SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Computer Science / Engineer
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Digital Systems Design***			Subject code	**11**
2.2 Course responsible / lecturer	Lect. dr. eng. Lișman Dragoș-Florin - Dragos.Lisman@cs.utcluj.ro Lect. dr. eng. Miclea Vlad - Vlad.Miclea@cs.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Lect. dr. eng. Lișman Dragoș-Florin - Dragos.Lisman@cs.utcluj.ro Lect. dr. eng. Miclea Vlad - Vlad.Miclea@cs.utcluj.ro				
2.4 Year of study	I	2.5 Semester	1	2.6 Type of assessment (E - exam, C - colloquium, V – verification)	E
2.7 Subject category	Formative category: DF – fundamental, DS – speciality, DC – complementary				DF
	Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)				DOB

3. Estimated total time

3.1 Number of hours per week	5	of which:	Course	3	Seminars	-	Laboratory	2	Project	-
3.2 Number of hours per semester	70	of which:	Course	42	Seminars	-	Laboratory	28	Project	-

3.3 Individual study:	
(a) Manual, lecture material and notes, bibliography	25
(b) Supplementary study in the library, online and in the field	20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	20
(d) Tutoring	6
(e) Exams and tests	9
(f) Other activities:	-
3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))	80
3.5 Total hours per semester (3.2+3.4)	150
3.6 Number of credit points	6

4. Pre-requisites (where appropriate)

4.1 Curriculum	Logic Design
4.2 Competence	At least one high level programming language (i.e. C)

5. Requirements (where appropriate)

5.1 For the course	A minimum of 80% course attendance rate is mandatory for being admitted to the final exam
5.2 For the applications	Preliminary preparation of summaries from the indicated bibliography (laboratory textbook)

6. Specific competences

6.1 Professional competences	**C2 –** Designing hardware, software and communication components • **C2.1 -** Describing the structure and functioning of computational, communication and software components and systems • **C2.2 –** Explaining the role, interaction and functioning of hardware, software and communication components • **C2.3 –** Building the hardware and software components of some computing systems using algorithms, design methods, protocols, languages, data structures, and technologies • **C2.4 –** Evaluating the functional and non-functional characteristics of the computing systems using specific metrics • **C2.5 –** Implementing hardware, software and communication systems
6.2 Cross competences	• Technical communication and the ability to synthesize information. • Problem-solving for the analysis and synthesis of digital systems. • Optimization of structural elements in computing architectures. • Teamwork.

7. Expected Learning Outcomes

Knowledge	Describes, identifies, and summarizes concepts regarding the modeling, design, and testing of digital systems/devices, namely: • Methods for designing and implementing microprogrammed devices • Modeling of synchronous finite state machines • Modeling of asynchronous finite state machines • Modeling of linear finite state machines
Skills	Design and then implement digital circuits of various complexity levels by using the VHDL hardware description language. Implement medium/high complexity digital devices using field-programmable gate arrays (FPGAs) and design environments such as Xilinx Vivado. Simulate digital circuits using VHDL, including finite state machines, through the use of testbenches. Develop, test, and validate medium-complexity projects involving the creation and testing of a digital system starting from specifications provided in informal language.
Responsibilities and autonomy	Demonstrates initiative and proactive action in updating professional, economic, and organizational culture knowledge.

8. Discipline objectives (as results from the *key competences gained*)

8.1 General objective	• The main objective of this discipline is to give to the students the bases of Digital Systems Design, in order to make them able to analyze, design and implement any complex digital system.
8.2 Specific objectives	To reach this goal, students will learn to: • Apply Digital System Design principles and descriptive techniques; • Understand various aspects of Automata Theory with applications in the field of Digital Systems Design; • Describe any digital system in VHDL; • Utilize programmable devices such as FPGAs and PLDs to implement digital systems.

