Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și
Tehnologia Informației

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Applied Electronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Arhitectura microprocesoarelor 1 Microprocessor Architecture			
2.2 Course Lecturer				Conf. Dr. Horia Cucu, S.l. Dr. Diana-Elena Grosu-Sandru			
2.3 Instructor for practical activities				S.l. Dr. Diana-Elena Grosu-Sandru, S.l. Dr. Vlad Popescu, As. Andrei Daescu, As. Andrei Danlila, As. Alexandru Guzu			
2.4 Year of studies	2	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.03.O.003		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	3.5	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1.5
3.4 Total hours in the curricula	49.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	21
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					48
Tutoring					0
Examinations					3
Other activities (if any):					0

3.7 Total hours of individual study	51.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	• Computer Programming and Programming Languages 1 • Computer Programming and Programming Languages 2
4.2 Results of learning	Applying knowledge about the basic concepts and methods of programming languages and techniques

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	• Room equipped with a video projector.
5.2 Seminary/ Laboratory/Project	• Room equipped with computers and specific software. • Compulsory presence at laboratory classes, according to current POLITEHNICA Bucharest regulations.

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

Study of the basic concepts in CISC and RISC general microprocessor architecture: registers, memory management, addressing techniques, data transfer, instruction set, input/output strategies. The students should have the possibility to approach any specific microprocessor architecture, either general or dedicated.

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	**C2.** Design of hardware, software and telecommunication systems **C2.1.** Description of the structure and of the architecture for hardware, software and telecommunication systems **C2.2.** Explaining the purpose and the operation details for hardware, software and telecommunication systems **C4.** Using programming technologies and environments
Transversal (General) Competences	• Honorable, responsible and ethical behavior to ensure the reputation of the profession. • Awareness of the need for continuous training; efficient use of resources and learning techniques for personal and professional development.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* • Defines specific characteristics of general purpose microprocessors • Lists the main architecture attributes for x86 • Classify instructions into the three categories • Describes the activation of functional blocks within instructions • Highlight the main differences between CISC and RISC
Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* • Uses specific principles in the development of applications for computing systems • Adequately interprets causal relationships between instructions, instruction format, and timing • Identifies solutions and develops plans to solve the proposed problem • Analyze, compare and group microprocessors based on their main characteristics • Motivate the identified solutions and the ways of solving them • Formulates conclusions on developed applications
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Demonstrates responsiveness to new learning contexts • Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities • Demonstrates autonomy in organizing the learning context and the problem situation to be solved • Demonstrates social responsibility through involvement in academic community events • Contributes through new solutions related to the specialized field to improve the quality of social life • Realizes the value of his contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life • Apply principles of professional ethics in the analysis of the technological impact of the proposed solutions in the specialized field on the environment • Analyzes and exploits opportunities for entrepreneurial development in the specialized field • Demonstrates real-life situation management skills

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

The course lectures are performed in a lecture hall equipped with multimedia facilities. Course materials are: course notes and presentations. All materials are available in electronic format on the POLITEHNICA Bucharest "Moodle" platform.

In the laboratory-type applications, the tutor makes a short theoretical presentation of the concepts that will be used in the respective laboratory, then guides the students in developing applications for the 8086 microprocessor using the emu8086 simulator. The didactic materials are the laboratory platforms included in the laboratory guide.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	**Microcomputer Structure. Definitions** 1.1. Microcomputer Functional Blocks 1.2. CISC and RISC Microprocessors 1.3. Information in Digital Systems 1.4. Conventions	3
2	**Overview of a CISC, General Purpose Microprocessor Core** 2.1. First Step Approach: Data register and Address Register 2.2. Second Step Approach: General-Purpose Registers 2.3. Third Step Approach: Arithmetic Processing Unit 2.4. Forth Step Approach: Memory Addressing Control Unit 2.5. Fifth Step Approach: Microprocessor Control Unit 2.6. Functional Blocks of 16 or 32 bit Microprocessor	4
3	**Fundamentals of a Typical CISC Architecture** 3.1. Registers 3.2. Microcomputer Memory Architecture 3.3. Data Transfers 3.4. Addressing Techniques 3.5. Types of Instructions	4
4	**Fundamentals of a Typical RISC Architecture** 4.1. Registers 4.2. Instruction Set and Addressing Techniques 4.3. Microprocessor Control Unit 4.4. ARM Microprocessor Family 4.5. RISC Advantages and Drawbacks	5
5	**Input/Output Strategies** 5.1. Input/Output Devices Map 5.2. Typical Input/Output Techniques 5.3. Interrupt System for General Purpose Microprocessor 5.4. Interrupts for x86 Intel Microprocessor (IA-32) in Real Mode	3
6	**Time-Dimension of a General Purpose Microprocessor Architecture** 6.1. CISC Instruction Timing 6.2. Speed Increase for Advanced CISC Microprocessor 6.3. RISC Instruction Timing	3
7	**Design of a simple processor: CISC vs. RISC** 7.1. Processor features 7.2. Processor design 7.3. Expanding processor capabilities	3

8	**An Overview of Intel x86 Architecture (IA-32) in Real Mode** 8.1. Block Diagram 8.2. Registers 8.3. Memory Organization 8.4. Port Organization 8.5. Addressing Modes	3
	Total:	28

Bibliography:

1. C. Burileanu, Arhitectura microprocesoarelor , suport de curs electronic, https://curs.upb.ro/2023/course/view.php?id=9565
2. C. Burileanu, "Arhitectura microprocesoarelor", Editura Denix, Bucureşti, 1994.
3. C. Burileanu s.a., "Microprocesoarele x86 – o abordare software", Ed. "Grupul microInformatica", Cluj-Napoca, 1999.

