SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	Bases of Electronics
1.4 Field of Study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Applied Electronics / Engineer
1.7 Form of education	Full time
1.8 Subject code	19.00

2. Data about the subject

2.1 Subject name	Digital Integrated Circuits						
2.2 Subject area	Theoretical area Methodologic area Analysis area						
2.3 Course responsible	Assoc.Prof Mihaela Cîrlugea, PhD eng., Mihaela.Cirlugea@bel.utcluj.ro						
2.4 Teachers in charge of applications	Assoc. Prof Mihaela Cîrlugea, PhD eng, Mihaela.Cirlugea@bel.utcluj.ro Assist.Prof. Paul Farago, Ph.D eng, Paul.Farago@bel.utcluj.ro						
2.5 Year of study	II	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DD/DI

3. Estimated total time

3.1 Number of hours per week	4	Of which: 3.2 course	2	3.3 seminary / laboratory	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminary / laboratory	28
Time distribution					hours
Studying the manual, lecture material and notes, references					18
Supplementary study in the library, online and in the field					-
Preparation for seminars/laboratory works, homework, reports, portfolios, essays					18
Tutoring					4
Exams and tests					4
Other activities					-

3.7 Total hours individual study	44
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Digital Integrated Circuits
4.2 Competencies	Bases of numeration, elements of logic and binary algebra: Bases of programming

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca

5.2. for the applications	Laboratory, Cluj-Napoca

6. Specific competencies

Professional Competencies	C1. Usage of the fundamental elements regarding the digital electronic devices, circuits, systems, instrumentation and technology • C1.4 Usage of the electronic instruments and of the specific methods for characterizing and evaluating the performances of digital electronic circuits and systems C2. Applying the basic methods for signal aquirements and processing • C2.3 Usage of simulation environments for digital circuits analysis and processing • C2.4 Usage of the specific methoda and instruments for digital signal analysis • C2.5 Design of elementary functional blocks for digital signal processing with hardware and software implementation C3. Application of the basic knowledge, concepts and methods regarding the architecture of computing systems, microprocessors, microcontrollers, programming languages and techniques • C3.4 Development of programs for a general and / or specific programming language, starting from the specification of the requirements and until the execution, debugging and interpretation of the results in correlation with the processor used • C3.5 Projects involving hardware (processors) and software (programming) components C4. Design and use of low complexity hardware and software applications specific to the applied electronics • C4.1 Defining the concepts, principles and methods used in the fields: computer programming, high-level and specific languages, CAD techniques for making electronic modules, microcontrollers, computer systems architecture, programmable electronic systems, graphics, reconfigurable hardware architectures • C4.2 Explanation and interpretation of the specific requirements of the hardware and software structures in the fields: computer programming, high-level and specific languages, CAD techniques for making electronic modules, microcontrollers, computer systems architecture, programmable electronic systems, graphics, reconfigurable hardware architectures C5 - To apply knowledge, concepts and basic methods from power electronics, automated systems, electric energy management, electromagnetic compatibility • C5.2 Qualitative and quantitative interpretation of the functioning of circuits in the fields of: power electronics, automatic systems, electricity management, medical electronics, auto electronics, consumer goods; analysis of the functioning from the point of view of electromagnetic compatibility • C5.5 Designing, using established principles and methods of subsystems of reduced complexity, from the fields of applied electronics: power electronics, automatic systems, electricity management, medical electronics, auto electronics, consumer goods
Transversal Competencies	N.A.

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

7.1 General objectives	Developing the competences regarding the use, analysis and (re)design of digital circuits
7.2 Specific objectives	1. Recognizing and understanding basic concepts specific to fundamental digital electronic circuits. 2. Developing skills and abilities necessary for the use of fundamental digital electronic circuits. 3. Developing skills and abilities for the analysis and (re)design of digital integrated circuits.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Observations
1. Introduction to the Binary Logic. Nummeration systems	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2. Boolean Algebra. Operations. Properties		
3. Combinational Logic Circuits. Fundamental logic gates. Analysis and synthesis of circuits containing gates. Logic functions minimization		
4. Function Minimization. Karnaugh Maps. Combinational circuit applications: summer, comparer, coder, parity decoder, etc		
5. Multiplexers. Binary Trees.		
6. Demultiplexers. Decoders.		
7. Memories and Programmable Logic Arrays Basics		
8. Sequential Logic Circuits. RS, D, JK, T flip-flops. Internal structures and functioning. Analysis and synthesis of sequential synchronous circuits containing flip-flops		
9. Synchronous and Asynchronous Counters with Flip-Flops		
10. Sequential Synchronous Automata with Flip-Flops		
11. Synchronous Counters. Applications with Counters.		
12. Synchronous and asynchronous frequency dividers with counters		
13. Latches and serial registers		
14. Sequential Synchronous Automata with Counters and Registers.		

