COURSE DESCRIPTION

Digital electronics

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeş-Bolyai University
1.2. Faculty	Faculty of Mathematics and Computer Science
1.3. Department	Department of Computer Science
1.4. Field	Mathematics and Computer Science
1.5. Level of study	Bachelor
1.6. Degree programme / Qualification	Information Engineering (in English)
1.7. Form of education	Full time

2. Course-related data

2.1. Course title	**Analysis and synthesis of circuits**			Course code	**MLE7029**
2.2. Course coordinator	Prof. dr. ing. Octavian Creţ				
2.3. Seminar coordinator	Prof. dr. ing. Octavian Creţ				
2.4. Year of study	2	2.5. Semester	4	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	6	of which: 3.2. course	3	3.3. ~~seminar~~/ laboratory/ project	2 lab 1 proj
3.4. Total of hours in the curriculum	84	of which: 3.5. course	42	3.6. ~~seminar~~/ laboratory/ project	42
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					8
Additional research in the library, on subject-specific electronic platforms, and on-site					3
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					1
Tutoring (professional guidance)					1
Examinations					3
Other activities					
3.7. Total hours of individual study (IS) and self-taught activities (ST)				16	
3.8. Total hours per semester				100	
3.9. Number of credits				4	

4. Prerequisites (where applicable)

4.1. curriculum-related	
4.2 skills-related	

5. Specific conditions (where applicable)

5.1. course-related	Class room with projector
5.2. seminar/laboratory-related	Laboratory with computers

6.1. Competencies resulting from the completion of the degree programme ***(as referred to in the curriculum)***

Professional competencies	
Competency code	**Competency**

PC1	Operating with the basics of mathematics, engineering and computer science
PC2	Designing hardware, software and communication components
PC5	Use of the basic concepts of electronic devices, circuits and instrumentation
Transversal competencies	
Competency code	**Competency**
TC1	Honorable, responsible, ethical behavior, in the spirit of the law, to ensure the professional reputation
TC3	Demonstrating initiative and pro-active behavior for updating professional, economical and organizational culture knowledge

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC1	The graduate knows and understands the basic concepts, theories and methods of Computer and Information Technology and is able to use them appropriately in professional communication.	• Note-Taking: Summarizing and recording key information from lectures or texts. • Critical Thinking: Analyzing, evaluating, and synthesizing information rather than just • Reading Comprehension: Active reading, scanning, skimming, and understanding complex texts.
PC2	The graduate is able to design / implement hardware, software and communications components using design methods, languages, algorithms, data structures, protocols and technologies, and evaluate their functional and non-functional characteristics based on metrics.	• Time Management: Prioritizing tasks, meeting deadlines, and organization. • Academic Writing: Constructing clear, structured, and evidence-based arguments. • Study Skills: Revision techniques, test-taking strategies, and memory aids.
PC5	The graduate is able to use electronic tools to characterize and evaluate the performance of electronic circuits.	• Digital Literacy: Using databases, software, and online tools effectively for research. • Problem-Solving: Applying logical reasoning to solve academic problems. • Communication & Presentation: Public speaking, presenting arguments, and group work. • Collaboration: Working effectively in teams and providing constructive critique.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. The main objective of this course is to provide students with the fundamentals of Logic Design, enabling them to analyze, design, and implement any digital system. To achieve this goal, students will learn to:
2. Analyze and synthesize combinational logic systems;
3. Analyze and synthesize synchronous and asynchronous sequential circuits;
4. Apply digital system design principles and descriptive techniques;
5. Use programmable devices, such as FPGAs and PLDs, to implement logic/digital systems;
6. Understand synchronization issues in logic/digital systems and study them through simulation and physical testing.
7. Programming in VHDL hardware description language
Specific academic skills
1. The graduate is able to diagnose and troubleshoot logic/digital circuits.
2. The graduate is able to test and evaluate the functional and non-functional characteristics of logic/digital circuits based on specific criteria.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks**
1. Introduction. Number systems and codes, errors. Binary arithmetic	Presentations, discussions	N/A
2. Boolean algebra. Boolean functions. Logic gates. Digital systems and the representation of Boolean functions		
3. Methods for minimizing Boolean functions		
4. Analysis and design (synthesis) of combinational logic circuits (CLC). SSI, MSI, LSI, and VLSI CLC circuits. Combinational hazard analysis		
5. Sequential logic circuits. Flip-Flops and Latches		
6. Applications of Flip-Flops : frequency dividers, counters		
7. Applications of Flip-Flops: data registers, converters, memories		
8. Methods for designing digital systems using Flip-Flops		
9. Methods for designing digital systems using memories, multiplexers, decoders, and counters		
10. Methods for designing synchronous sequential systems		
11. Methods for designing digital systems using programmable devices		
12. The VHDL language (I)		
13. The VHDL language (II)		
14. The VHDL language (III)		

