GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Microcontrollers and Microsystems, PG_00048074		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2022/2023
Education level	first-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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Zbigniew Czaja	
	Teachers	dr hab. inż. Zbigniew Czaja dr inż. Bartłomiej Dec	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

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	45	3.0	27.0	75

Subject objectives

Learning the basics of design, operation and control of microcontrollers and their peripheral devices, and also electronic systems: digital buffers, parallel random access memories, SPLD and CPLD, selected systems controlled via the SPI interface.

Acquisition of the ability to analyze ("read") electronic block schemes and timings describing the behavior of the system at the time (work in "real time"), as well as effective learning skills of the technical documentation.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_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	Student describes the principle of operation and control of systems that are part of electronic microsystems. Student analyzes program codes written in an assembler and a C language written for microcontrollers.	[SW1] Assessment of factual knowledge
[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study	Student explains the construction and principle of operation of the microcontroller and its peripherals. Student describes the principle of operation and control of systems that are part of electronic microsystems. Student uses IDE software for compilation, program simulation and programming of microcontrollers. Student analyzes program codes written in an assembler and a C language written for microcontrollers.	[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents	Lecture: 1. Introduction, plan of the lecture, definition of the microcontroller and features of the core processor 2. Addressing modes of the core processor 3. Classification of microcontrollers taking into account a memory map (definition of the memory map) and an instruction set 4. Features of the harward architecture and its modifications, proprieties of the Von-Neumann architecture in microcontrollers 5. RISC and CISC architectures of the core processor 6. Internal memories of microcontrollers (program and data memories) 7. Division of the microcontrollers regarding to a way of using of external memories 8. Microcontrollers with access to system buses through ports, with directly access to system buses, embedded microcontrollers 9. A stratified model of the embedded microcontroller 10. Classification and division of families of the microcontrollers 11. Building of an oscillator circuit and applications of circuits of generation and distribution of clock signals 12. Ways of reductions of power consumption and saving power modes of the microcontroller 13. Reset blocks of the microcontroller 14. Units supervising executing of programs by the microcontroller, generation of clock signal, supply voltage 15. The watchdog circuit 16. An interrupt system with program polling of devices and a vector interrupt system 17. Parallel ports of the microcontroller – the layer of multiplexers and input/output pins 18. Overview and classification of peripheral devices of the microcontroller 19. Basic information about timers and counters 20. Configurations of timers: 16-bit counter/timer, Input Capture, Output Compare, One Pulse, PWM 21. Examples of the timers: timers in PIC18F452, ST72215G 22. Internal analog to digital converters 23. Internal analog comparators 24. Internal EEPROMs (configuration and service). Example of the EEPROM in Atmega16 25. Characterization and division of serial interface controllers 26. Building, principle of working, controlling of the UART interface 27. Solutions of the UART interface in microcontrollers: 80C51/52, ATmega16, PIC18F452 28. The SPI interface service 29. Solutions of the SPI interface in the microcontrollers: Atmega16, PIC18F452 30. The 1-Wire interface 31. Applications of I2C, CAN, USB interfaces 32. The parallel interface PSP 33. Types of packages of the embedded microcontrollers 34. Definition of an embedded programming 35. Programming of the core processor in an assembler language 36. Writing programs in high level languages 37. Activating of programs written for microcontrollers 38. Programming methods of microcontrollers with FLASH 39. Definition of electronic microsystems 40. Standards of serial interfaces in distributed microsystems 41. Methods of addressing of external interface units 42. Interface functions of serial interfaces: listener, talker, repeater and Transmission methods in serial inter-faces: synchronous, asynchronous, full and half duplex 43. Components of microsystems 44. External memories: RAM and FLASH 45. Programmable circuits in microsystems: SPLD and CPLD 46. Division and overview of circuits controlled by the SPI interface 47. Serial EEPROMs with the SPI and Microwire interfaces 48. Analog to digital converters: A/D converters, digital temperature sensors, capacitance to digital converters with the SPI interface 49. Digital to analog converters: D/A converters, digital potentiometers with the SPI interface 50. DDS circuits (analog signal generators) and MEMS circuits (accelerometers) with the SPI interface 51. Analog switches and multiplexers with the SPI interface 52. Transceivers and controllers of serial interfaces: USB, CAN, Ethernet controlled by the SPI interface 53. Communication of the microsystem with an user: LCD displays, LEDs, sets of switches and push-buttons 54. Power supply of the electronic microsystems Lab: 1. Introduction. Presentation of laboratory boards for the microcontrollers: PIC18F452 of Microchip, AT-mega16 of Atmel, P89C51RC of Philips. 2. Utilization of IDE MPLAB 7 environment for activating of programs written in the assembler for the PIC18F452 microcontroller 3. Analysis of assembler codes written for the PIC18F452 (service of the RS232 interface, the LCD display) 4. Application of the MPLAB C18 language to write programs for the PIC18F452 5. Realization of the software in the assembler for the ATmega16 microcontroller of Atmel 6. Using of the C language for writing of programs for the ATmega16 7. Creating of the assembler programs for the P89C51RC of Philips 8. Analysis of the assembler codes written for the P89C51RC (service of the RS232 interface, the LCD dis-play) 9. Writing of the software with use of the C language for the P89C51RC
Prerequisites and co-requisites	No requirements
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	48.0%	60.0%
Practical exercise	50.0%	40.0%

Recommended reading	Basic literature	Czaja Z.: Mikrokontrolery i mikrosystemy – materiały do wykładu, http://www.pg.gda.pl/~zbczaja, Gdańsk 2010. Hadam P.: Projektowanie systemów mikroprocesorowych, Wyd. BTC, Warszawa 2004.
	Supplementary literature	Bogusz J.: Lokalne interfejsy szeregowe w systemach cyfrowych, Wyd. BTC, Warszawa 2004. Baranowski R.: Mikrokontrolery AVR ATmega w praktyce, Wyd. BTC, Warszawa 2005. Jabłoński T: Mikrokontrolery PIC16F8x w praktyce, Wyd. BTC, Warszawa 2002. Jabłoński T., Pławsiuk K.: Programowanie mikrokontrolerów PIC w języku C, Wyd. BTC, Warszawa 2005. Baranowski R.: Wyświetlacze graficzne i alfanumeryczne w systemach mikroprocesorowych, Wyd. BTC, Legionowo 2008.
	eResources addresses	Adresy na platformie eNauczanie: Mikrokontrolery i mikrosystemy - wykład i laboratorium 2022/2023 (semestr zimowy) - Moodle ID: 25375 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=25375
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	