GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Information Theory and Coding, PG_00055351		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study 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	English
Semester of study	3	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
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	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	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	The aim of the course is teach students the theory of information and methods of channel coding.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W06] Knows and understands, to an increased extent, the basic processes taking place in the life cycle of devices, facilities and technical systems.	Student identifies models of information sources. Student describes the characteristics of the telecommunications channel. Student presents the Shannon theorem. Student clarifies the purpose of channel coding. Student identifies the detection and correction codes.	[SK2] Assessment of progress of work
[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 the methods of data compression and various methods of channel coding. Student understands the functions of individual coding methods.	[SW1] Assessment of factual knowledge
[K7_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by:n- appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation,n- application of appropriate methods and toolsn	The student is able to search for code sequences using mathematical actions. He can use in practice the knowledge of coding procedures.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

Subject contents	1 Concept of information and information system, signals and informations 2 Information sources, classification, analog and digital sources 3 Models of analog and digital information sources with and without memory. Distributions of the instants of source informations generation: deterministic, Poisson 4 Distributions of the duration of analog informations: deterministic and exponential. Distributions of the length of digital informations: deter-ministic, geometric, Pareto. On-off model for voice. 5 Communication channel and its properties. Classification of channels, Disturbances and distortions in wire and wireless channels 6 Measure of information, entropy of the source, joint and conditional entropy. Mutual information for continuous and discrete random vari-ables 7 Source coding for digital sources, Kraft inequality, Huffman and Lempel-Ziv coding, arithmetic coding 8 Source coding of one-dimensional continuous sources. Distorted compression. Optimum allocation of bits. Quantization noise 9 Scalar and vector quantization, optimum quantization. LBG algorithm 10 Rate-distortion theory 11 Source coding of bandpass signals in time and frequency 12 Channel models: analog , discrete and analog-discrete. Stationary and nonstationary channels 13 Channel capacity, Shannon capacity theorem, Shannon limit 14 Channel coding, concept of redundant coding, coding aim and block scheme of communication system with channel coding, codes classification 15 Coding gain, detection and correction capabilities 16 Simple codes with detection and correction capabilities, calculation of the error probability 17 Linear block codes, generator matrix, canonical form 18 Parity-check matrix and its relationship to generator matrix 19 Syndrom testing, standard array 20 Simultaneous error correction and detection, calculation of an undetected error in an error detection code 21 Decoding optimization for block coding, maximum a posteriori criterion (MAP), maximum likelihood criterion (ML) 22 Equivalence of ML criterion to the minimum Hamming distance between the received sequence and the codeword 23 Cyclic codes and their algebraic structure 24 Cyclic coding/decoding with a shift register 25 Coding limits. Selected block codes: Hamming and Golay codes 26 Convolutional codes, their description with the state representation, state and trellis diagrams 27 Convolutional decoding problem, ML criterion, Viterbi algorithm 28 Block and convolutional interleaving 29 Hard and soft decoding 30 Principles of turbocoding and turbodecoding, performance and implementation of turbocodes
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Colloquim	50.0%	45.0%
Written exam	50.0%	55.0%

Recommended reading	Basic literature	T.M.Cover, J.A.Thomas : Elements of information theory, John Wiley & Sons Inc.
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	Based on Shannon-Fano’s method build optimal code, in which probabilites of signs in orginal alphabet are as follows 0,5 0,25 0,098 0,052 0,04 0,03 0,019 0,011 Calculate: average lenght of code word (Lśr) maximum entropy (HMAX)	
Work placement	Not applicable	