Bibliography
1. Contemporary Logic Design, Randy H. Katz, Benjamin Cunnings / Addison Wesley Publishing Co., 1993.
2. Digital Design Principles and Practices, John F. Wakerly, Prentice-Hall, 2000.
3. FPGA-based System Design, Wayne Wolf, PRENTICE HALL Professional Technical Reference Upper Saddle River, NJ 07458 www.phptr.com ISBN: 0-13-142461-0.

8.2. Seminar/ laboratory	**Teaching and learning methods**	**Remarks**
1. Introduction to laboratory topics. Initial experiments	Hands-on exercises using educational test boards, FPGA boards, specialized software (simulators), blackboard presentations, additional explanations, and discussions	N/A
2. Basic logic circuits		
3. The schematic editor and Logisim Evolution simulator (I)		
4. The schematic editor and Digital simulator		
5. Combinational logic circuits (I)		
6. Combinational logic circuits (II) – MSI circuits		
7. Combinational logic circuits (III) – Complex circuits		
8. Synthesis of combinational logic circuits using programmable logic devices		
9. Flip-Flops		
10. Counters (I)		
11. Counters (II)		
12. Registers and shift registers		
13. Complex sequential logic circuits		
14. Laboratory test		

Bibliography
1. Analiza şi sinteza dispozitivelor numerice, Îndrumător de laborator, Ediţia a-3-a, L. Văcariu, O. Creţ, A. Neţin, Ed. U.T. Press, Cluj-Napoca, 2009.
2. Limbajul VHDL, Îndrumător de laborator, Ediţia a-3-a. O. Creţ, L. Văcariu, Ed. U.T. Press, Cluj-Napoca, 2007.

9. Evaluation

Type of activity	9.1 Evaluation criteria	9.2 Evaluation methods	9.3 Percentage in the final grade
9.4. Course	Problem-solving skills. Presence, (inter)activity	Written exam	70%
9.5. Seminar/ laboratory	Problem-solving skills.	In-person and/or written exam, or via the TEAMS platform, if necessary	30%
9.6 Minimum standard for passing			
• Requirements for taking the final written exam: grade on practical assignments ≥ 5 • Requirements for passing the exam: grade on practical assignments ≥ 5 AND grade on the written exam ≥ 5; • Formulating and solving typical logic design problems using the formal tools specific to the field.			

10. SDG labels (Sustainable Development Goals)

	○ Sustainable Development Generic Label							
1 FĂRĂ SĂRĂCIE	2 FOAMETE „ZERO"	3 SĂNĂTATE ŞI BUNĂSTARE	4 EDUCAŢIE DE CALITATE	5 EGALITATE DE GEN	6 APĂ CURATĂ ŞI SANITAŢIE	7 ENERGIE CURATĂ ŞI LA PREŢURI ACCESIBILE	8 MUNCĂ DECENTĂ ŞI CREŞTERE ECONOMICĂ	9 INDUSTRIE, INOVAŢIE ŞI INFRASTRUCTURĂ
○	○	○	○	○	○	○	○	○
10 INEGALITĂŢI REDUSE	11 ORAŞE ŞI COMUNITĂŢI DURABILE	12 CONSUM ŞI PRODUCŢIE RESPONSABILE	13 ACŢIUNE CLIMATICĂ	14 VIAŢA ACVATICĂ	15 VIAŢA TERESTRĂ	16 PACE, JUSTIŢIE ŞI INSTITUŢII EFICIENTE	17 PARTENERIATE PENTRU REALIZAREA OBIECTIVELOR	No label applies
○	○	○	○	○	○	○	○	◉

Date of entry:
May 9, 2026

Signature of course coordinator

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Signature of seminar coordinator

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Date of approval in the department:
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Signature of the head of department

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