

Białystok University of Technology										
Field of study	Computer Science							Degree level and programme type	Engineer's degree full-time programme	
Specialization/ diploma path	---							Study profile	academic	
Course name	Embedded Systems							Course code	FCS-00072	
								Course type	obligatory	
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	2	
	30				30			No. of ECTS credits	6	
Entry requirements	Computer Organization and Architecture (FCS-00011),									
Course objectives	Familiarizing students with the methodology of designing embedded systems, embedded systems base technology and tools for the design of embedded systems. Learning how to use hardware description languages for the design of embedded systems. Learning the basics of embedded systems design using appropriate technological base. Learning methods for the use of external devices (keypad, LED and LCD displays, sensors). Implementation and testing of simple embedded systems.									
Course content	Lectures: Basic concepts related to the control and embedded systems. Types of architectures of microcontrollers, logic diagram of the microcontroller and its features, architecture, addressing modes, interrupt systems, power reduction. PIC microcontrollers family. Input-output ports, LED and LCD displays, timers, switches. CPLD and FPGA as a base for embedded systems. Hardware description languages with Verilog language for example. Real-time operating systems. Methodology for the design of embedded systems. Designing reliable embedded systems. Specialization workshops: Design of combinational circuits in hardware description language: multiplexers, decoders, arithmetic circuits. Design of sequential circuits in hardware description language: registers, counters, timers, finite state machines, memories. Design of processors in hardware description language. Hardware implementation of algorithms. Design of simple filters.									
Teaching methods	informative lecture, lecture problem, programming, laboratory exercises, simulation,									
Assessment method	Lectures - written exam; specialization workshops - evaluation of reports, answers on questions concerning designed projects									
Symbol of learning outcome	Learning outcomes								Reference to the learning outcomes for the field of study	
L01	knows the construction, operation and input-output interfaces of embedded systems								K_W02 K_W03	
L02	knows and understands the processes of design and manufacture of simple embedded systems on the base of microcontrollers and programmable logic devices.								K_W09	
L03	knows programming languages (Verilog) used in the design of embedded systems								K_W04	
L04	can implement a simple embedded system or its component, using appropriate methods, programming languages and tools, and taking into account the specified criteria.								K_U05	
L05	is able to formulate a simple embedded system specification and the specification of software and hardware components and can implement and test specified system.								K_W06 K_U05	
L06	can write a software for embedded systems using low-level languages, uses mechanisms and resources provided by these systems.								K_U05	
Symbol of learning outcome	Methods of assessing the learning outcomes								Type of tuition during which the outcome is assessed	
L01	exam								L	
L02	exam								L	
L03	exam								L	
L04	Reports, observation of student's work								Sw	
L05	Report, realisation of project task, observation of student's work								Sw	
L06	Report, discussion on project and report, observation of student's work								Sw	
Student workload (in hours)								No. of hours		
Calculation	1 - Attendance at lectures - 15x2h								30	
	2 - Attendance at specialization workshops - 15x2h								30	
	3 - Preparation for specialization workshops -								15	
	4 - Preparation of reports and realization of homeworks -								60	
	5 - Participation in student-teacher sessions -								5	
	6 - Preparation for the exam -								8	
	7 - Presence during exam -								2	
TOTAL:								150		
Quantitative indicators								HOURS	No. of ECTS credits	
Student workload - activities that require direct teacher participation								67 (1)+(5)+(7)+(2)	2.7	
Student workload - practical activities								105 (2)+(3)+(4)	4.2	
Basic references	1. Taraate, Vaibbhav. Digital Logic Design Using Verilog. 2nd Ed. 2022 ed. Singapore: Springer Singapore. Web. 2. Chonnad, Shivakumar S, and Needamangalam B Balachander. Verilog. New York, NY: Springer New York, 2004. Web. 3. Jack Ganssle: Embedded hardware: Elsevier, 2008. 4. Tammy Noregaard: Embeded Systems Architecture, Elsevier, 2005. 5. Steve Kilts: Advanced FPGA design : architecture, implementation, and optimization. Hoboken : John Wiley a. Sons, 2007 336 p.									
Supplementary references	1. Deschamps, Jean-Pierre, Enrique Cantó, and Gustavo D Sutter. Guide to FPGA Implementation of Arithmetic Functions. 1. Aufl. ed. Vol. 95. Dordrecht: Springer Netherlands, 2012. Lecture Notes in Electrical Engineering. Web. 2. Uwe Meyer-Baese: Digital signal processing with field programmable gate arrays. Berlin; Heidelberg: Springer, 2007. 774 p. 3. Patrick Lysaght: New algorithms, architectures and applications for reconfigurable computing. Dordrecht : Springer, 2005. 313 p. 4. Ashenden, Peter J. Digital Design (Verilog) : An Embedded Systems Approach Using Verilog. Amsterdam: Morgan Kaufmann, 2007. Web. 5. Frank Vahid, Tony Givargis: Embedded system design: a unified hardware/software introduction. New York : Wiley J., 2002.									
Organisational unit conducting the course	Department of Digital Media and Computer Graphics								Date of issuing the programme	
Author of the programme	dr inż. Adam Klimowicz								Feb. 17, 2022	

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW – field work, S – seminar