

## 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	Basis 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	48.20

### 2. Data about the subject

2.1 Subject name	Microelectronics						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Assist. Prof. Groza Robert, PhD Eng.– robert.groza@bel.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assist. Prof. Groza Robert, PhD Eng.– robert.groza@bel.utcluj.ro						
2.5 Year of study	IV	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DS /DOP

### 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					20
Supplementary study in the library, online specialized platforms and in the field					10
Preparation for seminars / laboratories, homework, reports, portfolios and essays					10
Tutoring					5
Exams and tests					3
Other activities: .....					
3.7 Total hours of individual study	48				
3.8 Total hours per semester	104				
3.9 Number of credit points	4				

### 4. Pre-requisites (where appropriate)

4.1 curriculum	Analog integrated circuits, Circuit analysis and synthesis, Computer-aided design, Systems with Analog Integrated Circuits.
4.2 competence	Knowledge of the properties and applications of semiconductor materials Knowledge of mathematical methods of circuit analysis Analysis and design of fundamental analog circuits at the transistor level Use of CAD tools for analyzing and designing electronic circuits

## 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	<p>C2. Applying the basic methods for signal acquisition and processing</p> <ul style="list-style-type: none"> <li>• C2.1 Temporal, spectral and statistical characterization of signals</li> <li>• C2.2 Explaining and interpreting the methods of acquisition and processing of signals</li> <li>• C2.3 Use of simulation environments for signal analysis and processing</li> <li>• C2.4 Use of the specific method and tools for signal analysis</li> <li>• C2.5 Design of basic functional blocks for digital signal processing with hardware and software implementation</li> </ul> <p>C3. Application of knowledge, concepts and basic methods related to Computing Systems Architectures, microprocessors, microcontrollers, programming techniques and languages</p> <ul style="list-style-type: none"> <li>• C3.3 Solving practical problems that include algorithms and data structure elements and use microprocessors or microcontrollers</li> <li>• C3.4 Software elaboration, starting from specifications up to execution, debug and testing, written in a general or processor-specific programming language,</li> <li>• C3.5 Elaboration of projects involving hardware-software co-existence</li> </ul> <p>C4. Design and use of simple hardware and software applications, specific to the Applied Electronics domain</p> <ul style="list-style-type: none"> <li>• C4.1 Definition of concepts, principles and methods used in computer Programming, High-Level Description Languages, CAD design tools, microcontrollers, Programmable and Reconfigurable Electronic Circuits,</li> <li>• C4.5 Design of dedicated electronic systems containing microcontrollers, FPGA or other computing systems in the Applied Electronics domain</li> </ul>
Cross competences	N.A.

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

7.1 General objective	Developing professional skills in the field of analog integrated circuit design
7.2 Specific objectives	Assimilation of theoretical knowledge regarding the analysis and design of non-linear analog circuits Obtaining the skills and abilities necessary for designing systems with analog integrated circuits and their characterization through simulations and measurements

