Implementation Group	
Doc.:	EuCTSds/ EI-03
Date :	30 06 2023
Origin:	EuCTSds Project

Countries	Institutions	Common Module	ECTS
Romania **Poland** **Greece** **France** **Bulgaria**	Military Technical Academy "Ferdinand I" Military University of Technology Hellenic Air Force Academy French Air Force Academy "Vasil Levski" National Military University	**Microcontrollers** *European Common Technical Semester for Defence and Security*	**3.0**

Service	**Minimum Qualification of Instructors**
Technical/ALL	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Expertise in relevant topics. ○ Relevant academic publications.
Language **English**	

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge in technical systems for security and defence	• Developing students' skills in solving simple problems arising at using and configuring computer networks. • To introduce students with the architecture and operation of typical microprocessors and microcontrollers. • To familiarize the students with the programming and interfacing of microprocessors and microcontrollers. • To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Learning outcomes		
	Know-ledge	• Understanding the basic principles of Microcontroller based design and development • To encourage the students to have a better understanding of the state-of-the-art interfacing technologies, their potential applications and their market views
	Skills	• Ability to design and build functional prototypes for real-world applications. • Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
	Respon-sibility and autonomy	• Compare accepted standards and guidelines to select the appropriate Microprocessor and Microcontroller to meet specified performance requirements. • Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.

Verification of learning outcomes:

- **Observation**: Throughout the Module students will meet with the systems applications, and they will discuss the given topics in the plenary and present teamwork results. During this workshop, students will be evaluated to verify their competencies.
- **Project**: Teamwork project and project defence.
- **Test**: Final examination at the end of the module.

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Module details

Main Topic	Recom-mended WH	Details
Introduction to microprocessors and microcontrollers.	6	Definitions and types of processors. Differences between microprocessor and microcontroller. Construction and operation of the processor of 8-bit AVR microcontrollers. Main functional blocks and microprocessor registers. Electrical parameters, power supply systems, generating the clock signal and resetting the microprocessor. Characteristics of the most popular microcontroller families. (Lecturer 2, Applications 4h)
Organization of program and data memory, methods and elements of microcontroller programming	6	. Structure of a RAM and ROM memory cell. Memory map and organization of Flash, EEPROM and SRAM memory in AVR microcontrollers. Microcontroller programming languages. Program (runtime) environments. Program structure and application software development cycle. Programming methods, access and protection of Flash memory contents. EEPROM memory support . (Lecturer 2, Applications 4h)
Basic input-output circuits and the interrupt system of microcontrollers.	6	Construction of ports - basic input and output circuits of microcontrollers. Port lines in input / output mode with required properties. Dedicated registers for handling ports and input-output lines. Interrupt sources, interrupt vector. Interrupt service registers. Interrupt handling functions. Examples of handling interrupts from a digital input. (Lecturer 2, Applications 4h)
Timer-counter systems of microcontroller	6	Operation of basic timer-counters. Clock signal sources for counters. Configure the subsystem of counters / timers in compare and capture mode. The use and program service of timer-counters to generate pulses with a given time and square waveforms with a given frequency, filling and shift. The use and program service of timer-counters to measure the pulse duration, period and filling of a square wave, shift between two waveforms. (Lecturer 2, Applications 4h)
Specialized input-output systems of microcontrollers (analog comparators, A / C and C / A converters).	6	Construction of comparators, analog-to-digital (A / C) and digital-to-analog (D / A) converters used in AVR microcontrollers. Review of registers for A / C and D / A converters. Interrupts generated by these devices. Programming of converters without and with the use of interrupts. (Lecturer 2, Applications 4h)
Built-in drivers for serial transmission	6	. Characteristics of USART, I2C (TWI) and SPI transmission standards. Construction of USART, TWI and SPI controllers in microcontrollers of the AVR family. Registers and program service of individual interfaces. Usage and handling of interrupts generated by USART, TWI and SPI controllers. (Lecturer 2, Applications 4h)
Organization of the microprocessor system, examples of ready-made hardware platforms.	6	The concept of a microprocessor system. Microprocessor environment systems. Specialized circuits and input / output devices. Program support for SD memory, matrix keyboard, LED displays, character and graphic LCD displays and electric motors. Examples of ready-made microprocessor systems (e.g. Arduino) and SoC platforms (e.g. Raspberry Pi, Banana Pi) . (Lecturer 2, Applications 4h)
Total WH	**42**	

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Module details		
Main Topic	**Recom-mended WH**	**Details**
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Specific online RFC documents. • Individual preparation for the group project; • Team work for the group project; • Simulation software self-study.
Total WH	**75**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

WH ..... Working Hour

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