GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Architecture of Real-Time Systems, PG_00048805		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	Optional subject group Specialty 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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Signals and Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Iwona Kochańska	
	Teachers	dr hab. inż. Iwona Kochańska dr inż. Jan Schmidt mgr inż. Mariusz Rudnicki	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	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	4.0	16.0	50

Subject objectives	Lecture introduces students with the architecture of multi-processor and multi-computer systems and with the process of manufacture and testing of software performing the RTS required functions.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W04] knows and understands, to an increased extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or other elements or programmable devices specific to the field of study, and organization of work of systems using computers or such devices	The student knows and understands at an advanced level the principles, methods and techniques of programming dedicated microprocessor systems	[SW1] Assessment of factual knowledge
	[K7_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 advanced 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 of the functioning of existing solutions dedicated to microprocessor systems	[SU2] Assessment of ability to analyse information
	[K7_W03] knows and understands, to an increased 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 in depth the structure and operation of dedicated microprocessor systems	[SW1] Assessment of factual knowledge
	[K7_U03] can design, according to required specifications, and make a complex 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, according to the given specification, the embedded system based on a dedicated microprocessor system	[SU1] Assessment of task fulfilment

Subject contents

Course content – lecture
1. Interfacing computer system and object. Simple interface and with reciprocal acknowledgement, idea of transfer acknowledgement algorithm.
2. Mono- and multi-level interruption systems, algorithms of interruption arbitration, masking problems, special masking, typical solutions. Evaluation of influence of reaction time, delays, execution time and interruptions intensity on computer efficiency.
3. Multiprocessor and multi-computer systems. Architecture, conditions for increase of efficiency compared to mono- processor systems.
4. Buses of multiprocessor systems. Resources partition for local and common ones, consequences of working with common resources.
5. Typical solutions of multiprocessor control systems buses: STE, MULTIBUS, VME, PCI, COMPACT PCI. Arbitration of access to common resources.
6. Influence of common resources on system software, semaphores, access interlocks.
7. Multi-computer systems, principles of information interchange, possible hardware solutions, architecture of multi-computer systems.
8. Buses in distributed systems. Bus as a communication system between multiple users, communica-tions protocol, layer hierarchy of communications protocols. ISO 4- and 7-layers reference model of communications protocol.
9. Hardware and software techniques for increasing the reliability of communications links, types and selection criteria of data transmission medium, operations carry out on signal related to adaptation to trans-mission medium, equipment – line transmitters and receivers. Tech-niques of error detection and correction.
10. Microcontrollers – architecture, resources, languages and programming methods.
11. Realizations of microcontroller interface with object, construction of real time gate, hardware support of context change.
12. Maintenance-free systems, methods of increasing reliability of maintenance-free systems, techniques ensuring energy economy of autonomous systems.
13. Techniques of interfacing computer systems with continuous working systems. A/D and D/A converters, criteria of selecting type of converter to solved problems, sample-and-hold devices and extrapolators, systems with PWM output, voltage – frequency converters.
14. Signal processors. Signal processors, their architecture and resources.
15. Languages and specificity of creating software for signal processors.
16. Applications of signal processors.
17. PC class computers in dedicated systems. PC class computers in measurement systems, industrial standards of PC computers, modular solutions.
18. Creating graphical user interface (GUI).
19. PC cards with signal processors, rules of cooperation.
20. System software for real time applications. Construction of multipurpose real-time operating system, static and dynamic description of the task, mechanisms of task creation, removal and switching, interruption system vs. switch over system.
21. Examples of typical operating systems in computers systems: DOS, WINDOWS, LINUX, QNX – their advantages and disadvantages.
22. Creating software for real time of system. Fundamentals of creating software for dedicating systems.
23. Problems of creating multi-plot software, concurrency of processes, rules of access to common resources, interlock systems and interlock management.
24. Problem of correct realizing concurrent tasks, criteria of tasks schedul-ing, examples of algorithms for checking tasks scheduling.
25. Examples of applications. Multi-computer systems of traffic monitoring in three-dimensional space – echolocation systems.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Project	60.0%	50.0%
Written exam	60.0%	50.0%

Recommended reading

Basic literature

1. A. Pyrchla, B. Danowski, „BIOS. Przewodnik”, Helion 2007
2. A. S. Tanenbaum, „Strukturalna organizacja systemów komputerowych”, Helion 2006
3. M. Szafarczyk, D. Śmigulska-Grądzka, R. Wypysiński „Podstawy układów sterowań cyfrowych i komputerowych” PWN 2007 Metzger P. "Anatomia PC", HELION, 2008.
4. N. Noam, S. Shimon „Elementy systemów komputerowych. Budowa nowoczesnego komputera od podstaw.”, WNT 2008 W. Stallings, „Organizacja i architektura systemu komputerowego”, WNT 2003
5. E. Berger, M. Corner, "Computer Systems Principles", 2009-2010
6. A.P. Godse, "Computer Organisation", Technical Publications Pune, 2009

Supplementary literature: S. Pllana, F. Xhafa, "Programming Multi-Core and Many-Core Computing Systems", Wiley-Blackwell, 2014

eResources addresses:

Example issues/ example questions/ tasks being completed

Practical activites within the subject	Not applicable

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