References

1. S Hintea, G Csipkes, D Csipkes, P Farago, M Cirlugea:Digital Integrated Circuits, Casa Cartii de Stiinta, Cluj-Napoca, 2017
2. M. Cîrlugea: DIC Course notes
3. Paul Farago, Botond Kirei, Gabor Csipkes, Sorin Hintea - DESCRIEREA IN VHDL A SISTEMELOR CU CIRCUITE INTEGRATE DIGITALE - Indrumator de Proiectare si Simulare. Editura U.T.PRESS, Cluj-Napoca, 2014
4. S. Hintea, Lelia Feştilă, Mihaela Cîrlugea – Circuite Integrate Digitale.UT Press, 2005
5. Gabor Csipkes, Doris Csipkes, Sorin Hintea, Mihaela Cîrlugea - "Circuite integrate digitale: culegere de probleme", editura UT Press 2011
6. Lelia Feştilă – Electronică digitală - Circuite logice secvenţiale, Lito, UTC-N, 1994.

7. S. Hintea, Lelia Feştilă, Mihaela Cîrlugea – Circuite Integrate Digitale. Culegere de probleme, Ed. Casa Cărţii de Ştiinţă, 1999.
8. Dan Nicula. Electronica digitala. Carte de invatatura. Editura Universităţii TRANSILVANIA din Braşov, 2012
9. A.E.A. Almaini. Electronic Logic Systems, Ed. Prentice Hall, 1994.
10. John F. Wakerly. Circuite Digitale, Editura Teora, Bucuresti, 2002.
11. Rabaey J.M., Chandrakasan A., Nikolic B. Digital Integrated Circuits. A design perspective. Prentice Hall, 2003.
12. Weste, N.H.E., Eshraghian, K. Principles of CMOS VLSI Design. A System perspective. Addison-Wesley Publishing Company, 1993
Materiale didactice virtuale
13. Hintea, S. Pagina web a disciplinei de Circuite integrate digitale (prezentari curs, lucrari de laborator, probleme propuse, subiecte de examen), http://www.bel.utcluj.ro/ci/rom/cid/index.htm 8. Marcovitz: Introduction to Logic Design, McGraw Hill, New York, 2005
14. Morris Mano, Michael Ciletti: Digital Design, Prentice Hall, SUA, 2007

8.2 Seminary / laboratory / project	Teaching methods	Notes
Laboratory	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, computers, white/magnetic board
1. Labour protection. Introduction in VHDL, Vivado medium and the digital development board Basys3		
2. Circuits with logic gates		
3. Circuits with multiplexers		
4. Flip-flops basics		
5. Applications with flip-flops		
6. Circuits with counters		
7. Circuits with shift registers		
Seminary		
1. Fundamental logic functions, minimization, logic operations		
2. Analysis and synthesis of circuits containing gates.and elementary logic gates simulation		
3. Multiplexers and their applications		
4. Decoders and demultiplexers		
5. Analysis and synthesis of circuits with flip-flops (D, T, RS, JK).		
6. Sequential synchronous automata with flip-flops and CLC.		
7. Analysis and synthesis of sequential automata with counters		

References
Gabor Csipkes, Doris Csipkes, Sorin Hintea, Mihaela Cîrlugea - "Circuite integrate digitale: culegere de probleme", editura UT Press 2011
C. Rus, S.Hintea, Doris Csipkes. Circuite integrate digitale.Structuri interne. Indrumator de laborator. U.T. Press, Cluj-Napoca, 2006

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

The discipline content and the acquired skills are in agreement with the expectations of the professional organizations and the employers in the field of digital integrated circuits design, developers in hardware languages, where the students carry out the internship stages and/or occupy a job, and the expectations of the national organization for quality assurance (ARACIS).

10. Assesment

Activity type	10.1 Assesment criteria	10.2 Assesment methods	10.3 weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	- Summative evaluation written exam (theory and problems)	90%
10.5 Laboratory/Seminary	The level of acquired abilities	- Continuous formative evaluation - practical lab test	10%
10.6 Minimum standard of performance			

Quality level:

Minimum knowledge:

- Knowledge of combinational Logic Circuits
- Synchronous and Asynchronous Counters with Flip-Flops
- Synchronous and asynchronous frequency dividers with counters

Minimum competences:

- Developing skills and abilities for the analysis and (re)design of digital integrated circuits
- Developing skills and abilities necessary for the use of fundamental digital electronic circuits

Quantitative level:

- $L \geq 5$ and $E \geq 5$ and $0,9*E+0,1*L \geq 5$

Data of filling in:	**Responsible**	**Titlu Prenume NUME**	**Semnătura**
29.09.2019	Course	Assoc.Prof Mihaela Cîrlugea, PhD Eng.	
	Applications	Assoc.Prof Mihaela Cîrlugea, PhD Eng.	
		Assist.Prof. Paul Farago, Ph.D eng	

Date of approval in the Department of Bases of Electronics _____	Head Departament Prof. Sorin HINTEA, PhD Eng.
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology _____	Dean Prof. Gabriel OLTEAN, PhD Eng.