Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Automation. Applied Informatics and Intelligent Systems
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name			***Microprocessor-Based Systems***			Discipline code	29.00
2.2 Course responsible/lecturer			S.L. Dr. Ing. Madalin Neagu – Madalin.Neagu@cs.utcluj.ro				
2.3 Teachers in charge of applications			Prof. Dr. Ing. Anca Hangan – Anca.Hangan@cs.utcluj.ro S.L. Dr. Ing. Madalin Neagu – Madalin.Neagu@cs.utcluj.ro As. Dr. Ing. Andrei Stancovici – Andrei.Stancovici@cs.utcluj.ro				
2.4 Year of study	2	2.5 Semester	2	2.6 Assessment *(E/C/V)*			E
2.7 Type of subject	Formative category						DID
	Optionality						DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	3.2 Course	2	3.3 Seminar		3.3 Laboratory	2	3.3 Project		3.3 Practical	
3.4 Number of hours per semester	56	of which:	3.5 Course	28	3.6 Seminar		3.6 Laboratory	28	3.6 Project		3.3 Practical	

3.7 Individual study	
(a) Evaluation	3
(b) Manual, lecture material and notes, bibliography	30
(c) Supplementary study in the library, online and in the field	10
(d) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	26
(e) Tutoring	0
(f) Other activities	0
3.8 Total hours of individual study (sum of (3.7(a)...3.7(f))	69
3.9 Total hours per semester (3.4+3.8)	125
3.10 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	Analog and digital circuits
4.2 Competence	Programming

5. Requirements (where appropriate)

5.1. For the course	Video projector, computer, interactive board/blackboard, Teams, Moodle
5.2. For the applications	Computers, microcontroller development systems

6. Specific competences

Professional competences	C2. Operating with basic concepts of computer science, information technology and communication C4. Design, implementation, testing, operation and maintenance of systems with generic and dedicated equipments, including computer networks for control engineering and applied informatics. C5. Development and implementation of automatic control structures and algorithms based on project management principles, software environments and technologies based on microcontrollers, signal processors, programmable logic controllers and embedded systems.

Cross competences	-

7. Expected learning outcomes

Knowledge	The student describes the architecture and operation of microprocessor-based systems, including the CPU, ALU, control unit, registers, system buses, memory, and input/output interfaces. The student explains instruction execution phases, instruction formats, addressing modes, and control mechanisms used in microprocessor-based systems. The student identifies the main characteristics of general-purpose microprocessors, microcontrollers, digital signal processors, memory hierarchies, input/output interfaces, communication interfaces, and advanced computer architectures.
Skills	The student analyzes the functional structure of a microprocessor-based system and identifies the role of its main hardware and software components. The student applies instruction sets and addressing modes in the development and analysis of low-level programs for microprocessor-based systems. The student designs, implements, tests, and debugs basic memory modules, input/output interfaces, and embedded applications using microcontroller development platforms. The student selects appropriate data transfer mechanisms, such as programmed transfer, interrupt-based transfer, direct memory access, serial communication, and USB communication, according to the application requirements.
Responsibilities and autonomy	The student works independently and responsibly in the analysis, implementation, testing, and documentation of microprocessor-based and embedded applications. The student uses laboratory equipment, development boards, software tools, and technical documentation in a safe, correct, and responsible manner. The student collaborates effectively in laboratory and project activities, assumes responsibility for assigned tasks, and justifies technical decisions based on functional and performance requirements.

8. Course objectives

General objective	Study of the principles, architecture, organization, and operation of microprocessor-based systems, with emphasis on processor structure, memory organization, input/output interfaces, communication mechanisms, and advanced computer architectures.
Specific objectives	Understanding the architecture and operation of microprocessor-based systems, including CPU organization, system buses, instruction formats, addressing modes, and instruction execution mechanisms. Studying the structure and operation of general-purpose and special-purpose processors, including microprocessors, microcontrollers, digital signal processors, and system-on-chip architectures. Understanding memory organization and memory subsystem design, including memory circuits, SRAM/DRAM technologies, cache memories, virtual memory, and memory hierarchy principles. Studying the design and operation of input/output interfaces, interrupt systems, direct memory access, serial communication, USB interfaces, and data transfer mechanisms. Analyzing advanced and networked computing architectures, including RISC/CISC processors, pipeline and parallel architectures, computer networks, distributed systems, and computer-based control systems.

