GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Concurrent programming and real time systems, PG_00064786		
Field of study	Mechatronics		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Signals and Systems -> Faculty of Electronics Telecommunications and Informatics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Iwona Kochańska	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	15.0	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	8.0	22.0	75

Subject objectives

The aim of the course is to familiarize the student with the techniques of programming the real-time systems and issues related to software development in multi-process and multi-thread systems. Students learn about the mechanisms of resource sharing in real-time systems the specificity of programming systems based on computers of industrial standards VMEBus, cPCI, PC104, PC104-PLUS.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K11] is aware of importance of professional acting, the need for critical verification of acquired knowledge and consulting experts opinion in case of facing difficulties with individual problem solving	The student knows the standards of programming real-time systems and understands the need to comply with them.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	The student is able to use at an intermediate level programming techniques of multiprocess and multithreaded real-time systems	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K7_W04] demonstrates knowledge encompassing selected issues in the field of detailed knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Mechatronics	The student knows the basic architectures of embedded systems, especially multiprocessor systems, and understands the basic problems associated with the software of such systems and ways to solve them.	[SW1] Assessment of factual knowledge
[K7_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of study	The student knows the techniques of concurrent programming of embedded systems working with different operating systems, especially real-time systems.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

<table>
<tr><td>Subject contents</td><td>1. Review of real-time operating systems
2. Concepts and elements of real-time systems
3. Kernel and its environment in RT operating systems
4. Process manager, resource manager, namespace management
5. Memory management in RT systems.
6. Processes and threads.
7. Thread scheduling in RT systems.
8. Thread synchronization methods in RT systems.
9. Implementation of thread and process support in POSIX standard
10. Implementation of thread support in the C ++ 11 language standard
11. Basic problems of concurrent programming and ways of solving them</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basics of programming in C or C ++</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td></td><td>50.0%</td><td>50.0%</td></tr>
<tr><td></td><td>50.0%</td><td>50.0%</td></tr>
</table>
</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. M. Ben-Ari, Principles of Concurrent and Distributed Programming, Addison Wessley, 2005
2. Andrew S. Tanenbaum, Herbert Bos, Modern Operating Systems (4th Edition), Pearson Prentice Hall, 2016</td></tr>
<tr><td>Supplementary literature</td><td>• R. Love, Linux system programming", O'Reilly Media, 2013
• J. Corbet, A. Rubini, G. Kroah-Hartman, Linux Device Drivers, Third Edition, OReilly</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table>
</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Describe rigorous real-time systems.
Describe the classical architecture of a real-time system.
Advantages and disadvantages of a microkernel operating system architecture.
What is priority inversion?
Explain the race condition.
Describe fork() and wait() functions in Linux.
Describe the basic mechanisms for synchronizing threads in a concurrent program.
Describe the basic problems of concurrent programming.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.