SYLLABUS

1. Data about the program of study

1.1 Institution	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 Analytic area						
2.3 Course responsible/lecturer	Assist. Prof Mihaela Cîrlugea, Ph.D eng., Mihaela.Cirlugea@bel.utcluj.ro						
2.4 Teachers in charge of applications	Assist. Prof Mihaela Cîrlugea Ph.D eng, Mihaela.Cirlugea@bel.utcluj.ro Lecturer Paul Farago, Ph.D eng, Paul.Farago@bel.utcluj.ro						
2.5 Year of study	II	2.6 Semester	3	2.7 Assessment	E	2.8 Subject category	DD

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	20
Supplementary study in the library, online and in the field	-
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	18
Tutoring	3
Exams and tests	3
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. Electronic swithcing devices

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca/Microsoft Teams
5.2. for the applications	Laboratory, Cluj-Napoca/Microsoft Teams

6. Specific competencies

Professional Competencies	C1. Use of the fundamental elements related to devices, circuits, systems, instrumentation and electronic technology C1.1 Description of the functioning of electronic devices and circuits and of the fundamental methods of measuring electrical parameters C1.2 Analysis of electronic circuits and systems of low/ medium complexity, for the purpose of designing and measuring them C1.5 Design and implementation of electronic circuits of low/ medium complexity using CADCAM technologies and standards in the field C2.2 Explaining and interpreting the methods of signal acquisition and processing C2.3 Use of simulation media for signal analysis and processing C2.4 Use of specific methods and tools for signal analysis C2.5 Design of basic functional blocks for digital signal processing with hardware and software implementation
Transversal Competencies	CT1 Methodical analysis of the problems encountered in the activity, identifying the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks. CT2 Defining the activities in each stage and distributing them to the subordinates with the complete explanation of the duties, according to the hierarchical levels. It ensures the efficient exchange of information and inter-human communication. CT3 Adaptation to new technologies, professional and personal development, through continuous training. Use of printed documentation sources, specialized software and electronic resources in Romanian and in (at least) one language of international circulation

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 Course	Teaching methods	Observations
1. Introduction to the Binary Logic. Boolean algebra, logic operation properties.	Presentation, heuristic conversation,	Use of .ppt presentation, projector, blackboard,

2. Binary codes, error detection, serial data transmission. Arithmetics in base 2. Basic logic operations	exemplification, problem presentation, teaching exercise, case study, formative evaluation	Microsoft Teams platform
3. Combinational Logic Circuits. Fundamental logic gates. Analysis and synthesis of circuits containing gates. Logic functions minimization		
4. Combinational circuit applications: summer, comparer, coder, parity decoder, decoders, encoders		
5. Multiplexing and demultiplexing circuits. Multiplexer applications. Binary Trees. Logic functions implementation.		
6. RS, D, JK, T flip-flops. Internal structures. Analysis and synthesis of synchronous logic sequential circuits containing flip-flops.		
7. Synchronous sequential circuits with flip-flops. Binary counters, registers, ring counters, Johnson counters.		
8. Sequential logic circuits with flip-flops: signal generators and frequency dividers		
9. Synchronous sequential automata with flip-flops		
10. Synchronous integrated counters. Examples and applications		
11. Sequential Synchronous Automata with Flip-Flops		
12. Synchronous and asynchronous frequency dividers with counters. Cascading, capacity extensions.		
13. Sequential Synchronous Automata with integrated counters		
14. Asynchronous sequential circuits with flip-flops, binary asynchronous counters.		

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. J. Wakerly – Digital Design, Principle & Practices, Prentice Hall, 1999
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
13. 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
14. Marcovitz: Introduction to Logic Design, McGraw Hill, New York, 2005
15. 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, Microsoft Teams platform
1. Labour protection. Logic combinational circuits. Implementation with logic modules		
2. Analogic decoders, multiplexers and demultiplexers digitally CMOS controlled. Logic gates		
3. Integrated flip-flops		
4. Sequential synchronous automata with flip-flops		
5. Applications with integrated counters 74193 and 74163		
6. Circuits with counters: frequency dividers, signal generators, synchronous sequential automata		
7. Asynchronous sequential circuits. Laboratory tests		
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 and other circuits 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
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

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 (problems)	70%
10.5 Laboratory/Seminary	The level of acquired abilities	- Continuous formative evaluation - Laboratory test or project presentation	30%
10.6 Minimum standard of performance $L \geq 5$ and $E \geq 5$ and $0{,}7E + 0.3L \geq 5$			

Quality level:
Minimum knowledge:
- ✓ *Knowing the basic binary mathematical operations*
- ✓ *Knowing the basic digital circuit components*
- ✓ *To understand signal and state diagrams specific to digital components*
- ✓ *To recognize the main digital circuit applications*

Minimum competences:
- ✓ *To be able to solve K-maps*
- ✓ *To be able to implement simple digital circuits in given specifications*
- ✓ *Knowledge of basic procedures for circuit design*

Quantitative level:
- ✓ *Participation to all laboratory classes*
- ✓ *Minimal 5 grade for each, laboratory and exam*

*The final grade is calculated as: 0,7*Exam_grade+0,3*Laboratory_grade*

Data of filling in:	Responsible	Titlu Prenume NUME	Semnătura
1.07.2023	Course	Assist. prof M Cîrlugea, Ph.D eng.	
	Applications	Assist. prof M Cîrlugea, Ph.D eng.	
		Lecturer PhD. eng. Paul FARAGO	

Date of approval in the Bases of Electronics Department Council _11.07.2023_____	Head Departament Prof.PhD. eng. Sorin HINTEA
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 12.07.2023 _____	Dean Prof.PhD. eng. Ovidiu POP