9. Contents

9.1 Lecture	No.hours	Teaching methods	Notes
C1. Introduction – Brief history of computer science, evolution of microprocessors, performance parameters of computing systems	2	Oral presentations from slides, examples on interactive board/blackboard	
C2. General structure of a computer – Central processing unit, arithmetic and logic unit	2		
C3. Computer design – Design phases, design of a simple computer, structure of a pipeline computer, hazard situations	2		

C4. Microprocessors – Definition, structure of a microprocessor-based system, microprocessor signals, Intel x86 family processors, P6 superscalar architecture, NetBurst architecture	2		
C5. Specialized microprocessors – Digital signal processors, microcontrollers	2		
C6. Memory design – ROM, RAM, and DRAM memory circuits, operating principles, design methodology for memory modules	2		
C7. Memory hierarchies – Cache memory, implementation examples, virtual memory, memory segmentation, memory paging	2		
C8. Design of input/output interfaces – Design principles, interface structure, transfer modes, programmed transfer, interrupt system	2		
C9. Design of input/output interfaces (cont.) – Direct memory access transfer, input/output processor transfer	2		
C10. Serial interface – Synchronous and asynchronous serial transfer, RS232 protocol specifications, RS485 protocol, message-based serial transfer	2		
C11. Design of input/output interfaces (cont.) – USB interface, parallel interface, design example of an interface	2		
C12. Computer networks – ISO-OSI model, protocol layers, types of communication networks, detailed presentation of the ISO-OSI protocol layers	2		
C13. Distributed control systems – Definition, implementation principles of distributed systems, implementation of control systems using distributed systems	2		
C14. Advanced computer architectures – RISC architectures, parallel architectures	2		
Bibliography 1. D. Gorgan, G. Sebestyen, Structura sistemelor de calcul, Editura Albastra, 2000 2. D. Gorgan, G. Sebestyen, Proiectarea calculatoarelor, Editura Albastra, 2005 3. Gheorghe Sebestyen, Informatica industriala, Editura Albastra, 2006 4. S. Nedevschi, "Microprocesoare", Editura UTCN, 1994 5. Course slides: http://users.utcluj.ro/~madalin			

9.2 Applications (seminar/laboratory/project/practical work)	No.hours	Teaching methods	Notes
L1. Structure of a personal computer	2	Practical exercises, laboratory experiments, and implementation of small-scale projects	
L2. ISA x86 architecture	2		
L3. Intel x86 processor family instruction set	2		
L4. Intel x86 processor family instruction set (Part II)	2		
L5. Addressing modes	2		
L6. Programming techniques in assembly language	2		
L7. Design of memory modules	2		
L8. Design of input/output interfaces	2		
L9. Study of the sensing, computing, and communication features of an Arduino-type board	2		
L10. IoT – Internet of Things – Accessing simple objects or devices over the Internet	2		
L11. IoT wireless sensor networks	2		
L12. Control of complex processes using an Arduino-type platform – Part	2		
L13. Control of complex processes using an Arduino-type platform – Part II	2		
L14. Examination/Colloquium	2		
Bibliography 1. Laboratory works and additional resources: http://users.utcluj.ro/~madalin			

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The course and laboratory activities cover current technologies used in microprocessor-based systems, including processors, memories, input/output interfaces, microcontrollers, and digital communication devices. The curriculum is aligned with the requirements and expectations of the ICT and automation industry, the professional community, and relevant employers.

11. Evaluation

Activity type	11.1 Assessment criteria	1.2 Assessment methods	11.3 Weight in the final grade
11.4 Course	Degree of knowledge of specific concepts and notions	Written exam	70%
11.5 seminar/laboratory/project/ practical work	Design and implementation skills	Colloquium - Moodle	30%
11.6 Minimum performance standard: Attendance at all laboratory works Course grade calculation: 70% written exam + 30% laboratory grade Conditions for participation in the final exam: laboratory grade ≥ 5 Passing conditions: Written exam grade ≥ 5			

Date of filling in:		Title Firstname NAME	Signature
07.07.2026	Course	S.L. Dr. Ing. Madalin Neagu	
	Applications	Prof. Dr. Ing. Anca Hangan	
		As. Dr. Ing. Andrei Stancovici	

Date of approval by the Department Board	Head of Department Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Faculty Council	Dean Prof.dr.ing. Vlad MUREȘAN