GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Computer-controlled Systems I, PG_00047401		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2022/2023
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	English
Semester of study	2	ECTS credits	3.0
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. Paweł Raczyński	
	Teachers	dr inż. Paweł Raczyński	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	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	6.0	39.0	75

Subject objectives

The main aim of the course is to familiarize students with techniques of using computers to control and experience skill of computer control system architecture design and improvement of programming techniques to create control software working in real time.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W06] Knows and understands, to an increased extent, the basic processes taking place in the life cycle of devices, facilities and technical systems.	The student knows the issues related to the life cycle of technical devices.	[SW1] Assessment of factual knowledge
[K7_W04] Knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	He knows various programming languages, can create software that works directly with equipment operating in the time dependence regime. It can run and test such software.	[SW1] Assessment of factual knowledge
[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	Student knows in a deep degree the role of computers in the implementation of control systems, knows and understands the principles of construction of such systems and knows how to implement, run and test them.	[SW1] Assessment of factual knowledge

Subject contents	1. Computer system – controlled plant interfacing technique; simple interfacing and wit both side acknowledgement; ideas, algorithms, acknowledge passing. 2. Methods of acknowledgement passing: software checking and passing, using interrupt techniques, using readiness checking (ready – wait lines). The best solution optimization criteria. 3. Examples of typical solutions using standard programmable input/ output ports. 4. Different ways of interrupt handling in computer control systems, pooling, vectorized systems, centralized interrupt controllers and daisy-chain controllers. 5. Single level and multi level interrupt systems, arbitration of priority, mask modes and special mask modes, typical solu-tions. 6. Examples of implementing of interrupt system in computer control; interrupt latency estimation, system reaction time, density of interrupts and control computer efficiency. 7. Multi-processor and multi-computer systems architecture, requirements of increase in computing power over single processor systems possibilities. 8. Multi-processor and multi-computer systems buses, local and global resources, global resources administration. 9. Multi-processor bus standards: STE, MULTIBUS, VME PCI, COMPACT PCI. 10. Common resources access arbitration, examples of hardware and software arbiters, centralized and daisy-chain solu-tions, arbitration algorithms. 11. Arbitration methods examples. 12. Main processor – coprocessor cooperation ideas. 13. Software techniques in common resources access control – semaphores, access blockades. 14. Multi-computer systems, data exchange rules, hardware and software solutions, multi-computer systems architecture. 15. Interfacing techniques using DMA, hardware and software aspects of using DMA, interrupt driven contrary DMA data transfer. 16. Bus as a communication system between multi-users, communication protocols, hierarchy of communication proto-cols. 17. Hierarchy of communication protocols standards, 4 and 7 layer ISO models. 18. Communication protocol layers, bottom 4 layers specifications, protocol specification examples RS232, RS485, I2C and others. 19. Advantages and disadvantages of communication protocol standardization; decision criteria standard or dedicated solutions. 20. Hardware methods of communication interfaces reliability improvement; types and characteristics of different data transmission media; signal processing methods used for signal matching to media characteristics; different kinds of line transmitters and receivers. 21. Software methods of communication interfaces reliability improvement; Error detection codes and error correction codes. 22. Examples of bit-parallel and bit-serial protocols. 23. Communication protocol organization: bit-oriented, character counting protocols, character-controlled protocols; ex-amples of standards. 24. Micro-controllers in control systems. 25. INTEL MCS-51 micro-controller family; basic model, resources and programming language. 26. Architecture and resources of some advanced MCS-51 family members offered by PHILIPS, DALLAS, MAXIM, Analog Devices and ATMEL. 27. Build-in micro-controller interfaces, real-time ports; hardware support for context-switching methods. 28. User interface hardware and software techniques; contacts interfacing – keyboards; pointing and control input devices – mouse, touch pads, joysticks and others. 29. Process status displaying techniques, numeric and alpha-numeric displays interfacing; CRT and LCD monitors inter-facing, software problems in graphic displaying, graphic processors and accelerators. 30. Special memories used in control systems: FIFO and LIFO buffers, cyclic buffers, dual gated RAM memories. 31. Nonvolatile memories: battery supported RAM memories, FLASH memories with parallel and serial access, EEPROMS, software consequences of using nonvolatile memories. 32. Service less systems, service less system reliability increasing techniques; methods used for decreasing of power con-sumption in autonomous systems. 33. Analog inputs and outputs to computer interfacing; A/D and D/A converters; methods of conversion, its base parame-ters and application criteria; sample and hold circuits, extrapolators, PWM outputs, U/F converters. 34. PC type computer in control systems, industrial standards in PC compatible computers, modular computers. 35. Floppy and hard disk memories, organization and software interfacing; disk memories as an example of techniques of controlling of electromechanical device, methods used for reliability increasing; electromechanical clearance compensa-tion. 36. Multitask real-time operating systems for control systems; system organization; static and dynamic process descrip-tion; process creating, killing and switching techniques; different ways of interrupt servicing. 37. Examples of standard systems used in computer aided control systems: DOS, WINDOWS, LINUX, QNX; advantages and disadvantages of systems. 38. Basics of dedicated systems software development. 39. Typical data structures used in control systems; data structure developing criteria; data structure optimization tech-niques. 40. Multi-threat software development; process concurrency; access to common resources rules; collision in access detec-tion and avoiding its methods; blockade and deadlock. 41. Correctness in concurrent process execution; examples of process scheduler algorithms; examples of scheduler testing methods. 42. Build-in microprocessor hardware support of multitask computations and tasks private resources protection mecha-nism. 43. Computer controlled systems – examples. 44. Control software for microcomputers – examples and some interesting details.
Prerequisites and co-requisites	No requirements
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
2 partial exams	51.0%	100.0%

Recommended reading	Basic literature	Misiurewicz P. Podstawy techniki mikroprocesorowej. WNT 1991. Katalogi, strony WWW i podręczniki firmowe. Misiurewicz P. Układy mikroprocesorowe struktury i programowanie. WNT 1983. Niederliński A. Mikroprocesory mikrokomputery mikrosystemy. WSiP 1988. B. Zieliński, Układy mikroprocesorowe. Przykłady rozwiązań, Helion 2002 N. Noam, S. Shimon Elementy systemów komputerowych. Budowa nowoczesnego komputera od podstaw., WNT 2008 B. Danowski, Leksykon pojęć sprzętowych, Helion 2005 Metzger P. "Anatomia PC", HELION, 2008. Rydzewski A. "Mikrokomputery jednoukładowe rodziny MCS-51", WNT Warszawa 1992. Mielczarek W. "Szeregowe interfejsy cyfrowe", HELION, 1993.
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie: Computer controlled systems - 2022/2023 - Moodle ID: 24983 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=24983
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	