SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Electronics, Telecommunications and Information Technology
1.3	Department	Bases of Electronics
1.4	Field of study	Electronics and Telecommunications Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Telecommunications Technologies and Systems/ Engineer, Applied Electronics/ Engineer
1.7	Form of education	Full time
1.8	Subject code	TST-E27.00, EA-E27.00

2. Data about the subject

2.1	Subject name					Systems with Digital Integrated Circuits					
2.2	Subject area					Electronic devices and circuits					
2.3	Course responsible/lecturer					Prof.dr.ing. Sorin Hintea					
2.4	Teachers in charge of applications					Assoc. Prof. Mihaela Cirlugea, PhD Assist. Prof. Paul Farago, PhD eng.					
2.5	Year of study	II	2.6	Semester	2	2.7	Assessment	Exam	2.8	Subject category	DD/DI

3. Estimated total time

Year/ Sem.	Subject name	No. of weeks	Course [hours/week]	Applications [hours/week]			Course [hours/sem.]	Applications [hours/sem.]			Indiv. study	TOTAL	Credits
				S	L	P		S	L	P			
II / 2	Systems with Digital Integrated Circuits	14	2		1	1	28		14	14	69	125	5

3.1	Number of hours per week	4	3.2	of which, course	2	3.3	applications	2
3.4	Total hours in the curriculum	56	3.5	of which, course	28	3.6	applications	28

Individual study	Hours
Manual, lecture material and notes, bibliography	25
Supplementary study in the library, online and in the field	-
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	38
Tutoring	3
Exams and tests	3
Other activities	0

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	N / A
4.2	Competence	Electric signals, passive components connection, electric circuit relations and theorems, capacitor and coil time and frequency behavior and frequency response

5. Requirements (where appropriate)

5.1	For the course	Amphitheatre, Cluj-Napoca
5.2	For the applications	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	Theoretical knowledge (what the student must know):	Internal structure of digital integrated circuits. Principal electrical DIC parameters. Signal propagations in DIC. Compensation methods of great capacitive charge effects. Design principles of digital VLSI circuits. Numerical circuit synthesis using VHDL language. Semiconductor memory functioning. Applications with semiconductor memories. Communication protocols with sequential synchronous circuits. PLA functioning. Pulse generators
	Acquired skills (what the student is able to do):	After completing the discipline, the students will be able to: - develop medium complex designs that contain gates, multiplexers, counters, registers, etc - to analyze and describe digital systems using VHDL language - to know the internal structure of DIC and their effects over the circuit real performances; delays in signal propagation, logic hazard, consumed power, area - to use specific DIC design environments, including those containing VHDL - to analyze circuit behavior from the signal propagation point of view - to develop abilities for circuit design for optimizing their performances: small delay time, reduces power consumption and small area - to avoid logic hazard through design
	Acquired abilities: (what type of equipment the student is able to handle)	After completing the discipline, the students will be able to: - use the lab instrumentation (power supply, oscilloscope, function generator, multimeter) for the experimental study of electronic circuits - use the experimental boards - connect the lab instrumentation with the experimental boards, in order to experimentally study electronic circuits - use the computer to the numerical data obtained through the explorations - store and analyze the numerical data obtained through the explorations
	In accordance with Grila1 and Grila2 RNCIS	C1. To use the fundamental elements regarding electronic devices, circuits, systems, instrumentation and technology C2. To apply basic methods for signal acquisition and processing C3. To apply knowledge, concepts and basic methods regarding computing systems' architecture, microprocessors, microcontrollers, programming languages and techniques C4. To design, implement and operate data, voice, video and multimedia services, based on the understanding and application of fundamental concepts from the field of communications and information transmission. C5. To select, install, configure and exploit fixed and mobile telecommunications equipment. To equip a site with common telecommunications networks.
Cross competences (Grila1 and Grila2 RNCIS)		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 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. 3. Developing skills and abilities for the analysis and (re)design of digital integrated circuits.

