GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Information Theory and Coding, PG_00048295 | | |
| Field of study | Electronics and Telecommunications | | |
| Date of commencement of studies | February 2026 | Academic year of realisation of subject | 2026/2027 |
| Education level | second-cycle studies | Subject group | Obligatory subject group in the field of study<br>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 -> Wydziały Politechniki Gdańskiej | | |
| 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 |

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| 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_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by: - appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation, - application of appropriate methods and tools | 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<br>[SU3] Assessment of ability to use knowledge gained from the subject |
| [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_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 | The student knows the methods of encoding, decoding and compression. The student is able to perform, for example, the decoding process for convolutional codes. | [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 select coding methods appropriate for the designed system, depending on the required level of error protection. | [SU3] Assessment of ability to use knowledge gained from the subject |

## Subject contents

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.

## 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% | 50.0% |
| Activity on exercise | 0.0% | 5.0% |

## Recommended reading

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| 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-Fanos 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 ($H_{MAX}$)

## Work placement

Not applicable

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