GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Radiotransmission methods in biomedical applications, PG_00053370		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2024/2025
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	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Sławomir Ambroziak	
	Teachers	dr hab. inż. Sławomir Ambroziak	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	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	41.0	75

Subject objectives

The aim of the course is to familiarize students with issues related to radiocommunication systems and networks in terms of possible applications in biomedicine.

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.	Student knows and deeply understands the structure and principles of operation of radiocommunication systems and networks for biomedical applications.	[SW1] Assessment of factual knowledge
[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	Student knows and deeply understands the methods of designing of radiocommunication networks for biomedical applications.	[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	Student is able to design, build and configure a radiocommunication network for medical data transmission in accordance with valid standards and with the use of appropriate engineering methods.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment

Subject contents

Lecture scope:

1. Basic notions in telecommunications (telecommunications, information, sources of information, signal, telecommunication service, telecommunication system, telecommunication channel, telecommunication network).
2. Analog signals description in time and frequency domain; logarithmic measures of signal level.
3. Transmission media and their parameters; baseband and band-pass signals transmission.
4. Basic notions in radio communications (radio link, radio wave propagation, link equation, radio frequency bands, free space propagation, basic radio waves propagation mechanisms, role of the antenna in radio communication system and its parameters).
5. Radio communication networks operating within and in the immediate vicinity of the human body (BAN definition, classification, frequency bands)
6. Electrical properties of the human body.
7. Selected issues of the lower layers of the OSI model in BAN (narrowband modulations used, ultra-wideband techniques, channel coding).
8. Antenna issues in BAN (miniaturized antennas, implantable antennas, wearable antennas, examples of antenna solutions).
9. Radio channel in various types of BAN networks (characteristics of radio channel, empirical and simulation methods of radio channel modelling, overview of radio channels).
10. BAN power sources.
11. Human safety aspects (SAR definition, methods of its analysis and assessment).
12. Issues of data security in BAN networks.
13. Assessment of the quality of BAN network operation of various types (bit error rate, radio link budget, coverage issues).
14. Legal and standardization conditions (regulations regarding UWB, ISM, MICS, WMTS, LP-AMI, SRD, standards that can be used in BAN networks: IEEE 802.11, IEEE 802.15.1, IEEE 802.15.4, IEEE 802.15.6).

Laboratory scope:

1. Basics of analog modulation and demodulation (Matlab, Python).
2. Digital modulation and demodulation systems.
3. Configuration and operation of the mesh network in the ZigBee standard.
4. Configuration and operation of communication in Bluetooth and BLE (with a focus on medical data).
5. Transmission of medical data over WiFi networks.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture	50.0%	60.0%
Laboratory	50.0%	40.0%

Recommended reading

Basic literature

1. S.J. Ambroziak, "Kanał radiowy w sieciach WBAN", WKŁ, 2020.
2. IEEE 802.15.6-2012, *IEEE Standard for Local and Metropolitan Area Networks - Part 15.6: Wireless Body Area Networks*, 2012.
3. Wang J., Wang Q., *Body Area Communications: Channel Modeling, Communication Systems, and EMC*, Wiley, 2013.
4. Li H.-B., Yazdandoost K.Y., Zhen B., *Wireless Body Area Network*, River Publishers, 2010.
5. Gupta S.K.S., Mukherjee T., Venkatasubramanian K.K., *Body Area Networks Safety, Security, and Sustainability*, Cambridge University Press, 2013.

Supplementary literature

1. Hall P.S., Hao Y., *Antennas and Propagation for Body-Centric Wireless Communications - Second Edition*, Artech House, USA, 2012.
2. Gabriel C., Compilation of the Dielectric Properties of Body Tissues at RF and Microwave Frequencies, *Brooks Air Force Technical Report*, 1996.
3. Molisch A.F., *Wireless Communications Second Edition*, Wiley, 2011.
4. Yazdandoost K.Y., Sayrafian K., *Channel Model for Body Area Network (BAN),* IEEE P802.15-08-0780-09-0006, 2009.
5. Yuce M.R., Khan J.Y., *Wireless Body Area Networks Technology, Implemetation, and Applications*, Pan Stanford Publishing, 2012.
6. Zimmermann T., Personal Area Networks: Near-Field Intrabody Communications, *IBM System Journal*, tom 35, nr 3&4, str. 609-617, 1996.

eResources addresses

Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed

Will be given during the lecture.

Work placement

Not applicable