



Subject card

Subject name and code	Programmable Circuits, PG_00047841						
Field of study	Biomedical Engineering						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2025/2026		
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	6	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Microelectronic Systems -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Miron Kłosowski					
	Teachers	dr inż. Miron Kłosowski					
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		3.0		42.0	75
Subject objectives	The aim of the course is to provide students with the basic knowledge and skills in the design of digital electronic systems using FPGA technology and VHDL. As a result, students will be prepared to work in companies producing electronic systems using FPGAs and students will be able to participate in specialized EDA software development.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[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 designs digital circuits using VHDL hardware description language. Student implements and tests digital systems in a real hardware and software environment based on FPGA. Student uses VHDL language for hardware implementation of simple algorithms.			[SU1] Assessment of task fulfilment	
	[K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications		Student simulates the operation of digital systems using VHDL and SystemC languages.			[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 describes the features of hardware description languages. Student knows the hardware description language VHDL. Student understands the processes of synthesis and simulation. Student is able to determine the conditions of code synthesis in VHDL language. Student knows the basics of SystemC environment. Student describes the structure and applications of FPGA systems. Student describes the methods of FPGA systems configuration.			[SW1] Assessment of factual knowledge	

Subject contents	1. Introduction to VHDL, origin and applications. 2. Abstraction levels and description methods of digital circuits. 3. Design entity description in VHDL. 4. Assignments, signals, variables and operators in VHDL. 5. Data types in VHDL. 6. Resolution function. 7. Vectors and operations on vectors in VHDL. 8. Combinatorial processes. Synthesis of combinatorial logic in VHDL. 9. Project simulation in VHDL. 10. Conditional, case and loop statements in processes. 11. Constants and initial values of signals and variables. 12. Hierarchy and configuration of design entities. 13. Sequential processes in VHDL. 14. State machines. State encoding. Forbidden states. 15. Type conversion in VHDL. 16. Functions and procedures in VHDL. 17. Introduction to SystemC environment. 18. Applications of SystemC environment. 19. System design with hardware-software partitioning. 20. System on Chip technology. 21. Soft-processors - architecture and applications. 22. Programmable circuits taxonomy. 23. Architecture of FPGAs. 24. Configuration methods of FPGAs. 25. Hardware functional blocks in FPGAs. 26. "Reconfigurable computing" as a programming paradigm. 27. Applications of RC in signal processing. 28. Applications of RC in image processing. 29. Applications of RC in supercomputers. 30. Algorithm representation in RC. 31. Arithmetic systems in RC.											
Prerequisites and co-requisites												
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="453 463 794 495">Subject passing criteria</th> <th data-bbox="799 463 1141 495">Passing threshold</th> <th data-bbox="1145 463 1485 495">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 501 794 533">Practical exercise</td> <td data-bbox="799 501 1141 533">50.0%</td> <td data-bbox="1145 501 1485 533">70.0%</td> </tr> <tr> <td data-bbox="453 539 794 562">Midterm colloquium</td> <td data-bbox="799 539 1141 562">50.0%</td> <td data-bbox="1145 539 1485 562">30.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Practical exercise	50.0%	70.0%	Midterm colloquium	50.0%	30.0%
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Example issues/ example questions/ tasks being completed	<p data-bbox="453 732 662 754">Sample lab exercises:</p> <ol data-bbox="453 831 847 1093" style="list-style-type: none"> <li data-bbox="453 831 727 853">1. Simple LED display driver. <li data-bbox="453 909 847 931">2. Simple RS232 receiver and transmitter. <li data-bbox="453 987 847 1010">3. Video signal generator for VGA display. <li data-bbox="453 1066 815 1088">4. Embedded system based on FPGA. 											
Work placement	Not applicable											