



## Subject card

Subject name and code	BAN Radio Networks, PG_00048144						
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				1.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Department of Radiocommunication Systems and Networks -> 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	0.0	0.0	0.0	15
	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	15	1.0		9.0		25
Subject objectives	Familiarization with radio networks operating within and in the immediate vicinity of the human body (WBAN - Wireless Body Area Networks), their parameters and properties taking into account the impact of the human body, as well as basic applications.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_K02] is ready to critically assess possessed knowledge and acknowledge the importance of knowledge in solving cognitive and practical problems	The student is ready to critically assess the knowledge in the field of Wireless Body Area Networks and recognizes its importance in solving problems related to existing and potential applications of these networks.			[SK5] Assessment of ability to solve problems that arise in practice [SK4] Assessment of communication skills, including language correctness		
	[K6_W03] Knows and understands, to an advanced 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 and understands at an advanced level the structure and principles of operation of particular components of the Wireless Body Area Networks.			[SW1] Assessment of factual knowledge		
	[K6_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment	The student is able to make a critical analysis and assessment of the Wireless Body Area Networks and their functioning.			[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		
	[K6_U31] can identify telecommunications network architectures, differentiates their areas and functional elements, evaluates the quality of service delivery, calculates parameters of functional elements	The student is able to identify and distinguish the functional areas of the Wireless Body Area Networks, as well as to assess the quality of services in these networks based on functional parameters.			[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		

Subject contents	<ol style="list-style-type: none"> <li>1. Radio networks operating within and in the immediate vicinity of the human body (Wireless Body Area Networks - WBAN) - definition, classification, frequency bands.</li> <li>2. Radio channel in various types of WBAN networks.</li> <li>3. Physical layer solutions - narrowband modulations used, ultra-wideband techniques, channel coding and demodulation.</li> <li>4. Mechanisms of radio wave propagation inside and on the surface of the human body.</li> <li>5. Antenna issues - miniaturized antennas, implantable antennas, antenna antennas, examples of antenna solutions.</li> <li>6. WBAN power sources.</li> <li>7. Assessment of the quality of WBAN network operation of various types - bit error rate, radio link balance, coverage issues.</li> <li>8. Issues of data security in WBAN networks.</li> <li>9. Human safety aspects - definition of the absorption coefficient (SAR), methods of its analysis and assessment.</li> <li>10. Legal conditions in the world - regulations on ultra-wideband signals (UWB) and ISM bands, frequency bands for medical applications, short-range devices.</li> <li>11. WBAN standardization.</li> <li>12. WBAN networks in medical applications.</li> <li>13. WBAN networks in military applications.</li> <li>14. WBAN networks in civil applications.</li> <li>15. WBAN development trends.</li> </ol>								
Prerequisites and co-requisites									
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Subject passing criteria</th> <th style="width: 33%;">Passing threshold</th> <th style="width: 33%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Final test</td> <td>50.0%</td> <td>100.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Final test	50.0%	100.0%
Subject passing criteria	Passing threshold	Percentage of the final grade							
Final test	50.0%	100.0%							
Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. J. Wang, Q. Wang, „Body area communications”, Wiley, 2013.</li> <li>2. H.-B. Li, K.Y. Yazdandoost, B. Zhen, „Wireless Body Area Network”, River Publishers, 2010.</li> <li>3. G.-Z. Yang, „Body Sensor Networks”, Springer, 2006.</li> <li>4. IEEE, "IEEE standard for local and metropolitan area networks part 15.6: Wireless body area networks", IEEE Std 802.15.6-2012, February 2012.</li> <li>5. R. Cavallari, F. Martelli, R. Rosini, C. Buratti, R. Verdone, „A Survey on Wireless Body Area Networks: Technologies and Design Challenges”, IEEE Communications Surveys &amp; Tutorials, Vol. 16, No. 3, 2014.</li> <li>6. Ambroziak S., "Radiowe sieci BAN", Przegląd Telekomunikacyjny i Wiadomości Telekomunikacyjne, Nr 2-3, ISSN: 1230-3496, Warszawa 2017, s. 36-50.</li> </ol>							
	Supplementary literature	<ol style="list-style-type: none"> <li>1. S.J. Ambroziak, L.M. Correia, R.J. Katulski, M. Mackowiak, C. Oliveira, J. Sadowski, K. Turbic, „Off-Body Channel Model for Body Area Networks”, IEEE Transactions on Antennas and Propagation, Vol. 64, No. 9, pp. 4022 - 4035, Sept. 2016.</li> <li>2. Ambroziak S.J., "Measurement stand and methodology for research of the off-body and body-to-body radio channels in WBANs with different diversity schemes", International Journal of Antennas and Propagation, vol. 2019, Article ID 3837190.</li> <li>3. K.Y. Yazdandoost, K. Sayrafian, „Channel Model for Body Area Network (BAN)”, IEEE P802.15-08-0780-09-0006, 2009.</li> </ol>							
	eResources addresses								
Example issues/ example questions/ tasks being completed	Issues in line with the topic of the lecture.								
Work placement	Not applicable								