SYLLABUS

1. Program information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	Communications
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Study program / Qualification	Telecommunications Technologies and Systems/ Engineer
1.7 Form of education	IF – full-time education

2. Course information

2.1 Course title	Microprocessor-based Systems			Course code	TST-E37.00
2.2 Course coordinator	*Professor Eugen LUPU, Ph.D. - Eugen.Lupu@com.utcluj.ro*				
2.3 Laboratory coordinator	*Professor Eugen LUPU, Ph.D. - Eugen.Lupu@com.utcluj.ro* *Assoc. Prof. Anca APATEAN, Ph.D. - Anca.Apatean@com.utcluj.ro*				
2.4 Year of study	3	2.5 Semester	6	2.6 Type of assessment	E
2.7 Course status	Formative category				DS
	Optionality				DOB

3. Estimated total time

3.1 Hours per week	4	of which:	3.2 Lecture	2	3.3 Seminar	-	3.3 Laboratory	2	3.3 Project	-	3.3 Practical training	-
3.4 Hours per semester	56	of which:	3.5 Lecture	28	3.6 Seminar	-	3.6 Laboratory	28	3.6 Project	-	3.3 Practical training	-

3.7 Time distribution (hours per semester) for individual study and assessment:	
(a) Assessment	3
(b) Study using textbook, course materials, bibliography, and notes	14
(c) Additional documentation in the library, on specialized electronic platforms, and in the field	10
(d) Preparation for seminars/laboratories, assignments, reports, portfolios and essays	14
(e) Tutoring	3
(f) Other activities	-
3.8 Total hours of individual study and assessment (sum of (3.7(a)...3.7(f))	44
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credits	4

4. Prerequisites (where applicable)

4.1 curriculum	Basics on computers and microprocessors, digital integrated circuits, Boolean algebra, digital integrated circuit design, synthesis of logic functions
4.2 competencies	Programming skills: x86 assembly language, C

5. Requirements (where applicable)

5.1. for the development of the lecture	Cluj-Napoca
5.2. for the development of the seminar/ laboratory/ project	Cluj-Napoca

6. Specific competencies acquired

Professional competencies	C3. Application of the basic knowledge, concepts and methods regarding the architecture of computer systems, microprocessors, microcontrollers, languages and programming techniques C4. Design, implementation and operation of data, voice, video and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks
Transversal competencie	N/A

7. Expected learning outcomes

Knowledge	**K4.** The student/ graduate describes, identifies, summarizes concepts and elementary methods of signal acquisition, analysis and processing, implemented in systems with general-purpose processors or signal processors and their application in concrete problems. **K5.** The student/graduate describes, identifies, summarizes elementary concepts and methods regarding the architecture of computer systems, microcontrollers, programming languages and techniques and their application in concrete problems

Skills	**S16.** The student/ graduate designs functional blocks of low/medium complexity for digital signal analysis and processing and implements them on signal processors, microcontrollers or dedicated processors. **S17.** The student/graduate evaluates, based on specific performance criteria, the type of computing system, its architecture and the way of use necessary for an efficient solution of concrete problems. **S18.** The student/graduate specifies requirements, develops programs in general-purpose programming languages (C, etc.) and/or object-oriented (C++, Java, etc.), executes, debugs and interprets the results of the programs developed to solve a concrete problem. **S19.** Modify the scope of an information and communications technology (ICT) system by adding or reallocating additional ICT system components, such as network components, servers, or storage media to meet capacity demands. **S20.** The student/graduate carries out projects of low/medium complexity that involve the simultaneous use of hardware components (microprocessors or microcontrollers) and software components (related programs)
Responsibility and autonomy	**R9.** The student/ graduate demonstrates initiative and takes action to update their professional, economic, and organizational culture knowledge. **R10.** The student/ graduate has honorable, responsible, and ethical behavior, in accordance with the law to ensure the reputation of the profession.

8. Course objectives (based on the grid of specific competencies acquired)

8.1 General objective of the course	Developing the competences regarding the use of microprocessors, microcontrollers and interfaces in microsystems and computers.
8.2 Specific objectives	1. Understanding of main architectures in data processing 2. Understanding basic microprocessors concepts and programming using Intel x86 as reference 3. Interfaces, buses and programmable devices study and use 4. To assess the requirements of a microprocessor / microcontroller for a specific application 5. To develop applications using PC resources and ESP8266 microcontrollers

9. Contents

9.1 Lecture	**No. of hours**	**Teaching methods**	**Remarks**
Course description. Evaluation mode. Pentium Processors. Architecture. Registers. Pipeline. Cache memory. Floating Point Unit. Branch prediction. New generation of Pentium. Multicore architectures.	2	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case	Use of .pptx presentation, projector, blackboard
PC memory. The memory map (main memory, video, UMA, HMA). Memory extended and expanded. Virtual memory. Connecting additional memory to the PC memory map.	2		
Memory Hierarchy in terms of technology. The cache role. The basic models of the cache. Cache Memory Architectures. The Pentium cache.	2		