## 8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Current trends in microelectronics. Features of high frequency integrated applications and low supply voltages.	Exposure, discussions, interactive teaching style	Power point presentations, video projector, board are used
2. Integrated microelements modeling. The intrinsically non-linear characteristic of electrical devices. The translinear principle.		
3. Analysis of the main classes of ELIN circuits, implementation in CMOS and BiCMOS technologies. The effect of the non-idealities of the active components.		
4. Analog filters: basic ELIN blocks, parameters, methods to reduce the effects of non-ideals of active components.		
5. Design of higher order ELIN filters: synthesis method based on the cascade of the 1st and 2nd floors, the nonlinear signal graph method.		
6. Synthesis of higher order ELIN filters using the method based on the description of the systems using the state equations.		
7. Method of synthesis of ELIN circuits based on the direct Lin-ELIN transformation. Impedance converter.		
8. Analysis and design of integrated oscillators. The effect of non-ideals of the active devices on the parameters.		
9. Introduction to the analysis and design of the functional blocks within a classifier Vector Support Car: the principle of operation, assembly circuits and weighted subtraction, the sum integrator.		
10. Circuits of multiplication current way of working: implementation in the logarithmic domain, the effect of the non-idealities of the active devices on the parameters.		
11. Manufacture of semiconductors. Manufacturing processes: bipolar, CMOS, BiCMOS.		
12. Integrated passive components: resistors, capacitors and coils.		
13. Integrated active components: diode, bipolar transistor and MOS transistor.		
14. CMOS layout.		
Bibliography 1. Mihaela Cirlugea, Circuite neuronale celulare, Risoprint, 2010; 2. Mihaela Cirlugea, Microelectronics: a perspective, U.T. Press, 2013 3. Lelia Feștilă, Analog Integrated Circuits. Translinear Networks, U.T. Press, 2003; 4. R. Schaumann & M.E.V. Valkenburg, Design of Analog Filters, Oxford University Press, 2001; 5. G. Hurst & L. Meyer, Circuite Integrate Analogice. Analiza și proiectare, Editura Tehnică 1997; 6. G. W. Roberts & V.W. Leung, Design and analysis of integrator-based log-domain filter circuits, Springer, 2000; 7. A. Hastings, The art of analog layout, Prentice Hall, 2001; 8. Wai-Kai Chen, The VLSI Handbook, CRC Press, 2006; On-line 1. <a href="http://www.bel.utcluj.ro/ci/rom/me/index.html">http://www.bel.utcluj.ro/ci/rom/me/index.html</a> 1. <a href="http://ecee.colorado.edu/~bart/book/book/title.htm">http://ecee.colorado.edu/~bart/book/book/title.htm</a> 2. <a href="http://dspace.mit.edu/handle/1721.1/34219">http://dspace.mit.edu/handle/1721.1/34219</a>		
8.2 Seminar / laboratory / project	Teaching methods	Notes
1. Bipolar transistor and MOS - parameters, effect of non-ideals		
2. Compression circuits		

3. Expansion circuits	Exposure and applications	Calculator, specific program		
4. The ELIN integrator				
5. Two order ELIN structures go down				
6. ELIN structures of two order pass band				
7. ELIN impedance converter				
8. Higher-order ELIN filters pass down and pass through the tape				
9. Higher-order ELIN filters go up and stop the tape				
10. Harmonic oscillators made with circuits in the logarithmic field				
11. PLL current working mode with ELIN blocks				
12. Assembly and subtraction circuits with logarithmic and exponential cells				
13. Analog multipliers current working mode				
14. Implementation of an SVM classifier				
Bibliography				
On-line <a href="http://www.bel.utcluj.ro/ci/rom/me/index.html">http://www.bel.utcluj.ro/ci/rom/me/index.html</a>				

### 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, where the students carry out the internship stages and/or occupy a job (in the field of applied electronics), 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 exam (dealing with theoretical topics and problem solving)	70% (E) 10 pct.
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Project supported at the end of the semester	30% (L) 10 pct.
10.6 Minimum standard of performance			
<p><b>Quality level:</b></p> <p>Minimum knowledge:</p> <ul style="list-style-type: none"> <li>✓ Knowledge of analog filters: basic ELIN blocks</li> <li>✓ Knowledge of analysis and design of integrated oscillators</li> <li>✓ Knowledge of integrated passive components: resistors, capacitors and coils</li> </ul> <p>Minimum competences:</p> <ul style="list-style-type: none"> <li>✓ Skills and abilities necessary for designing systems with analog integrated circuits</li> </ul> <p><b>Quantity aspects:</b></p> <ul style="list-style-type: none"> <li>✓ Passing the Project (P) and Written Exam (WE), minimal grade: 5 (<math>E \geq 5</math>, <math>L \geq 5</math>)</li> </ul>			

Date of filling in:	Responsible	Title Surname NAME	Signature
29.09.2019	Course	Assist. Prof. Groza Robert, PhD Eng.	
	Applications	Assist. Prof. Groza Robert, PhD Eng.	

Date of approval in the Department of Basis of Electronics _____	Head of Department 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.