	Syllabus of the academic discipline «ELECTRONIC EMBEDDED SYSTEMS AND THEIR PROGRAMMING» Educational-professional programs: «Electronic systems» «Electronic technologies of the Internet of Things» «Computerized Means of Monitoring Tools of Frequency Resource» Specialty: 171 Electronics Field of knowledge: 17 Electronics and telecommunications
Higher education level	Bachalor
Discipline status	Academic discipline of the professional component of Educational
Course	3 (third), 4 (fourth)
Semester	odd, even
The scope of discipline, ECTS credits / hours	12 credits/360 hours
Teaching language	Ukrainian, English
What will be studied (subject of study)	This discipline is the theoretical basis of the set of knowledge and skills that form the system profile of a specialist in the field of programmable embedded electronic systems.
Why it is interesting /necessary to study (goal)	The purpose of teaching the discipline is to study the basic concepts of design of programmable embedded electronic systems, acquaintance with the circuitry and programming languages of microcontrollers, which are widely used to create programmable embedded electronic systems.
What can be learned (learning outcomes)	- independently develop software for embedded electronic systems; - independently choose the means of designing programmable embedded electronic systems; - independently plan and adjust the system to the required operating mode.
How can you use the acquired knowledge and skills (competences)	The knowledge and skills acquired by the student during the study of this discipline allow - independently use the tools of design and research of programmable embedded electronic systems based on microcontrollers. - independently develop algorithms and control programs for programmable embedded electronic systems based on microcontrollers using high-level algorithmic languages and assembler and configure them.

Educational logistics	**Course content**: Basic concepts and definitions of programmable embedded electronic systems. Features of embedded electronic systems. Size miniaturization and testing process. Minimization of energy consumption. Multitasking. Software and hardware dualism. Microcontrollers and FPGAs are the cores of programmable embedded electronic systems. FPGA application. Microcontrollers of MC68, PIC and AVR families. The structure of AVR microcontrollers from Atmel. AVR microcontrollers of the Tiny, Classic, Mega families. Hardware composition of AVR microcontrollers. Arithmetic and logic device. Memory. Registers. Timers. I / O ports. Serial ports. Analog comparator. Analog-to-digital converter. Parallel exchange. Serial interfaces. Asynchronous (UART) and synchronous-asynchronous (USART) interfaces. SPI interface. TWI (I2C) interface. Universal serial USI interface. AVR microcontroller assembler language command system. Programming of AVR microcontrollers. The structure of the program in assembly language. Time delay programming. Application of macros. Timer programming. Application of interrupts. Connecting standard I / O devices to microcontrollers. Discrete data input devices: buttons, switches, keyboards. Indication devices: LEDs, seven-segment indicators, liquid crystal indicators. Examples of embedded control systems. Software for designing embedded electronic: PonyProg, AVR-studio, CodeVision, Proteus. Hardware for designing and researching programmable embedded electronic systems based on microcontrollers. Overview of STM32 family microcontrollers. Schemes of inclusion of STM32. Types of cases. Supply voltage. Reset scheme. Generators. Download control conclusions and in-system programming. Download modes. Debugging port. Design tools. Starter kits. Libraries and protocol stacks. Real-time operating systems. Software development environments for MK STM32. Operating modes of STM32 microcontrollers. **Activities:** Lectures, laboratory work, computational and graphic work, modular tests. **Teaching methods:** Educational research based on storytelling, discussion, computer modeling, laboratory work and online work. **Forms of training:** group, individual, frontal, collective, classroom and extracurricular.
Prerequisites	General and professional knowledge obtained at the first (bachelor's) level of higher education (higher mathematics, physics, analog and digital circuitry and electronics, algorithmic programming languages, microprocessors and microcontrollers)
Requisites	There is a basis for such disciplines as: "Electronic systems", "Basics of electronic circuits design process", "Professional technological practice", "Pre-diploma practice". Mastering the principles of building digital measuring instruments will be useful when performing bachelor's and master's work.
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Location and logistics	Training sessions are held in a specialized classroom equipped with computer and projection equipment. Students are provided with electronic teaching aids, laboratory practice, programs, laboratory digital equipment.
Semester testing and examination methodology	Checking measures for the discipline are carried out in the form of: ***current check*** - the teacher's definition of knowledge based on the work performed by the student, including independent, tests and other tasks, with scoring according to the criteria and assessment scale approved by the department; ***intermediate checking*** - diagnostics of the level of mastery of educational material within the meaningful module; ***final checking*** (**exam**) - diagnostics of the level of mastery of educational material within the entire academic discipline with an assessment of the results on the national scale and the ECTS scale; The form of the exam is determined by the relevant decision of the department and can be based both on the traditional survey system for exam tickets, and on the basis of an interview.
Department	Electronics, robotics, monitoring and IoT technologies
Faculty	Aeronavigation, electronics and telecommunications (FAET)
Teacher 	**Full Name:** Bidnyi Mykola Semenovich **Position:** senior teacher **Teacher profile:** http://kafelec.nau.edu.ua/sklad_bidnuy-ukr.html **Tel.:** +380936708425 **E-mail:** nick@nau.edu.ua; bms4u@ukr.net **Workplace:** 3.409
Originality of academic discipline	Author's course; teaching in English or Ukrainian (at the request of students)
Link to discipline	http://kafelec.nau.edu.ua

Developer Mykola Bidnyi

Head of the Department Volodymyr Shutko