GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Information Theory and Coding, PG_00048295		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
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	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 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_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_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 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_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.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject

<table>
<tr><td>Subject contents</td><td>1. Channel coding, concept of redundant coding, coding aim and block scheme of communication system with channel coding, codes classification. Channel capacity, Shannon capacity theorem, Shannon limit.
2. Coding gain, detection and correction capabilities. Simple codes with detection and correction capabilities, calculation of the error probability.
3. Linear block codes, generator matrix. Parity-check matrix and its relationship to generator matrix.
4. Syndrom testing, standard array . Simultaneous error correction and detection, calculation of an undetected error in an error detection code
5. Decoding optimization, maximum a posteriori criterion (MAP), maximum likelihood criterion (ML) for block coding.
6. Cyclic codes and their algebraic structure. Cyclic coding/decoding with a shift register.
7. Coding limits. Selected block codes: Hamming and Golay Codes.
8. Convolutional codes, their description with the state representation, state and trellis diagrams.
9. Convolutional decoding problem, ML criterion, Viterbi algorithm. Block and convolutional interleaving.
10. Principles of turbocoding and turbodecoding, performance and implementation of turbocodes.
11. Concept of information and information system, signals and informations. Information sources, classification, analog and digital sources.
12. On-off model for voice.
13. Measure of information, entropy of the source, joint and conditional entropy. Mutual information for continuous and discrete random variables.
14. Source coding for digital sources, Kraft inequality, Huffman algorithm.
15. Shannon-Fano algorithm and Byte Run method.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Activity on exercise</td><td>0.0%</td><td>5.0%</td></tr>
<tr><td>Written exam</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Colloquim</td><td>50.0%</td><td>45.0%</td></tr>
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<tr><td>Recommended reading</td><td>
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<tr><td>Basic literature</td><td>T.M.Cover, J.A.Thomas : Elements of information theory, John Wiley & Sons Inc.</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Teoria informacji i kodowania 2023/2024 - Moodle ID: 32049
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32049</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>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)</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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