



Subject card

Subject name and code	Real-time Operating Systems, PG_00048441						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	February 2023	Academic year of realisation of subject				2022/2023	
Education level	second-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	1	Language of instruction				Polish	
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						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Marcin Pazio				
	Teachers		dr inż. Marcin Pazio				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	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	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.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information		
	[K7_U08] while identifying and formulating engineering tasks specifications and solving these tasks, can:n- apply analytical, simulation and experimental methods,n- notice their systemic and non-technical aspects,n-make a preliminary economic assessment of suggested solutions and engineering workn	Student describes and knows how to apply the techniques in practice management computer system.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information		
	[K7_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	Student describes and knows how to use in practice most commonly used real-time operating systems.			[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		

Subject contents	<ol style="list-style-type: none"> <li>1. Introduction to operating systems. The development of operating systems. Microsoft Windows and Unix-based operating systems.</li> <li>2. Processes. Definitions, description methods, method of process management.</li> <li>3. Threads. Implementation of single and multi-processor with examples.</li> <li>4. The kernel of the operating system. Concept of the microkernel . The tasks held by microkernel and threads management.</li> <li>5. Concurrency problems and methods of solving them. Rules for synchronization and mutual exclusion. Semaphores and message passing techniques.</li> <li>6. Imprisonment and deadlock. Methods of detection, avoidance and solving the problem of threads interaction. Examples of the actual system solutions.</li> <li>7. Memory management. Mechanisms of memory management, software solutions and hardware support mechanisms.</li> <li>8. Virtual Memory. Management methods. Examples of solutions.</li> <li>9. Process scheduling in single-CPU systems. Examples of solutions.</li> <li>10. Process scheduling in a multiprocessor system. Examples of solutions.</li> <li>11. File management methods. Examples.</li> <li>12. Resource management and input-output operations and storage. Examples</li> <li>13. Real time operating systems.</li> <li>14. Distributed computing. Technologies, client / server. Clusters.</li> <li>15. Computer networks. Security problems.</li> </ol>											
Prerequisites and co-requisites	No requirements											
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">Subject passing criteria</th> <th style="width: 30%;">Passing threshold</th> <th style="width: 30%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Midterm colloquium</td> <td>50.0%</td> <td>70.0%</td> </tr> <tr> <td>Homework - simple computer program</td> <td>80.0%</td> <td>30.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Midterm colloquium	50.0%	70.0%	Homework - simple computer program	80.0%	30.0%
Subject passing criteria	Passing threshold	Percentage of the final grade										
Midterm colloquium	50.0%	70.0%										
Homework - simple computer program	80.0%	30.0%										
Recommended reading	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 40%;">Basic literature</td> <td colspan="2" data-bbox="802 759 1487 882">           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 colspan="2" data-bbox="802 893 1487 938">           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 colspan="2" data-bbox="802 949 1487 983">Adresy na platformie eNauczanie:</td> </tr> </tbody> </table>			Basic literature	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		Supplementary literature	J. W. S. Liu, „Real – time systems.”, Prentice Hall, 2000. R. Williams, „Real – time systems development.”, BH/Elsevier 2006.		eResources addresses	Adresy na platformie eNauczanie:	
Basic literature	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											
Supplementary literature	J. W. S. Liu, „Real – time systems.”, Prentice Hall, 2000. R. Williams, „Real – time systems development.”, BH/Elsevier 2006.											
eResources addresses	Adresy na platformie eNauczanie:											
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> <li>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?</li> <li>2. What are the main differences between thread and process? What are the advantages of introducing multiple threads? What states can have thread in Linux?</li> <li>3. Discuss briefly threads / processes synchronous, asynchronous / secondary. What are the main differences?</li> <li>4. Discuss the three main structures of operating systems. What do you do and what are the advantages of microkernel?</li> <li>5. Discuss the problems of concurrency. Briefly describe what a mutex, semaphore and conditional variable.</li> <li>6. What is a deadlock and starvation. Is there a general method of elimination of the impasse? What are ways to prevent starvation?</li> <li>7. What is the relocation of memory, memory protection and main memory sharing? What is the "twin system"?</li> <li>8. What is the resident set? What is the segmentation and paging of virtual memory?</li> <li>9. Discuss the types of scheduling. What is the priority of the task? Are there ways to avoid starvation process?</li> <li>10. What are the main differences between the scheduling in the single- and multi-processor systems?</li> <li>11. Discuss methods of caching I / O devices.</li> <li>12. Discuss Linux elevator algorithm.</li> </ol>											
Work placement	Not applicable											