GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Microprocessors and Controllers, PG_00047831		
Field of study	Biomedical Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2024/2025
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	4.0
Learning profile	general academic profile	Assessment form	exam
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	

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	4.0	51.0	100

Subject objectives

Learning the basics of design, operation and control of microprocessors, microcontrollers and their peripheral devices, and also electronic systems: digital buffers, RAM and FLSAH memories, 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_U02] can perform tasks related to the field of study in an innovative way as well as solve complex and nontypical problems, applying knowledge of physics, in changing and not fully predictable conditions	Student is able to analyze block and logic diagrams describing complex integrated electronic circuits. The student knows how to analyze timings describing the behavior of digital systems in time.	[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
[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 explains the structure and principle of microprocessors. Student describes the principle of operation and software of microcontrollers. Student uses IDE software for compilation, program simulation and programming of microcontrollers. Student creates software in assembler and C language for microcontrollers.	[SW1] Assessment of factual knowledge

Subject contents	1. Introduction. Basics: microprocessor, microcomputer, microcomputer system 2. Functional components of microprocessor: arithmetical-logical unit, instruction pointer, specificity of general purpose and dedicated regis-ters of microprocessor, control unit 3. Address, data and control busses of microprocessor 4. A microprocessor memory map. Von Neumann and harward architectures 5. Types and parameters of memories used in microprocessor systems 6. EEPROM, FLASH, FRAM, MRAM nonvolatile memories 7. Cooperation of the microprocessor with external memories. Address decoders. Read/Write bus timings for SRAM and DRAM memories 8. Stack in data memory versus hardware stack 9. Direct memory access. DMA controller 10. Machine cycle of microprocessor. Addressing modes 11. Instruction types, microprocessor assembler instruction syntax. Macroassemblers 12. Advantages of RISC versus CISC microprocessors 13. Instructions for arithmetic and logical operations, data movement, conditional and unconditional jump, stack management 14. Microprocessor communication with external circuits. Programmable, universal and specialized input-output circuits 15. Interrupt system of microprocessor. External and internal interrupts. Interrupt masking. Interrupt servicing 16. Co-processor. Architecture, basic operations 17. Methods of elargement of computing power of microprocessors. Pipeline work. VLIW and EPIC architectures. 18. Multiplot. Multicore. 19. Acceleration of access to memories. Cache memory. Methods of writing and reading to/from cache memory. 20. Comparison of modern microprocessor families (ARM, PowerPC, MIPS) to Intel architecture 21. Definition, architecture and applications of microcontrollers 22. Families of microcontrollers 23. A stratified model of the microcontroller 24. Internal memories of microcontrollers (program and data memories) 25. Building of an oscillator circuit and applications of circuits of generation and distribution of clock signals 26. Ways of reductions of power consumption and saving power modes of the microcontroller 27. Reset blocks of the microcontroller 28. Units supervising executing of programs by the microcontroller (BOR, LVD, watchdog) 29. Parallel ports 30. Overview and classification of peripheral devices of the microcontroller 31. Basic information about timers and counters 32. Configurations of timers: 16-bit counter/timer, Input Capture, Output Compare, One Pulse, PWM 33. Internal analog to digital converters 34. Internal analog comparators 35. Configuration and service of internal EEPROM 36. Digest of serial interface controllers 37. Serial interfaces UART, SPI 38. Serial interfaces 1-Wire, I2C, USB 39. Programming and debugging methods of microcontrollers with FLASH in ISP mode 40. Types of packages of the microcontrollers 41. Architecture and working principle of ARM7TDMI microprocessor 42. Examples of ARM7TDMI microcontrollers (ATMEL AT91SAM, STMicrocelectronics STR7, Analog Devices ADuC7000, Philips LPC2100) 43. Characteristics and architecture of microcontroller family AT91SAM 44. Specificity of software development for microprocessors and microcontrollers. Assembler language, linker, debugger, software simulator, development systems 45. Digest of IDE tools for AT91SAM microcontroller family 46. Exemplary IDE tools: WinARM, GnuARM
Prerequisites and co-requisites	No requirements
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Written examination	45.0%	60.0%
Practical exercise	50.0%	40.0%

Recommended reading	Basic literature	Czaja Z.: Mikroprocesory i mikrokontrolery – materiały do wykładu, http://www.pg.gda.pl/~zbczaja, Gdańsk 2014. Michalski J. A.: Mikroklocki. Mikroprocesory dla początkujących, Wyd. BTC, Warszawa 2007. Krzyżanowski R.: Układy mikroprocesorowe, Wyd. PWN 2007,
	Supplementary literature	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. Bryndza L.: LPC2000 - Mikrokontrolery z rdzeniem ARM7, Wyd. BTC, Legionowo 2007.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	