GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Information theory, PG_00031971		
Field of study	Technical Physics		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
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	2	Language of instruction	Polish
Semester of study	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Theoretical Physics and Quantum Information -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Marek Czachor	
	Teachers	prof. dr hab. Marek Czachor	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	30.0	60

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	60	8.0	32.0	100

Subject objectives

Introduction to basic information theory with some modern applications.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W03] Has general knowledge of current development paths and discoveries in the scope of physics and related fields of science and technology.	Student knows general foundations of the theory and its modern applications	[SW1] Assessment of factual knowledge
[K7_W04] Has enhanced knowledge of mathematical, numerical and simulation methods applied in the description and modelling of physical phenomena.	Knows how to apply the theory to concrete computer science problems	[SW1] Assessment of factual knowledge
[K7_U04] Can formulate and test hypotheses related to research problems.	Is capable of formulating an independent research problem	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_U09] Can popularize the achievements in physics and related fields of science.	Can present laymen-lectures	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	Hartley information measure Amount of information according to Shannon Additivity of information Shannon entropy MaxEnt principle Method of Lagrange multipliers Ekstremum entropii przy kilku więzach Kolmogorov-Nagumo averages Derivation of Renyi entropy from KN averages Additivity of Renyi information Tsallis entropy Shannon entropy as a limit of Renyi entropy Zipf-Mandelbrot law MaxEnt principle for Renyi entropies Fractals Richardson's law Fractal dimension Joint entropy Conditional entropy Mutual information Mutual information vs. conditional entropy Relative entropy Concave and convex functions Jensen inequality Information inequality

	Log-sum inequality Non-negativity of mutual information Entropy vs. 2nd law of thermodynamics 2nd law of thermodynamics for Markov chains Codes Alphabets Dictionaries Prefix code Kraft inequality Shannon theorem on discrete coding Shannon code Shannon-Fano code Arithmetic coding Huffman code Bernoulli law of large numbers Asymptotic equipartition principle for the Bernoulli process Theorem on capacity of a channel
Prerequisites and co-requisites	Elementary probability calculus.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Seminar	60.0%	50.0%
Oral exam	60.0%	50.0%

Recommended reading

Basic literature	T. M. Cover, J. A. Thomas, Elements of information theory (Wiley, New York, 1991).
Supplementary literature	A. Renyi, Selected papers of Alfred Renyi (Akadmiai Kiado, Budapest, 1976).
eResources addresses	Podstawowe https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30118 - Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Properties of Shannon information Construct a Huffman code for a given set of events Prove Jensen inequality
Work placement	Not applicable