GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Buses and Communication Protocols, PG_00067983		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Metrology and Electronic Systems Department -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Grzegorz Lentka	
	Teachers	dr hab. inż. Grzegorz Lentka	

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

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=5455

Moodle ID: 5455 Magistrale i protokoły komunikacji https://enauczanie.pg.edu.pl/2025/course/view.php?id=5455

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

Getting familar with categories and topologies of intefaces, inteface model based on interface and device functions. Description of the examples of popular interfaces. Pratice with configuring, programming and diagnostics of the common interfaces.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	Based on an analysis of requirements—including transmission speed, bandwidth, reliability, power consumption, and interference resistance—the engineer selects the appropriate interface type and transmission protocol, and then configures and tests it.	[SU4] Assessment of ability to use methods and tools
[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	Classifies interface systems into bus, star, and ring topologies and describes their characteristics. Interprets an interface model based on the concept of interface functions and messages, as well as device functions and messages. Explains the generalized asynchronous transmission negotiation protocol (handshake). Lists the basic parameters and applications of example interfaces and communication protocols.	[SW1] Assessment of factual knowledge
[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study	Organizes the system based on selected interfaces. Integrates the hardware layer and selects drivers and protocols. Applies methods and devices for interface and protocol conversion.	[SU4] Assessment of ability to use methods and tools

Subject contents

Course content – lecture

Characteristics of electronic systems and the role of the interface within the system; paradigms of electronic systems: modularity, hierarchy, structurality, and communication compatibility.
The importance of interfaces and communication protocols in automation and embedded systems.
Interface topologies and their properties: star, ring, and bus.
Classifications and properties of transmission types: bit-serial and bit-parallel, synchronous and asynchronous, etc.
An interface model based on the concept of interface functions and messages, as well as device functions and messages.
Layered interface model: physical layer, data link layer, protocol layer, application layer.
Generalized asynchronous transmission negotiation protocol (handshake).
Interaction of the hardware interface with software layers.
RS-class interfaces application in system development and diagnostics.
CAN interface node model, physical layer, CSMA/CD collision-free arbitration, basic and extended frames, broadcast communication, error detection and control.
Modbus protocol: RTU and ASCII modes, RS485 and TCP/IP physical layer implementations, data types and mapping, and Modbus functions, error handling.
Profinet: client-server structure, support for real-time (RT) and ultra-low-latency (IRT) communication;
Profinet topologies: point-to-point, star, line, switch- and router-based networks.
Zigbee: architecture and device types, power consumption minimization, scalability.

Course content – laboratory

Frame analysis and testing of the RS-485 interface.
Configuration and analysis of CAN frames.
RS-485-based Modbus protocol hardware and software implementation of slave and master devices.
Modbus over TCP/IP configuration and mapping.
Investigation of the impact of Zigbee network configuration and topology on throughput and latency.
Profinet: investigation of the impact of configuration on latency.

Prerequisites and co-requisites

No requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lab exercises	60.0%	30.0%
Activity (eNauczanie tasks)	0.0%	10.0%
Test during semster	50.0%	60.0%

Recommended reading

Basic literature	1. J. Bogusz: Lokalne interfejsy szeregowe w systemach cyfrowych, BTC 2004 2. W. Mielczarek: Szeregowe interfejsy cyfrowe, Helion 1994 3. W. Mielczarek: USB uniwersalny interfejs szeregowy, Helion 2005 4. W. Nawrocki: Komputerowe systemy pomiarowe, WKiŁ 2006
Supplementary literature	1. P. Metzger: Anatomia PC 2. NXP: UM10204: I2C-bus specification and user manual, 2014 3. Analog Devices: Introduction to SPI Interface, Analogue Dialog 2018
eResources addresses	

Example issues/ example questions/ tasks being completed	Describe the RS frame. Explain the differences between RS-232 and RS-485. CAN frame. Explain what lossless arbitration is. Discuss error control in CAN. Zigbee configurations. Discuss the impact of multihop communication on transmission delays.
Practical activites within the subject	Not applicable

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