GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Real Time Systems, PG_00038097		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Intelligent and Decision Support Systems -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Tomasz Rutkowski	
	Teachers	dr inż. Tomasz Rutkowski	

Lesson types and methods of instruction

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	66.0	100

Subject objectives

The aim of the course is for the student to master the knowledge of real-time systems related to computer control systems. The student will learn the characteristics of such systems, their division by time constraints, methods of their analysis, and principles of their operation and design. In addition, the student will learn rapid prototyping tools and hardware-in-the-loop simulation (HILS) techniques.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U05] can use analytical and simulation methods to solve tasks in the field of automation and robotics and use various techniques to carry out engineering tasks related to automation and robotics devices and systems	Uses rapid prototyping and hardware-in-the- loop simulation techniques to evaluate the performance of designed control systems. Use selected tools for programming AVR family microcontrollers, PLCs and Matlab/ Simulink rapid prototyping environment (including Simulink Desktop Real-Time and StateFlow toolboxes).	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_W06] knows the structure of computers and microprocessors and the tasks of operating systems, has basic knowledge of the basics of computer software, drivers, microprocessor technology, design of simple algorithms and the operation of information networks	Defines a real-time system. Classifies real-time systems according to the type of time constraints considered. Identifies the role and place of real-time systems in computer control systems. Describes various types of digital control devices/platforms. Defines the architecture and explains the basic mechanisms of a real-time operating system.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K6_K02] can work in a group taking on different roles in it	Completes tasks individually and as part of group work in the implementation and verification of control systems using rapid prototyping and hardware loop simulation environments.	[SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work [SK1] Assessment of group work skills

Subject contents	LECTURE: History and basic definitions and issues related to real-time systems domain. Continuous time systems versus discrete time systems. Differential equation versus difference equation. Examples of real-time systems: microcontrollers, DSP, FPGA, PLC/PAC, industrial computers. Structure of classical and distributed control system. Real-time systems in computer control systems, examples of: industrial networks, digital control devices, industrial databases. Structure, functioning and programming of real-time systems examples: PLC/PAC controllers, Matlab/Simulink Desktop Real-Time. Rapid prototyping idea and tools. Hardware in the loop simulation idea. A finite state machine modelling using the StateFlow Matlab/Simulink toolbox. Features, architecture and fundamental elements of real-time operating systems. Selected real-time operating systems characteristics, including: QNX, RTLinux, Nut/OS, FreeRTOOS. TRAINING LABORATORY: Introduction to PLC controllers: configuration, programming, basic control algorithms implementation. Introduction to Matlab/Simulink (Desktop Real-Time and StateFlow toolboxes): configuration, basics of programming, basic mathematical models of control systems implementation and/or control algorithms implementation (rapid prototyping). Simulation analysis with hardware in the loop simulation technique. Design and implementation of a control algorithm for the autonomic mobile robot.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory exercise reports	50.0%	50.0%
Lecture test	50.0%	50.0%

Recommended reading	Basic literature	1) K. Lal, T. Rak, K. Orkisz. RTLinux system czasu rzeczywistego. Helion, 2003. 2) H. Kopetz, W. Steiner. Real-Time Systems, Design Principles for Distributed Embedded Applications. Springer, 2022. 3) B. Amos. Hands-On RTOS with Microcontrollers, Building real-time embedded systems using FreeRTOS, STM32 MCUs, and SEGGER debug tools. Packt Publishing, 2020.
	Supplementary literature	1) Sacha K. Systemy czasu rzeczywistego. Oficyna WPW 2006. 2) Ułasiewicz J. System czasu rzeczywistego QNX6 Neutrino. Wydawnictwo BTC, 2007. 3) A.S. Tanenbaum, H. Bos. Systemy operacyjne. Helion, 2024.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	[1] Define the real time system. [2] Describe classification of the real time systems according to various time constrains types. [3] Describe role and place of real time systems in the computer control systems. [4] Describe similarities and differences between rapid control prototyping and hardware in the loop simulation techniques. [5] Describe basic architectures of real time operating systems.	
Work placement	Not applicable	

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