GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Real-Time Operating Systems, PG_00064538		
Field of study	Automatic Control, Cybernetics and Robotics		
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	English
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Automatic Control -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marcin Pazio	
	Teachers	dr inż. Marcin Pazio	

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

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

The aim of the course is to acquaint students with architecture of a real-time operating systems and mechanisms available to users/programmers in a RTOS environment.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	Student describes and knows how to assess the suitability of various mechanisms offered by operating systems to solve practical problems.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_U07] can apply advanced methods of process and function support, specific to the field of study	Student describes and knows how to put into practice the basic distributed computing technologies. Student describes and knows how to put into practice the basic techniques used in computer networks.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[K7_U08] while identifying and formulating engineering tasks specifications and solving these tasks, can: - apply analytical, simulation and experimental methods, - notice their systemic and non-technical aspects, - make a preliminary economic assessment of suggested solutions and engineering work	Student describes and knows how to apply the techniques in practice management computer system.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools

<table>
<tr><td>Subject contents</td><td>Course content – lecture
1. Introduction to operating systems. The development of operating systems. Microsoft Windows and Unix-based operating systems.
2. Processes. Definitions, description methods, method of process management.
3. Threads. Implementation of single and multi-processor with examples.
4. The kernel of the operating system. Concept of the microkernel . The tasks held by microkernel and threads management.
5. Concurrency problems and methods of solving them. Rules for synchronization and mutual exclusion. Semaphores and message passing techniques.
6. Imprisonment and deadlock. Methods of detection, avoidance and solving the problem of thread interaction. Examples of the actual system solutions.
7. Memory management. Mechanisms of memory management, software solutions and hardware support mechanisms.
8. Virtual Memory. Management methods. Examples of solutions.
9. Process scheduling in single-CPU systems. Examples of solutions.
10. Process scheduling in a multiprocessor system. Examples of solutions.
11. File management methods. Examples.
12. Resource management and input-output operations and storage. Examples.
13. Real time operating systems.
14. Distributed computing. Technologies, client / server. Clusters.
15. Computer networks. Security problems.

Course content – laboratory
1. Introduction to the BASH shell,
2. Examples of concurrency in Linux using BASH scripts,
3. Introduction to process management and interprocess communication,
4. Shared memory and semaphores,
5. The pthread library - threads and their synchronization,
6. Using basic scheduling algorithms,
7. Kernel-mode programming,
8. Basics of driver development in Linux.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>No requirements</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>Homework - simple computer program</td><td>80.0%</td><td>30.0%</td></tr>
<tr><td>Midterm colloquium</td><td>50.0%</td><td>70.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>Jędrzej Ułasiewicz "Systemy czasu rzeczywistego QNX6 NEUTRINO", Wydawnictwo btc, 2007.
William Stallings "Systemy operacyjne, struktura i zasady budowy", Wydawnictwo Naukowe PWN, 2006.
Krzysztof Stencel "Systemy operacyjne", Wydawnictwo PJWSTK, 2004.</td></tr>
<tr><td>Supplementary literature</td><td>J. W. S. Liu, Real time systems., Prentice Hall, 2000.
R. Williams, Real time systems development., BH/Elsevier 2006.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. What is the process and what is control block? Briefly discuss the states of process. What is the effect of the presence of virtual memory on a graph of the process?
2. What is the main differences between thread and process? What are the advantages of introducing multiple threads? What states can have thread in Linux?
3. Discuss briefly threads / processes synchronous, asynchronous / secondary. What are the main differences?
4. Discuss the three main structures of operating systems. What do you do and what are the advantages of microkernel?
5. Discuss the problems of concurrency. Briefly describe what a mutex, semaphore and conditional variable.
6. What is a deadlock and starvation. Is there a general method of elimination of the impasse? What are ways to prevent starvation?
7. What is the relocation of memory, memory protection and main memory sharing? What is the "twin system"?
8. What is the resident set? What is the segmentation and paging of virtual memory?
9. Discuss the types of scheduling. What is the priority of the task? Are there ways to avoid starvation process?
10. What are the main differences between the scheduling in the single-and multi-processor systems?
11. Discuss methods of caching I / O devices.
12. Discuss Linux elevator algorithm.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
</table>

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