8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	Introduction in VHDL. Description of digital circuits in VHDL	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2	Internal digital circuit CMOS structures. CMOS functioning and characteristics		
3	Combinational and sequential circuits in CMOS VLSI technology. CMOS inverter and fundamental gates		
4	Performance analysis of CMOS circuitry. Propagation time and dissipated power		
5	Optimizing speed performances for CMOS VLSI circuits		
6	Internal structures of bipolar digital circuits. TTL and subfamilies		
7	Logic hazard in digital circuits. Static and dynamic hazard, methods for hazard elimination in combinational and sequential circuits		
8	Arithmetic operations. Adders, subtractors and multiplying CMOS circuits		
9	VLSI arithmetic circuits. Adders, subtractors and multiplying circuits in VHDL code		
10	Semiconductor memories, structures and organizing. ROM, PROM, EPROM, EEPROM, FLASH memories, structures and configuration. Electric and temporal characteristics		
11	Dynamic and static RAM memories. Structures and characteristics		
12	Semiconductor memories, extending the memory capacity		
13	Programmable logic arrays. Connection and memory capacity extension		
14	Pulse generators. Monostable circuits for digital signal processing; interface and display		
8.2. Applications		Teaching methods	Notes
Laboratory			
1	Labour protection. Functioning parameters of CMOS and TTL integrated circuits	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, computers, white/magnetic board
2	Signal propagation and response delay for CMOS integrated circuits		
3	Logic hazard and it's elimination		
4	Arithmetic operations. Adders, subtractors and multiplying CMOS circuits		
5	Circuits with ROM and RAM		
6	CMOS oscillators and monostables for pulse processing		
7	Laboratory test		
Project			
1	Project structure and content. The project theme		
2	VHDL tutorial		
3	VHDL code description of design modules		
4	Obtaining the clock signals; oscillators, programmable frequency dividers. Synchronous and asynchronous frequency dividers		
5	Detailed design of functional blocks I		
6	Detailed design of functional blocks II		
7	Project presentation and evaluation		

Bibliography
1. S. Hintea, Lelia Feştilă, Mihaela Cîrlugea – Circuite Integrate Digitale.UT Press, 2005.
2. Gabor Csipkes, Doris Csipkes, Sorin Hintea, Mihaela Cîrlugea - "Circuite integrate digitale: culegere de probleme", editura UT Press 2011
3. S. Hintea Proiectarea circuitelor digitale VLSI, Ed. Casa Cărţii de Ştiinţă, 1997.
4. C. Rus, S.Hintea, Doris Csipkes. Circuite integrate digitale.Structuri interne. Indrumator de laborator. U.T. Press, Cluj-Napoca, 2006
5. Hintea, Tehnologii de proiectare cu arii logice programabile. Editura UT Press, Cluj-Napoca, 2002
6. Lelia Feştilă – Electronică digitală- Circuite logice combinaţionale, Lito. UTC-N, 1994.
7. Lelia Feştilă – Electronică digitală - Circuite logice secvenţiale, Lito, UTC-N, 1994.
8. Dan Nicula. Electronica digitala. Carte de invatatura. Editura Universităţii TRANSILVANIA din Braşov, 2012
9. Ştefan, Gh - Circuite integrate digitale, Probleme, proiectare, Ed. EDP,1992.
10. A.E.A. Almaini. Electronic Logic Systems, Ed. Prentice Hall, 1994.
12. John F. Wakerly. Circuite Digitale, Editura Teora.
13. Rabaey J.M., Chandrakasan A., Nikolic B. Digital Integrated Circuits. A design perspective. Prentice Hall, 2003.
14. Weste, N.H.E., Eshraghian, K. Principles of CMOS VLSI Design. A System perspective. Addison-Wesley Publishing Company, 1993
14. M.D. Ercegovac. Introduction to Digital Systems, Ed. JohnWiley&Sons, 1999.

Didactic virtual materials
1. Hintea, S. Pagina web a disciplinei de Sisteme cu circuite integrate digitale (prezentari curs, lucrari de laborator, probleme propuse, subiecte de examen), http://www.bel.utcluj.ro/ci/rom/sd/index.htm

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

Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

10. Evaluations

Activity type	10.1	Assessment criteria	10.2	Assessment methods	10.3	Weight in the final grade
Course		The level of acquired theoretical knowledge and practical skills		- Summative evaluation written exam (theory and problems)		- E, max 10 pts. 50%
Applications		The level of acquired abilities		- Continuous formative evaluation - practical lab test -project evaluation		- L, max. 10 pts. 20% -P max. 10 pts. 30%
10.4 Minimum standard of performance						
$L \geq 5$ and $E \geq 5$ and $0,5E+0,2L+0,3P \geq 4.5$						

Date of filling in 1.10.2018

Course responsible
Prof. Sorin Hintea, PhD

Teachers in charge of applications
Assoc. Prof. Mihaela Cirlugea, PhD
Assist.Prof. Paul Farago, PhD