University of Gdańsk

Subject card

Subject name and code	Advanced electronic chemical diagnostics, PG_00080906						
Field of study	Chemical Business						
Date of commencement of studies	February 2025		Academic year of realisation of subject		2024/2025		
Education level	postgraduate studies		Subject group		Obligatory subject group in the field of study		
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	academic		Assessment form				
Conducting unit	Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Cezary Czaplewski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15		10.0		25.0	50
Subject objectives	Introduction to the construction and programming of microelectronic devices based on the Arduino microcontroller and their use for physicochemical measurements in the chemical diagnostics. Developing skill of unassisted designing experiments and interpretation of the obtained results of physicochemical measurements.						

Learning outcomes			
	Course outcome	Subject outcome	Method of verification
	[BCHMU2_W02] Knows and understands the axiological conditions regarding the use of modern measuring techniques and instruments as well as IT tools in chemistry, including economic aspects.	Knows the conditions regarding the use of analog and digital sensors in chemical diagnostics.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
	[BCHMU2_K02] Is willing to create and manage group work plans and to take responsibility for the work of the whole team, properly assess their work and individual team members.	Plans teamwork when designing, building and programming electronic devices, both as a group member and its leader. Develops the ability to make precise and logical conclusions.	[SK8] observation of student's independent or team work
	[BCHMU2_W04] Knows and understands specialist IT tools used in chemical diagnostics.	The student distinguishes the Python language instructions used to program communication between the computer and the Arduino microcontroller from the Arduino environment instructions used to program the microcontroller itself, names and describes the types and data structures used in both programming languages.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
	[BCHMU2_K09] Is willing to conduct research and develop scientific and creative achievements in the field of the specialisation studied.	Learns the principles of safe, responsible and effective work with digital devices (microcontrollers and computers). Understands the social aspects of the practical use of electronic devices in physicochemical measurements to detect threats to human health and the natural environment.	[SK8] observation of student's independent or team work
	[BCHMU2_U06] Is able to critically analyse experimental data by numerical and statistical methods using IT techniques and tools.	Builds electronic circuits using the Arduino microcontroller in accordance with the given diagrams. Is able to design appropriate changes in these electronic systems. Designs algorithms in the Arduino environment, compiles and tests the obtained programs on Arduino microcontrollers. Uses self-designed and built electronic systems to carry out measurements. Designs algorithms in Python for computer communication with the Arduino microcontroller, tests the obtained programs for analysis and visualization of measurement results made by devices based on the Arduino microcontroller. Analyzes the obtained measurement results using numerical and statistical methods.	[SU2] presentation/project/paper/ report
	[BCHMU2_W01] Knows and understands complex physicochemical processes and is able to analyse their course in connection with other fields of science.	Understands the physicochemical processes used in chemical diagnostics to build devices such as breathalyzer, colorimeter, pH meter, conductivity meter.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
Subject contents	Programming microcontrollers in the Arduino environment: using variables, conditional instructions, loop instructions, defining your own functions. Building, programming and testing electronic devices based on the Arduino microcontroller. The use of microcontroller based devices in chemical diagnostics for measurements of physicochemical quantities such as temperature, humidity, concentration of selected chemical substances. The use of analog and digital sensors. Construction, programming and calibration of the breathalyzer with a digital display or a display based on a set of LEDs and a sensor that changes resistance depending on the concentration of ethyl alcohol vapors. Construction and programming of the sensor detecting methane and other flammable gases. The use of a color sensor and RGB diode to build a colorimeter. Calibration of the constructed colorimeter according to Lambert-Beer law for various dilutions of several dyes. Construction, programming and calibration of a pH meter. Construction, programming and calibration of the conductivity meter. Construction and programming of a syringe pump using a stepper motor controlled by the Arduino microcontroller. Programming the communication of Arduino microcontrollers with a computer using Python scripts for the analysis and visualization of measurement results (complex data structures on the example of a list, matplotlib library for drawing charts, elements of object-oriented programming and numerical methods).		
Prerequisites and co-requisites	Information technology		

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>project</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>test exam</td><td>51.0%</td><td>50.0%</td></tr>
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<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Programming Arduino: Getting Started with Sketches, Simon Monk, McGraw-Hill Education Ltd 2022

Programming Arduino Next Steps: Going Further with Sketches, Simon Monk, McGraw-Hill Education Ltd 2018</td></tr>
<tr><td>Supplementary literature</td><td>Learning Python: Powerful Object-Oriented Programming, M. Lutz, O'Reilly Media 2013</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2"></td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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