GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Microprocessor Control Systems, PG_00065787		
Field of study	Electrical Engineering		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Power Converters and Energy Storage Group -> Department of Power Electronics and Electrical Machines -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Paweł Szczepankowski	
	Teachers	dr hab. inż. Paweł Szczepankowski	

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	5.0	15.0	50

Subject objectives

The subject aims to provide the student with knowledge of microprocessor control systems. The student will learn about the functions, applications and practical use of several digital logic elements, including DSP processors and FPGA systems. In addition, the student will learn the skills of designing the NIOS processor architecture in the Quartus Prime environment using a tool for designing platforms based on MAX10 systems and MAX10-DE10 Lite evaluation boards. The student will learn about the architecture of the TMS320F28379D processor dedicated to power electronics applications and how to configure and use it in applications. In addition, the aim of the subject is also to learn the skills of creating IoT communication solutions using the ESP32 device family and the Raspberry Pi5 microcomputer.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W06] has an in-depth knowledge of industrial electronics, microprocessor control systems and in the field of power electronics and drive systems, their control and diagnostic methods	Identifies microprocessor system tasks, determines the method of their implementation, and selects design and support tools for systems with DSP processors and FPGA systems. Designs conceptual and block diagrams of electronics intended for control systems in power electronics.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U04] is able to select industrial electronics equipment and prepare their software, design systems microprocessor systems	Selects electronic circuits for the microprocessor control system. Designs a digital structure project containing an NIOS processor according to specification using tools in the Quartus Prime environment. Configures and parameterizes components of TMS320F28379D processor architecture, then runs the project based on application guidelines. Creates programs in Visual Studio Code environment with Platform IO add-on for ESP32 modules.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents	LECTURE:Basic logic circuits: buffers, latches, registers, digital isolators, voltage translators, gates, flip-flops, generators, USB bridges, voltage reset and supervision circuits, data memories. Data interfaces: serial, parallel, isolated, differential, I2C, RS232, SPI. FPGA circuits: types, applications, construction, parameters. NIOS processor: creating processor architecture, designing test applications in C, and starting the system. TMS320F283XX family processors: system configuration using dedicated tools such as SysConfig, beginning the program and its verification. IoT elements: building a system project with file system support, WiFi network, Ethernet connection using the Arduino platform, supporting temperature, pressure, and touch sensors. Construction of microprocessor systems used in power electronics: power supplies, reset systems, transistor control path systems, overflow detection, failure handling, recording and logging, signal processing, industrial current and voltage sensors, and communication interfaces. Construction of voltage inverters in the context of mechanics and control.LABORATORY:Design, start-up and test the NIOS2 processor in the FPGA programmable structure using the DE10 Lite board with the MAX10 system. Design, start-up and tests of the TMS320F28379D processor using the F28379D LaunchPad board, the C2000Ware library and the C2000 Academy course. Design of a simple operating system for the ESP32-PoE2 module: file system, configuration file, WiFi connection support, HTTP server, FTP server, sensor support, JSON files, website design, and data visualization.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
evaluation of reports	60.0%	40.0%
assessment of preparation and activity during the implementation of laboratory tasks	60.0%	20.0%
evaluation of answers to questions from the lecture content	60.0%	40.0%

Recommended reading

Basic literature	Paweł Hadam, Projektowanie systemów mikroprocesorowych, ISBN: 83-910067-9-4 Jacek Majewski, Piotr Zbysiński, Układy FPGA w przykładach, ISBN: 978-83-60233-23-8 Henryk A. Kowalski, Procesory DSP w przykładach, ISBN 978-83-60233-78-8
Supplementary literature	Dag Stranneby, Cyfrowe przetwarzanie sygnałów. Metody, algorytmy, zastosowania, ISBN: 83-921073-4-9 Andrzej Pawluczuk, Układy programowalne dla początkujących, ISBN: 978-83-60233-65-8 Charles Kitchin, Lew Counts, Wzmacniacze operacyjne i pomiarowe. Poradnik projektanta, ISBN: 978-83-60233-39-9
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Example questions:1. Provide the designation of an 8-bit buffer powered by 3.3V with a settable data flow direction and increased resistance to voltage overshoot on digital inputs.2. Describe the functions of the DMA module in the NIOS2 processor.3. Draw and describe the I2C data frame.4. List the signals in the SPI interface and state their function.5. Characterize the EPWM module in the TMS320F28379D processor.6. List the DC and AC current sensors used in power electronics with a current output with a range not exceeding 100 mA.7. Methods of measuring voltages in microprocessor-controlled inverters.Example issues: 1. Design of the NIOS2 processor with SDRAM, FLASH memories and a DMA module connected to a parameterized parallel port.2. Programming an EPWM module to work in a voltage inverter: dead times, PWM modulation, synchronization, ADC processing.
Work placement	Not applicable