LABORATORY

Crt. no.	Content	No. hours
1	Introducing a development environment for x86 microprocessors: emu8086	3
2	Data Transfer instructions and array operations for x86 microprocessors in real mode.	3
3	Data processing instructions for x86 microprocessors in real mode.	3
4	Control program instructions for x86 microprocessors in real mode.	3
5	Interrupts for x86 microprocessors in real mode.	3
6	Translation of instructions from high-level programming into assembly	3
7	Laboratory assessment	3
	Total:	21

Bibliography:

1. C. Burileanu, Arhitectura microprocesoarelor , suport de curs electronic https://curs.upb.ro/2023/course/view.php?id=9565
2. Elena-Diana Şandru, Horia Cucu, Corneliu Burileanu, "Arhitectura Microprocesoarelor", Îndrumar de laborator, Editura MatrixRom (cod CNCSIS: 39), Bucureşti, 2018, ISBN 978-606-25-0443-4

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade

11.4 Course	• knowledge of fundamental theoretical issues; • solving typical, practical problems;	**Observations:** • The final exam can only be taken by students who have achieved a minimum grade of 5 in the laboratory; otherwise, the course will need to be retaken in the following academic year. • Students who do not achieve a minimum grade of 5 in the final exam have the option to retake the exam during the September session. Fourth-year students can also take the final exam during the special session. • A minimum grade of 5 in the final exam is mandatory for passing the course. If the grade in the final exam is below 5, then the course will need to be retaken in the following academic year. **The final exam consists of two stages:** 1. **Stage 1** - Verification Quiz to assess the understanding of fundamental concepts. 2. **Stage 2** - Optional, written exam and oral evaluation concerning all the lecture chapters. **Obtaining a minimum grade of 5 in Stage 1 ensures passing the final exam with a grade of 5. Participation in Stage 2, to obtain a grade above 5 in the final exam, is conditional on passing the Verification Quiz associated with Stage 1.**	50%

11.5 Seminary/laboratory/project	• designing an algorithm for solving a typical problem;
	• translating the algorithm in a program written in 8086 assembly language;
	• demonstrating the correct execution of the 8086 program;
		Observations:
		• A minimum grade of 5 in the laboratory is mandatory for passing the course. If the grade in the laboratory is below 5, then the course will need to be retaken in the following academic year.
		
		Evaluating laboratory activity consists of two stages:
		1. **Stage 1:**
		  ◦ 3 Verification Tests, of equal weights, during the semester.
		  ◦ The grade for this stage represents the average of the 3 Verification Tests.
		2. **Stage 2** - Optional, oral final evaluation to assess the implementation, debugging and execution of an application for the 8086 microprocessor.
		
		Obtaining a minimum grade of 5 in Stage 1 ensures passing the laboratory with a grade of 5. Participation in Stage 2, to obtain a grade above 5 in the laboratory, is conditional on passing Stage 1.
			50%

11.6 Passing conditions

To pass the course, it is necessary to **simultaneously fulfill** the following two conditions:

- Passing the **laboratory** with a **minimum grade of 5** (50% of the laboratory score)[1].
- Passing the **final exam** with a **minimum grade of 5** (50% of the final exam score)[1].

Passing the laboratory is a mandatory condition for passing the course [1]. Students who obtain a grade below 5 in the laboratory will retake the course in the following academic year.

[1] According to Art. 16 (2) of Completări specifice Facultății de Electronică, Telecomunicații și Tehnologia Informației la "REGULAMENTUL privind organizarea și desfășurarea procesului de învățământ universitar de licență în Universitatea POLITEHNICA din București" *a*pproved in the session of the Faculty Council of Electronics, Telecommunications, and Information Technology on 02.10.2020.

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

The course content is largely similar to that of courses with the same objectives taught in other universities in the European Union. The course content is continually updated and adapted after consultations with representatives from the business environment.

Date	Course lecturer	Instructor(s) for practical activities
09.09.2022	Conf. Dr. Horia Cucu, S.l. Dr. Diana-Elena Grosu-Sandru	S.l. Dr. Diana-Elena Grosu-Sandru, S.l. Dr. Vlad Popescu, As. Andrei Daescu, As. Andrei Danlila, As. Alexandru Guzu

Date of department approval	Head of department
16.10.2024	Conf. Dr. Bogdan Cristian FLOREA

Date of approval in the Faculty Council	Dean
25.10.2024	Prof. Dr. Mihnea Udrea