate coding, transmission frame format.
	Short-term and long-term prediction analysis in ACELP codec, adaptive codebook.
	Algebraic codebook, AMR-ACELP decoder.
	AMR-WB ACELP codec.
	Application of cyclic codes in radio communication systems. Examples of cyclic codes.
	Convolutional encoding, encoder representation by generating function and trellis.
	Correction capability of convolutional codes (CCs), free Hamming distance.
	Soft and hard decoding of convolutional codes.
	Viterbi algorithm. Computational complexity of Viterbi algorithm.
	MAP decoding algorithm.
	Systematic and nonsystematic CCs.
	Application of CCs in radio communication systems
	Interleaving for CCs.
	Puncturing of CCs and their decoding, influence of puncturing on correction capabilities.

	Turbocodes, principles of operation, correction capabilities.
	Turbocodes in radio communication systems.
	Turbo decoding.
	Low density parity check (LDPC) codes.
	Decoding of LDPC codes.

Prerequisites and co-requisites	

Assessment methods and criteria			
	Subject passing criteria	Passing threshold	Percentage of the final grade
	project	50.0%	30.0%
	source coding lecture	50.0%	35.0%
	channel coding lecture	50.0%	35.0%

Recommended reading	Basic literature	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 & Sons, 2007.
	Supplementary literature	No reqiurements
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Describe CELP coder. Viterbi algorithm.

Work placement	Not applicable