9. Contents

9.1 Lectures	Hours	Teaching methods	Notes
VHDL hardware description language – basic design units, signals	3	Presentation slides, blackboard examples, discussions.	Physical on-site lectures
VHDL hardware description language – generics, constants, operators, data types, attributes	3		
VHDL hardware description language – sequential domain	3		
VHDL hardware description language – concurrent domain	3		

Creating testbenches for simulating and testing circuits in VHDL	3		
Automata (Finite State Machines) Theory – classification, definitions, formal models	3		
Microprogramming	3		
Microprogrammed Devices	3		
Designing Synchronous Automata	3		
Analysis and Design (Synthesis) of Asynchronous Automata (I)	3		
Analysis and Design (Synthesis) of Asynchronous Automata (II)	3		
Automata Identification	3		
Lossless Machines	3		
Linear Automata	3		

Bibliography:

1. Digital Design Principles and Practices, John F. Wakerly, Prentice-Hall, 2000.
2. Automate programabile, Th. Borangiu, R. Dobrescu, Ed. Academiei, 1986.
3. Advanced Digital Logic Design Using VHDL, State Machines, and Synthesis for FPGA's, Sunggu Lee, Thomson-Engineering; 1 edition (April 25, 2005), ISBN 0534466028.
4. PowerPoint slides for VHDL and Automata Theory lectures + sets of problems for the individual study: http://users.utcluj.ro/~lucia/index.html

Bibliography:

1. Limbajul VHDL, Îndrumător de laborator, Ediţia a-3-a. O. Creţ, L. Văcariu, Ed. U.T. Press, Cluj-Napoca, 2007.
2. PowerPoint slides for VHDL and Automata Theory lectures + sets of problems for the individual study: http://users.utcluj.ro/~lucia/index.html

9.2 Applications - Seminars / Laboratory / Project	Hours	Teaching methods	Notes
Introduction to VHDL	2	Practical work on test boards, FPGA boards, specialized software, blackboard presentations, supplemental explanations and discussions.	Physical on-site laboratory works
Basic design units in VHDL	2		
Signals, generics, constants, in VHDL	2		
Operators, data types in VHDL	2		
Attributes in VHDL	2		
Sequential domain. Processes in VHDL	2		
Sequential statements in VHDL	2		
Concurrent domain in VHDL	2		
Concurrent statements in VHDL	2		
Sub-programs in VHDL	2		
Testbenches in VHDL	2		
Standard and predefined packages in VHDL	2		
Mini-projects delivery	2		
Lab test	2		

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

Since this discipline is a basic one in Computer Science, its content is “classic” but also modern because it familiarizes students with the modern principles of Logic Design (utilization of modern simulation and synthesis tools, FPGA and CPLD-based design etc.). Its contents have been discussed with major academia and industry actors from Romania, Europe and U.S.A. and it has been evaluated several times by Romanian Governmental Agencies like CNEAA and ARACIS.

11. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Problems solving abilities Presence, (Inter)activity, Homeworks	Written Exam	60%
Seminar	-	-	-
Laboratory	Problems solving abilities	Practical Evaluation	20%

Applications	Problems solving abilities Presence, (Inter)activity	Practical Evaluation	20%
Project	-	-	-

Minimum standard of performance:

• Conditions for participating in the final Written exam: Applications grade ≥ 5 AND Homeworks grade ≥ 5 AND a minimum of 80% course attendance rate;

• Conditions for passing the exam: Written exam grade ≥ 5;

• Modeling and solving typical Digital Systems Design problems using the domain-specific formal apparatus

Date of filling in: 05.05.2026	**Responsible**	**Title, First name Last name**	**Signature**
	Course	Lect. dr. eng. Dragos-Florin LISMAN	
		Lect. dr. eng. Vlad MICLEA	
	Applications	Lect. dr. eng. Dragos-Florin LISMAN	
		Lect. dr. eng. Vlad MICLEA	

Date of approval in the department	Head of department, Prof.dr.eng. Rodica Potolea
Date of approval in the Faculty Council	Dean, Prof.dr.eng. Vlad Mureșan