GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Digital Modulation Techniques, PG_00048147		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2025/2026
Education level	first-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	4	Language of instruction	Polish
Semester of study	7	ECTS credits	5.0
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	prof. dr hab. inż. Jacek Stefański	
	Teachers	prof. dr hab. inż. Jacek Stefański	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	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	5.0	60.0	125

Subject objectives

To familiarize students with selected types of digital modulation used in radio communication systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W34] Knows the characteristics of telecommunications channels, methods of securing information, modulation systems, methods of access to the channel.	The student knows the modulation techniques in modern radiocommunication systems with particular emphasis on block diagrams of selected modulators as well as demodulators and digital detectors. He knows the criteria for assessing the quality of transmission in digital systems and is able to explain which system parameters and how they affect the quality of transmission.	[SW1] Assessment of factual knowledge
[K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications	During laboratory exercises, students experimentally verify some of the issues presented in the lecture.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

1. Role of modulation and encoding in radiocommunication system 2. Digital passband transmission. 3. Multilevel modulation techniques MPSK. Signal constellation. 4. Signal envelope, bandwidth, and spectrum efficiency for phase keying modulation. 5. Multilevel modulation techniques: QPSK, OQPSK and Pi/4 DQPSK. 6. Reception of phase keying signals. 7. Noise characteristics for received signals with phase keying: bit and symbol error rate. 8. Phase and amplitude keying system. QAM signal constellation. Es/No ratio. 9. Block diagrams of QAM modulator and demodulator. 10. Minimum frequency keying modulation MSK features and applications. 11. Minimum frequency keying with Gaussian filter GMSK. 12. Intersymbol interference of GMSK signals. Parameters selection of pre-modulation filter. 13. Reception of GMSK signals. 14. Bit error rate as a function of BT for GMSK modulation. 15. Spectrum compactness of continuous phase signals. 16. Trellis coded modulation TCM and BCM. 17. Advantages of trellis coded modulation. 18. Principle of TCM modulation, mapping of coding sequences into the modulation symbols. 19. Free distance and Hamming distance. 20. Asymptotic coding gain (ACG). 21. TCM signals decoding. Calculation of a free distance. 22. Examples of signal constellation, selection of a convolutional code and ACG evaluation for TCM modulations. 23. The target of multi-carrier radiocommunication systems. 24. Selection of distance between sub-carriers. 25. Orthogonal frequency division multiplexing (OFDM). 26. Properties of OFDM signals in the radio fading channel. 27. Application of OFDM in the DAB system. 28. Application of OFDM in the DVB and DRM systems. 29. Role of a protective distance and its selection. 30. Example of a transceiver for OFDM system.

<table>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
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<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Written exam</td><td>50.0%</td><td>70.0%</td></tr>
<tr><td>Practical exercise</td><td>50.0%</td><td>30.0%</td></tr>
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</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Wilson S., Digital Modulation and Coding, Prentice Hall, 2000. 2. Knoch L., Ekiert T., Modulacja i detekcja, WKŁ, 1979</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>No issues / questions.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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