COURSE DESCRIPTION CARD - SYLLABUS

Course name
Wireless Local Area Networks [S1MiKC1>BSL]

Course

Field of study
Microelectronics and digital communications

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student is familiar with the basics of radiocommunication, signal propagation through different transmission channels, and should possess basic programming skills, as well as the ability to gather information from specified sources.

Course objective

The aim of the course is to provide students with the knowledge and skills necessary to consciously use, evaluate, compare, and choose modern wireless networks currently available on the market and/or in the standardization phase.

Course-related learning outcomes

Knowledge:
The student possesses knowledge of WLAN network standards, including IEEE 802.11a/b/g/n/ac/ax, and understands their operational principles.
They have an understanding of radio transmission mechanisms, modulation, electromagnetic wave propagation, and how interference impacts signal quality.
The student is knowledgeable about methods for configuring and managing WLAN networks, including

channel selection, security, and integration with wired networks.
They are also familiar with technologies related to Quality of Service (QoS) and traffic management, which allow for efficient use of network resources.
Additionally, the student is aware of current trends in wireless technology development.

Skills:
The student should have the ability to design and configure WLAN networks in accordance with the current IEEE 802.11 standards. They should be able to analyze and diagnose network issues using monitoring and testing tools such as Wireshark. An important skill is optimizing network parameters such as channels, signal strength, and QoS mechanisms to ensure high performance and stability. The student should also be capable of integrating WLAN networks with wired infrastructure and applying access control, authentication, and traffic management mechanisms. Additionally, the ability to interpret technical documentation and adapt the network to changing environmental conditions and user requirements is essential.

Social competences:
The student should be able to effectively collaborate in a team when designing and maintaining network infrastructure. The ability to clearly communicate technical issues and educate users on the use of WLAN networks is also important. Additionally, a key aspect is the awareness of security and an ethical approach to network management to ensure data protection and compliance with regulations.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is assessed through a written exam, typically consisting of several open-ended questions (usually five) selected from a provided list of topics, with varying point values. The passing threshold is set at 51% of the total points.
The skills gained in laboratory classes are evaluated based on completed exercises, tasks, and mini-projects. A minimum of 50% of the maximum points must be obtained, or at least half of the assigned exercises must be completed.
The project is also assessed based on achieving at least 50% of the possible points.
Grading scale: <50% - 2.0 (fail); 50% to 59% - 3.0 (satisfactory); 60% to 69% - 3.5 (fairly good); 70% to 79% - 4.0 (good); 80% to 89% - 4.5 (very good); 90% to 100% - 5.0 (excellent).

Programme content

The course covers topics related to wireless local area networks (WLAN): technologies, standards, and protocols, such as IEEE 802.11 (Wi-Fi), enabling wireless communication in computer networks. Key topics include WLAN network topologies, such as infrastructure, ad-hoc, and Mesh modes, as well as methods for ensuring Quality of Service (QoS) and performance optimization. An important element is the integration of WLAN with wired infrastructure, bandwidth management, and interference avoidance. Network diagnostics and monitoring are carried out using traffic analysis tools such as Wireshark and NetSpot. The future of WLAN includes the development of Wi-Fi 6/7 standards, the use of artificial intelligence for network management, and integration with IoT and 6G technologies.
In the project, students carry out tasks based on selected software. They assess and analyze selected parameters.
In the laboratory, students follow instructions and perform practical exercises using the available equipment.

Course topics

Lecture:
1. Wireless Network WiFi according to IEEE 802.11 standards (including a, b, g, p, s, n, ac, e, ad, ax, be), with a focus on the physical layer (OFDM modulation), data link layer, network layer, as well as security, interference management, etc. History and development of WLAN technology. (2h)
2. Topologies and Architectures of Wireless Networks. Building the data link layer. (2h)
3. Design Principles for WLAN Networks. Optimization of channel settings, bandwidth, and transmission power. (2h)
4. Implementing QoS principles in WLAN networks. Construction of different frame types in WLAN systems. (2h)

5. Issues in WLAN transmission. Monitoring and diagnosing WLAN networks. (2h)
6. The Future of Wireless Networks. AI and ML in Wi-Fi network management. (2h)
7. Security in Wireless 802.11 Systems. (3h)
Project: As part of the project, students must analyze selected aspects of the operation of wireless local area networks using chosen software.
Expected project results: Documentation containing: project assumptions and adopted technical solutions, system architecture diagrams, parameter analysis, tests, and conducted test scenarios.
Laboratory: Perform tasks given by the instructor and described in laboratory instructions.
1. Wi-Fi network configuration and optimization. (1h)
2. Analysis of Wi-Fi range and signal quality. (2h)
3. Traffic management in wireless networks. (2h)
4. Integration of Wi-Fi with wired networks. (2h)
5. Cooperation of different wireless network standards. (2h)
6. Application of MU-MIMO and Beamforming technologies. (2h)
7. Experiments with ad-hoc and mesh networks. (2h)
8. Security of wireless local area networks. (2h)

Teaching methods

1. Lecture: Multimedia presentation illustrated with examples.
2. Project: Completing tasks assigned by the instructor - practical exercises, teamwork, using software and simulation environments.
3. Laboratory Exercises: Completing tasks provided by the instructor and described in laboratory instructions - practical exercises using available laboratory equipment. Laboratories can be supplemented with multimedia presentations or examples provided on the board.

Bibliography

Basic:
1. Selected fragments of wireless networking standards available in the IEEE digital library.
2. Journal and Internet articles provided/indicated by the instructor.
3. Gast, M. (2013). 802.11ac: A Survival Guide. O'Reilly Media.
4. Ohrtman, F., & Roeder, K. (2003). Wi-Fi Handbook: Building 802.11b Wireless Networks. McGraw-Hill.
5. Perahia, E., & Stacey, R. (2013). Next Generation Wireless LANs: 802.11n and 802.11ac. Cambridge University Press.
6. Mishra, A. (2004). Security and Quality of Service in Ad Hoc Wireless Networks. Cambridge University Press.

Additional:
1. Any manual on Wi Fi networking (802.11) available in Polish or English.
2. Peterson, L. L., & Davie, B. S. (2021). Computer Networks: A Systems Approach. Morgan Kaufmann.
3. Scarfone, K., & Padgette, J. (2012). Guide to Enterprise Wireless Network Security (NIST SP 800-153). National Institute of Standards and Technology (NIST).
4. Cisco Systems. (2021). Wireless LAN Fundamentals. Cisco Press.

Breakdown of average student's workload

	Hours	ECTS
Total workload	85	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50