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	27.00

2. Data about the subject

2.1 Subject name	Systems with Digital Integrated Circuits						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Prof. Sorin Hintea, PhD Eng. – sorin.hintea@bel.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assist. Prof. Paul FARAGO, PhD Eng. – paul.farago@bel.utcluj.ro Assist. Prof. Robert GROZA, PhD Eng. – robert.groza@bel.utcluj.ro Assist. Prof. Botond KIREI, PhD Eng. – kirei.botond@bel.utcluj.ro Assoc.Prof. Mihaela Cîrlugea, PhD Eng. mihaela.cirlugea@bel.utcluj.ro						
2.5 Year of study	II	2.6 Semester	2	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 seminar / laboratory	2
3.4 To Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar / laboratory	28

Distribution of time	hours
Manual, lecture material and notes, bibliography	35
Supplementary study in the library, online specialized platforms and in the field	-
Preparation for seminars / laboratories, homework, reports, portfolios and essays	28
Tutoring	3
Exams and tests	3
Other activities	-

3.7 Total hours of individual study	69
3.8 Total hours per semester	125
3.9 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 curriculum	Digital Integrated Circuits, Electronic Devices, Fundamental Electronic Circuits

4.2 competence	Electric signals, passive and active electric components, electric circuit relations and theorems, frequency behavior and frequency response, binary logic, logic circuits behavior, logic circuits analysis and synthesis.

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca
5.2. for the seminars / laboratories / projects	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	C1. Usage of the fundamental elements regarding the 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 electronic circuits and systems C2. Applying the basic methods for signal aquirements and processing • C2.3 Usage of simulation environments for signal analysis and processing • C2.4 Usage of the specific methoda and instruments for 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 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 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
Cross competences	N.A.

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

7.1 General objective	Developing the competences regarding the use, analysis and (re)design of digital circuits and systems

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

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Introducing Digital Integrated Circuits Systems. The MOS Transistor. Functioning and characteristics.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2. Internal structures in CMOS digital circuits. The CMOS inverter and the fundamental logic gates.		
3. Combinational and sequential circuits in VLSI CMOS technology.		
4. Performance analysis of the CMOS circuits. Propagation times and dissipated power		
5. Optimization methods of the speed performances for VLSI CMOS circuits.		
6. Shift registers. Internal structure and functioning.		
7. Applications with shift registers		
8. Arithmetical opperations. CMOS adders, subtractors and multipliers.		
9. Arithmetic VLSI circuits. Adders, subtractors and multipliers in VHDL code. Design of the great capacity circuits		
10. Semiconductuncting memories: structure and organization. ROM, PROM, EPROM, EEPROM and FLASH memories. Internal structures and configurations. Electrical and time characteristics of the memories.		
11. RAM statical and dynnamic memories. Structures and characteristics.		
12. Applications with semiconducting memories. Connecting memories and memory extensions.		
13. Programmable logic areas. PLA, PAL and FPGA structures		
14. Pulse generators. Monostables and circuits fo digital signal processing. Circuits for interface and display.		

References

1. Sorin Hintea, Gabor Csipkes, Doris Csipkes, Paul Farago, Mihaela Cirlugea – Digital Integrated Circuits. Editura Casa Cărţii de Ştiinţă, Cluj-Napoca, 2017
2. Sorin Hintea, Mihaela Cirlugea, Lelia Festila. Circuite Integrate Digitale. Editura UT Press, Cluj-Napoca, 2005
3. Gheorghe Toacse, Dan Nicula, Electronică Digitală, Editura Tehnică 2005
4. J. Wakerly – Digital Design, Principle & Practices, Prentice Hall, 1999

5. Rabaey J.M., Chandrakasan A., Nikolic B. Digital Integrated Circuits. A design perspective. Prentice Hall, 2003.
6. Weste N.H.E, Harris D. CMOS VLSI Design. A Circuits and Systems Perspective. Pearson Addison Wesley, 2005.
7. H. Kaeslin, "Digital Integrated Circuit Design From VLSI Architecture to CMOS Fabrication", Cambridge University Press, 2008.
8. C. H. Roth, L.K. John, "Digital System Design using VHDL", Cengage Learning, 2008.
9. Ercegovac, M., Lang T., Moreno J. Introduction to Digital Systems. John Wiley &Sons Inc, New-York, 1999

8.2 Seminar / 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. Introduction in CAD environment		
2. The CMOS inverter.		
3. Logic CMOS gates		
4. Transmission gates. Circuits with transmission gates		
5. Shift registers. Applications.		
6. RAM Memories. Aplications.		
7. Laboratory tests.		
Project		
1. Introduction in the VHDL environment		
2. VHDL syntax and elementary logic gates simulation		
3. Structural design code VHDL		
4. Behavioral design code in VHDL		
5. Counters and shift registers in VHDL code. State automata		
6. Memories in VHDL code. Applications with memories.		
7. Project presentation and evaluation		

Bibliography

1. Sorin Hintea, Gabor Csipkes, Doris Csipkes, Paul Farago, Mihaela Cirlugea – Digital Integrated Circuits. Editura Casa Cărţii de Ştiinţă, Cluj-Napoca, 2017
2. Gabor Csipkes, Doris Csipkes, Sorin Hintea, Mihaela Cîrlugea - "Circuite integrate digitale: culegere de probleme", editura UT Press 2011
3. C. Rus, S.Hintea, Doris Csipkes. Circuite integrate digitale.Structuri interne. Indrumator de laborator. U.T. Press, Cluj-Napoca, 2006
4. 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 (for instance ARIES) and the employers in the field, 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. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Written test	80%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Ongoing verification through laboratory tests	20%
10.6 Minimum standard of performance			

Qualitative level

Minimal knowledge

- Knowledge of the construction of CMOS digital circuits
- Knowledge of the main categories of digital circuits and their incorporation into more complex systems

Minimal competences

- Be able to analyze the functioning of digital circuits using the SPice simulator
- Know how to design digital circuits using high level VHDL language

Quantitative level

- ✓ Performing all laboratory work
- ✓ The exam, laboratory and project marks must be at least 5: L ≥ 5, P ≥ 5 and E ≥ 5
- ✓ The mark for the discipline is calculated with the relation 0,5E+0,3P+0,2L ≥ 5

Date of filling in:	Responsible	Title Surname NAME	Signature
29.09.2019	Course	Prof. Sorin Hintea, PhD Eng.	
	Applications	Assist. Prof. Paul FARAGO, PhD Eng.	
		Assist. Prof. Robert GROZA, PhD Eng.	
		Assist. Prof. Botond KIREI, PhD Eng.	
		Assoc.Prof. Mihaela Cîrlugea, PhD Eng	

Date of approval in the Department of Basis of Electronics

Head of Department
Prof. Sorin HINTEA, PhD Eng.

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Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology

Dean
Prof. Gabriel OLTEAN, PhD Eng.

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