GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Radiotransmission methods in biomedical applications, PG_00068812		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Optional subject group Specialty 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	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Sławomir Ambroziak	
	Teachers	dr hab. inż. Sławomir Ambroziak	

Lesson types

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	3.0	17.0	50

Subject objectives

The aim of the course is to familiarize students with basics of telecommunications and radiocommunications in terms of possible applications of selected radiocommunication systems and networks 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_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
[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	The student knows and deeply understands the basic processes occurring in the life cycle of elements of radiocommunication systems and networks for biomedical applications and the methods of supporting the relevant processes and functions.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture Lecture scope: 1. Basics of telecommunications. 2. Basics of signal processing in telecommunications. 3. Basics of wireless technology. 4. The human body and its characteristics in terms of interaction with an external electromagnetic field. 5. Exposure of the human body to radio radiation and its safety. 6. Wireless Body Area Networks (BAN). 7. Power supply for BAN networks. 8. Methods of radio transmission in BAN networks. 9. Types of antennas used in BAN networks. 10. Modeling radio channels in BAN networks. 11. Analysis of the impact of radio channel characteristics on the quality of BAN network operation. 12. Cybersecurity of BAN networks as cyberphysical systems. 13. Basics of nanocommunication. 14. Applications of BAN networks. 15. Analysis of current legal regulations and standards. 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. 1. Basics of telecommunications. 2. Basics of signal processing in telecommunications. 3. Basics of wireless technology. 4. The human body and its characteristics in terms of interaction with an external electromagnetic field. 5. Exposure of the human body to radio radiation and its safety. 6. Wireless Body Area Networks (BAN). 7. Power supply for radio BAN networks. 8. Methods of radio transmission in BAN networks. 9. Types of antennas used in BAN networks. 10. Modeling radio channels in BAN networks. 11. Analysis of the impact of radio channel characteristics on the quality of BAN network operation. 12. Cybersecurity of BAN networks as cyberphysical systems. 13. Basics of nanocommunication. 14. Applications of BAN networks. 15. Analysis of current legal regulations and standards.

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<tr><td>Prerequisites and co-requisites</td><td colspan="2"></td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lecture</td><td>50.0%</td><td>60.0%</td></tr>
<tr><td>Laboratory</td><td>50.0%</td><td>40.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>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.</td></tr>
<tr><td>Supplementary literature</td><td>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.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Will be given during the lecture.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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