KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ SPOŁECZNY

Course title	ECTS code
Microcontroller-based chemical diagnostics	13.3.1303

Name of unit administrating study

null

Studies

faculty	field of study		
Wydział Chemii	Chemia	type	drugiego stopnia
		form	stacjonarne
		specialty	Digital Chemistry
		specialization	wszystkie

Teaching staff

dr hab. Artur Giełdoń; dr hab. Adam Sieradzan, profesor uczelni; prof. dr hab. Cezary Czaplewski, profesor uczelni

Forms of classes, the realization and number of hours

Forms of classes

Auditorium classes

The realization of activities

classroom instruction

Number of hours

Auditorium classes: 30 hours

ECTS credits

2
auditorium classes– 30 h
student's own work – 10 h
tutorial classes – 10 h
Total: 50 h – 2 ECTS

The academic cycle

2023/2024 summer semester

Type of course

an elective course

Language of instruction

English

Teaching methods

• Case studies in computer laboratory

Form and method of assessment and basic criteria for eveluation or examination requirements

Final evaluation

Graded credit

Assessment methods

- completion of the final project (building, programming, and testing of a selected microcontroller-based device used in chemical diagnostic)
- completion of all assigned projects during classes in the computer lab
- written report for each assigned project

The basic criteria for evaluation

- correctness of the reports on assigned projects, the final grade of the lab. is based on the partial grades received from each report and presentation of the final project; failure to complete the experimental part means failing the laboratory exercises

Method of verifying required learning outcomes

Required courses and introductory requirements

A. Formal requirements
Introduction to Python programming

B. Prerequisites
basis of calculus and linear algebra, ability to use the LINUX operating system

Aims of education

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.

Course 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 breathalyser 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 vapours. Construction and programming of the sensor detecting methane and other flammable gases. The use of a colour 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).

Bibliography of literature

Literature required to pass the course

Programming Arduino: Getting Started with Sketches, ISBN-10: 1259641635, ISBN-13: 978-1259641633

Extracurricular readings

Python Programming: Using Problem Solving Approach, ISBN-10: 0199480176, ISBN-13: 978-0199480173

The learning outcomes (for the field of study and specialization)

K_W03: demonstrates in-depth knowledge in the field of modern measuring techniques used in chemical analysis

K_W05: has extended knowledge in the field of the specialisation studied

K_W06: applies mathematics to the extent necessary to understand, describe and model chemical processes of extended complexity

K_U02: critically assesses the results of conducted, performed observations and theoretical calculations and discusses errors

K_U05: presents the results of research in the form of an independently written paper containing a description and justification of the purpose of the work, adopted methodology, results and their significance in comparison to other similar research

K_K01: knows the limitations of her/his own knowledge; understands the need for further education and can inspire other people to do so

K_K06: undertakes research tasks consciously and responsibly, understanding the social aspects of the practical application of the acquired knowledge and skills and the responsibility related to it

Knowledge

Defines the concept of the algorithm. Connects this problem with the constructed device. Describes the basic numerical algorithms. Calculates an electronic circuit. The student describes the numerical methods that can be applied so solve a given problem of computational chemistry or chemometrics

Skills

The student defines and solves the problems connected with the specific features chemical measurement equipment. Solves the computational problems that arise in chemistry. Designs, for this purpose, simple numerical applications that use own or library procedures. Can construct and repair electronic equipment.

Social competence

The student develops the skills of accurate and logical thinking and inference. Learns the principles of working safely, responsibly, and efficiently using the workstations connected to the Internet. Develops the responsibility for his/her personal account on the workstation. Develops the ability of working in a team

Contact

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