9.1 Lecture	No. of hours	Teaching methods	Remarks
1. 80x86 programmable interfaces family. Presentation of the timer I8254. Architecture. Pins and signals. The timer programming. Employment of the timer on the PC. Examples of use.	2	study, formative evaluation	
2. Classification of interrupts. PIC I8259A circuit architecture.PIC pins and signals. Programming of the PIC. Interrupts assignments on PC.	2		
3. Direct memory access basics. The DMA controller I8237A.The internal architecture. Pins and signals. I8237A programming.	2		
4. Serial Communications RS232. UART/USART. The I16550 device architecture. Programming. Applications.	2		
5. Serial interfaces. I2C, SPI, I2S Use and applications.	2		
6. Buses in the PC (ISA, PCI, AGP). ISA bus signals. Development of the ISA bus compliant cards.	2		
7. PCI Bus overview. Architecture and signals. Transfer modes	2		
8. PCI express overview. PCI Express bus topology, architecture, layers, transactions.	2		
9. USB Bus overview. USB On the Go. USB 3.0.	2		
10. ESP8266 microcontroller. Architecture.	2		
11. Applications. Review-exam topics.	2		

References:

1. E. Lupu, A. Mesaros, A.F. Suciu, *Microprocessors Architectures and Applications*, Editura Risoprint Cluj-Napoca 2002, ISBN 973-656-392-8.
2. E. Lupu, *Sisteme cu microprocesoare. Resurse hardware. Prezentare, programare şi aplicaţii.* Ed. Albast Cluj Napoca 2004, ISBN 973-650-109-4
3. M. Tischer, B. Jenneric, *La Bible PC Programmation Systeme*. MICRO Application 2000
4. W. Buchanan, *PC interfacing,Communications and Windows Programing* Addison Wesley 2002
5. N. Mathivanan, *Microprocessors, PC Hardware and Interfacing*, PHI Learning Pvt. Ltd., 2003

Online references:

6. E. Lupu, *Lecture slides*, Technical University of Cluj-Napoca, 2026, https://elupu.utcluj.ro/
7. *Microprocessors Reference Manual*, Intel Corporation, 2026, www.intel.com

9.2 Laboratory	No. of hours	Teaching methods	Remarks
1. Introduction. Laboratory Objectives topic.	2	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, computers, magnetic board
2. Identifying processors in PCs. Microprocessors resources determination employing CPUID instruction.	2		
3. The Cache memory. Application using CPUID instruction.	2		
4. The timer circuit 8254. Applications. Audio signals generation.	2		
5. Programmable Interrupt Controller -I8259A. Applications.	2		

9.2 Laboratory	No. of hours	Teaching methods	Remarks
6. 8237A DMA controller programming. DMA data transfer to PC in the video memory.	2		
7. The UART 16650 interface. Serial communication applications.	2		
8. LCD interfacing on SPP.	2		
9. USB Bus. Design USB devices using USB-serial converters FT232.	2		
10. Basic applications on ESP8266 platform. Arduino IDE.	2		
11. ADC applications on ESP8266 board.	2		
12. SPI interface on ESP8266 board.	2		
13. I2C application on ESP8266.	2		
14. Lab recovery and laboratory activity evaluation	2		
Online references: 1. E. Lupu, *Lecture slides*, Technical University of Cluj-Napoca, 2026, https://elupu.utcluj.ro/ 2. *Microprocessors Reference Manual*, Intel Corporation, 2026, www.intel.com			

10. Alignment of the course contents with the expectations of the epistemic community, professional associations, and representative employers in the field related to the program

The discipline content and the acquired skills are in agreement with the expectations of the professional Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods and type of assessment: continuous/ summative)	11.3 Weight in final grade
11.4 Course	The level of acquired theoretical knowledge and practical skills	Written exam (theory+ problems)	65%
11.5 Laboratory	The level of acquired knowledge and abilities	Laboratory tests (3-4)	35%

11.6 Minimum performance standard

Qualitative level:

Minimal knowledge:

- ✓ Knowledge of Intel processors architecture
- ✓ Knowledge of main interfaces employed in PC.
- ✓ Knowledge of main buses in PC.

Minimal competences:

- ✓ *To know the main architectural elements of Microprocessors*
- ✓ To be able to program the main interfaces employed in PC
- ✓ To know how to use the Arduino IDE tool

Quantitative level:

- ✓ Perform all laboratory work
- ✓ The exam and laboratory notes must be at least 5.
- ✓ The mark for the subject is calculated with the relation: 0.65 * Exam score + 0.35 * Labs score

Completion date:	**Course coordinators**	**teaching rank, title First name LAST NAME**	**Signature**
16.06.2026	Course	*Professor Eugen LUPU, Ph.D. - Eugen.Lupu@com.utcluj.ro*	
	Applications	*Professor Eugen LUPU, Ph.D. - Eugen.Lupu@com.utcluj.ro*	
		Assoc. Prof. Anca APATEAN, Ph.D. - Anca.Apatean@com.utcluj.ro	

Approval of the Head of the Department coordinating the course, only if this differs from the department organizing the study program	Head of Department

Date of approval by the Council of the Communications Department 19.06.2026	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval by the Council of the Faculty of Electronics, Telecommunications and Information Technology 30.06.2026	Dean, Prof. Ovidiu-Aurel POP, Ph.D.