

Subject card

Subject name and code	Advanced electronic chemical diagnostics, PG_00080906						
Field of study	Chemical Business						
Date of commencement of studies	February 2027		Academic year of realisation of subject		2026/2027		
Education level	Master's studies		Subject group		Obligatory subject group in the field of study 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	1		Language of instruction		Polish		
Semester of study	1		ECTS credits		2.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Faculty of Chemistry -> Rector						
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_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		
	[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_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		

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		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	test exam	51.0%	50.0%
	project	51.0%	50.0%
Recommended reading	Basic literature	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	
	Supplementary literature	Learning Python: Powerful Object-Oriented Programming, M. Lutz, O'Reilly Media 2013	
	eResources addresses		
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		

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