GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Industrial Computer Networks, PG_00038099		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	4	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Jarosław Tarnawski	
	Teachers	dr inż. Jarosław Tarnawski mgr inż. Kajetan Zielonacki mgr inż. Tomasz Ujazdowski	

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	2.0	18.0	50

Subject objectives	The aim of the course is to make students aware of the importance of communication in automation systems and to provide students with knowledge on the construction of industrial computer networks. During the course, the student will acquire knowledge on the nature of communication devices in industrial conditions and the requirements for industrial devices. The student will understand the importance of real-time network equipment and will become familiar with the mechanisms of access to the link. The student will learn about redundant mechanisms for improving the reliability of industrial networks. The student will learn about networks based on RS232, RS485, Ethernet and the Modbus protocol. The student will use industrial implementations of Profibus, Profinet, EGD Ethernet, and OPC UA technologies. The student will acquire practical skills in configuring and using wired and wireless communication. The student will have skills in securing computer networks against unauthorized access. The student will implement an industrial computer network for the control system.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_K02] can work in a group taking on different roles in it	Teamwork, information exchange and necessary coordination of device addresses or messages to communicate several devices and connect a distributed control system.	[SK2] Assessment of progress of work
[K6_W09] has knowledge in the field of security of ICT systems and networks	Implementation of security issues in industrial communication networks.	[SW1] Assessment of factual knowledge
[K6_W06] knows the structure of computers and microprocessors and the tasks of operating systems, has basic knowledge of the basics of computer software, drivers, microprocessor technology, design of simple algorithms and the operation of information networks	Knowledge of individual elements of the control system, implementation of communication via computer networks, communication protocols and the OPC data exchange standard.	[SW1] Assessment of factual knowledge
[K6_U05] can use analytical and simulation methods to solve tasks in the field of automation and robotics and use various techniques to carry out engineering tasks related to automation and robotics devices and systems	Implementation of the information exchange flow for the synthesis of the control system	[SU1] Assessment of task fulfilment

Subject contents

LECTURE

Information structure of the automation system. The role of communication in automation issues. Requirements for industrial networks. Basic concepts related to local and field industrial networks. Data transmission media: copper cables (pairs of wires, coaxial cable, twisted cables), optical fiber, radio waves. Serial communication and its applications (RS232, RS422, RS485). Routers and managed industrial switches as the basis for the construction of industrial networks. Network topologies (bus, ring, star, tree, mesh) with connection redundancy taken into account. Bus access mechanisms. Time determinism of the network as an important element of applications to automation issues. Ethernet as a natively non-industrial network and mechanisms of its industrialization. Profibus as an industrial network standard operating in real-time systems. CAN, EiB and LonWorks networks as industrial networks for universal applications that have a typical purpose. Wireless communication radio modems, WiFi networks, Bluetooth, ZigBee. Communication protocols. Modbus as a standard protocol in industrial automation applications. OPC as a modern, unified method of data exchange for automation devices. Tunneling of protocols and networks. Virtual private networks VPN. Network security methods of hardware and software protection of industrial networks.

LABORATORY

RS232, RS422, RS485 communication, MODBUS protocol using PLC and laboratory objects, PROFIBUS networks, ETHETNET EGD network, Implementation of a control system using the OPC UA standard, Providing access to the control system using wireless devices

Prerequisites and co-requisites

Computer Networks and Internet Technologies

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Practical exercise	50.0%	50.0%
Colloquium	50.0%	50.0%

Recommended reading

Basic literature	Oluyinka Oni, Design Of Industrial Communication Systems: How to design systems for improvement in performance, interoperability and cost optimization, LAP Lambert Academic Publishing, 2014 Bogdan M. Wilamowski, J. David Irwin, Industrial Communication Systems, CRC Press, 2011 Douglas E. Comer, Computer Networks and Internets with Internet Applications, Pearson, 2003 Andrew Tanenbaum, Nick Feamster, David Wetherall, Computer Networks, Pearson, 2021
Supplementary literature	Hamed a Idowu Pmp, Industrial Communication Networks, Createspace Independent Publishing Platform, 2017

	eResources addresses	Adresy na platformie eNauczanie: PRZEMYSŁOWE SIECI INFORMATYCZNE [ARiSS][2024/25] - Moodle ID: 43332 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=43332
Example issues/ example questions/ tasks being completed	1 Make a comparison of communication interfaces RS232C and RS485. 2 Characterize the types and features of Profibus network. 3 Specify industrial version of Ethernet 4 Specify the types and characteristics of OPC communication technology. 5 List and describe the mechanisms for protection against transmission errors in the CAN network. 6 Describe the wireless communication technologies, depending on the range. 7 Describe data exchange model (with figures of frames) in the MODBUS protocol.	
Work placement	Not applicable	

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