



Subject card

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| Subject name and code | Real Time Systems, PG_00038097 | | | | | | |
| Field of study | Automation, Robotics and Control Systems | | | | | | |
| Date of commencement of studies | October 2021 | Academic year of realisation of subject | | | | 2022/2023 | |
| 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 | Faculty of Electrical and Control Engineering | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Tomasz Rutkowski | | | | | |
| | Teachers | dr inż. Tomasz Rutkowski dr inż. Bartosz Puchalski | | | | | |
| 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 | Gain knowledge in the real-time systems domain related to the computer control systems. Getting to know the selected real-time systems. Acquiring the ability to properly use of the known issues in the control systems design and implementation for the purposes of solving simple engineering problems. | | | | | | |

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| Learning outcomes | Course outcome | Subject outcome | Method of verification |
| | [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 | | |
| | [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 | | |
| | [K6_K02] can work in a group taking on different roles in it | | |
| | K6_W06 | The student defines the real-time system. It classifies real-time systems depending on the type of time constraints. Identifies the role and location of real-time systems in computer control systems. Describes various types of digital control devices. Describes architecture and explains the basic mechanisms of the real-time operating system. | [SW1] Assessment of factual knowledge |
| | K6_K02 | The ability of individual and group work in the field of implementation and verification of control systems using environments enabling rapid prototyping and hardware-in-the-loop simulation. | [SK1] Assessment of group work skills [SK2] Assessment of progress of work |
| K6_U05 | The student defines the real-time system. It classifies real-time systems depending on the type of time constraints. Identifies the role and location of real-time systems in computer control systems. Describes various types of digital control devices. Describes architecture and explains the basic mechanisms of the real-time operating system. | [SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools | |
| Subject contents | LECTURE History and basic definitions and issues related to real-time systems domain. Continuous systems versus discrete 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 Real-Time Windows Target. Rapid prototyping idea and tools. Hardware in the loop simulation idea. Features, architecture and fundamental elements of real-time operating systems. Selected real-time operating systems characteristics, including: QNX, RTLinux, VxWorks, Azure RTOS, Nut/OS, FreeRTOS. TRAINING LABORATORY Introduction to PLC controllers: configuration, programming, basic control algorithms implementation. Introduction to Matlab/Simulink Real-Time Windows Target and xPC Target: 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 | Knowledge of subjects: Computer Science (0411200011) and Basics of Automatics (0411200017) | | |
| Assessment methods and criteria | Subject passing criteria | Passing threshold | Percentage of the final grade |
| | Laboratory reports | 50.0% | 40.0% |
| | Lecture test | 50.0% | 50.0% |
| | Tests during training laboratories | 50.0% | 10.0% |

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| Recommended reading | Basic literature | <p>1. Sacha K. Systemy czasu rzeczywistego. Oficyna WPW 2006.</p> <p>2. Szmuc T. Motet G. Specyfikacja i projektowanie oprogramowania systemów czasu rzeczywistego. AGH Uczelniane Wydawnictwo Naukowo-Dydaktyczne, Kraków 2000.</p> <p>3. Kopetz H. Real-Time Systems, Design Principles for Distributed Embedded Applications. Springer Real-Time Systems Series, 2011.</p> <p>4. Buttazzo G. C. Hard Real-Time Computing Systems, Predictable Scheduling Algorithms and Applications. Springer Real-Time Systems Series, 2011.</p> |
| | Supplementary literature | <p>1. Szymczyk P. Systemy operacyjne czasu rzeczywistego. AGH Uczelniane Wydawnictwo Naukowo-Dydaktyczne, Kraków 2003.</p> <p>2. Ułasiewicz J. System czasu rzeczywistego QNX6 Neutrino. Wydawnictwo BTC.</p> |
| | eResources addresses | |
| Example issues/ example questions/ tasks being completed | <p>[1] Define the real time system.</p> <p>[2] Describe classification of the real time systems according to various time constrains types.</p> <p>[3] Describe role and place of real time systems in the computer control systems.</p> <p>[4] Describe similarities and differences between rapid control prototyping and hardware in the loop simulation techniques.</p> <p>[5] Describe basic architectures of real time operating systems.</p> | |
| Work placement | Not applicable | |