GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Programmable Digital Circuits, PG_00047705
Field of study	Automatic Control, Cybernetics and Robotics

Date of commencement of studies	October 2020	Academic year of realisation of subject	2023/2024
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	4	Language of instruction	Polish
Semester of study	7	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 dr inż. Maciej Kokot

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	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	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_W03] Knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Student describes the architecture and applications of SPLD and FPGA programmable circuits. Student discusses methods of FPGA configuration. Student describes the properties of hardware description languages. Student knows the basics of the VHDL language. Student understands the processes of synthesis and simulation. Student is able to determine the conditions for the synthesis of the code in VHDL. Student knows the basics of the SystemC environment.	[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 designs digital systems using FPGAs integrated with microprocessors. Student implements embedded systems containing FPGAs using the Linux operating system.	[SU1] Assessment of task fulfilment
		[K6_U03] can design, according to required specifications, and make a simple device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	Student designs digital circuits using the VHDL language. Student simulates the behavior of designed systems using VHDL and SystemC simulators. Student implements and tests digital circuits in a real hardware environment based on FPGAs.	[SU1] Assessment of task fulfilment

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. Soft-processors - architecture and applications. 21. Architecture of FPGA. 22. FPGA configuration methods. 23. Architecture and properties of input/output blocks in FPGAs. 24. Hardware functional blocks in FPGAs. 25. Automatic synthesis of functional blocks. 26. Constrain driven design. 27. "Reconfigurable Computing" as a programming paradigm. 28. Applications of RC in signal processing. 29. Algorithm representation methods in RC. 30. Arithmetic systems in RC.

Prerequisites and co-requisites	

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	50.0%	30.0%
	Practical exercise	50.0%	70.0%

Recommended reading	Basic literature	Zwoliński Mark, "Projektowanie układów cyfrowych z wykorzystaniem języka VHDL", Wydawnictwa Komunikacji i Łączności WKŁ, Warszawa 2007.
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie: Programowalne układy cyfrowe - Moodle ID: 27814 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=27814

Example issues/ example questions/ tasks being completed	Sample lab exercises: 1. Simple LED display driver. 2. Simple RS232 receiver and transmitter. 3. Video signal generator for VGA display. 4. Embedded system based on FPGA.
Work placement	Not applicable