GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Embedded Systems & IoT, PG_00068196						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2029/2030			
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	3.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Tomasz Stefański					
	Teachers	dr hab. inż. Tomasz Stefański					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	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	45		3.0	27.0	75	
Subject objectives	To present students with modern embedded systems used in automation and robotics, especially in the area of IoT.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] can design, according to required specifications, and make a simple 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	The student is able to design simple embedded systems	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[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 the structure of embedded systems, especially IoT	[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	The student is able to program embedded systems	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[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	The student understands the principles of designing embedded systems, especially IoT	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
1. Origin of embedded systems as engineering based on computer science and automation.
2. Hardware and functional structure of computer control systems (CSC), classification and characterization of basic structures, hardware requirements for interrupts, memory and I/O channels.
3. Computers, microcontrollers and FPGA systems.
4. ARM processor family. Multiple-Processor System on Chip (MPSoC).
5. Support for peripheral devices.
6. Embedded system software on the example of ARM processors.
7. Operating systems used in embedded systems.
8. IoT systems.
9. Definition and role of edge computing in IoT systems, benefits of processing at the edge of the network: reduced latency, bandwidth savings, data privacy, etc.
10. Examples of edge devices: Raspberry Pi, ESP32, Nvidia Jetson Nano.
11. Processing hierarchy: edge, fog, and cloud.
12. Designing multi-stage tasks: pre-analysis on the edge device, intermediate processing in the fog layer, advanced analytics in the cloud.
13. Examples of task division: pre-analysis of images (edge), data aggregation (fog), AI modeling (cloud).
14. Optimizing energy consumption in IoT devices.
15. Optimizing code and algorithms for resource-constrained systems (e.g. TinyML).

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Final test	50.0%	40.0%
Project assignments	50.0%	60.0%

Recommended reading

Basic literature	1. Dorf R.C., Bishop R.H. Modern control systems, Addison Wesley, 1995 2. Marwedel P., Embedded System Design, Kluwer Academic Publishers, Boston 2003, ISBN 1-4020-7690-8 3. Olsson G., Piani G., Computer systems in automation, Prentice-Hall, Londyn New York 1992 4. Ting-pat So A., Intelligent building systems, Kluwer Academic Publ., Boston London 1999
Supplementary literature	No requirements

	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Real-time sound filtration system on the evaluation board. 2. LED control. 3. Control of the liquid crystal display.	
Practical activites within the subject	Not applicable	

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