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 Electronic Department
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Master
1.6 Program of study / Qualification	Integrated Circuits and Systems (CSI)
1.7 Form of education	Full time
1.8 Subject code	1.00

2. Data about the subject

2.1 Subject name	Advanced Analog Blocks						
2.2 Subject area	Theoretical area Methodological area Analytic area Design area						
2.3 Course responsible	Conf. Dr. Ing. Doris Csipkes – Doris.Csipkes@bel.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	S.L. Dr. Ing. Groza Robert –Robert.Groza@bel.utcluj.ro						
2.5 Year of study	I master	2.6 Semester	1	2.7 Tipul de evaluare	Assessment	2.8 Subject category	DS/DI

3. Estimated total time

3.1 Number of hours per week	3	din care: 3.2 course	2	3.3 laboratory/project	1
3.4 To Total hours in the curriculum	42	din care: 3.5 course	28	3.6 laboratory/project	14

Distribution of time	hours
Manual, lecture material and notes, bibliography	28
Supplementary study in the library, online specialized platforms and in the field	14
Preparation for seminars / laboratories, homework, reports, portfolios and essays	25
Tutoring	14
Exams and tests	2
Other activities:.....	

3.7 Total hours of individual study	83
3.8 Total hours per semester	125
3.9 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 curriculum	Semiconductor physics. Spectral analysis of signals. Elements of circuit theory. Analysis and design of fundamental analog blocks at transistor level. Analysis and design of linear, time invariant systems in time and frequency domain.
4.2 competence	Basic computer usage abilities along width background in computer aided design of electronic circuits.

5. Requirements (where appropriate)

5.1. for the course	Board and beamer or Microsoft Teams platform
5.2. for the seminars / laboratories / projects	Board and computer or Microsoft Teams platform

6. Specific competences

Professional competences	**C1 Fundamental skills in describing electronic devices, circuits and systems along with specific instrumentation and electronic technologies** C1.1 The operation of electronic devices and circuits. Measurements of electrical parameters. C1.2 Analysis of medium and high complexity circuits and systems targeting design and validation. C1.3 Electronic circuit diagnostics and fault elimination. C1.4 Design and implementation of complex electronic circuits by using specific CAD tools and the existing performance standards. **C4. Design and utilization of complex hardware and software applications specific to the area of applied electronics:** C4.1 Definition of concepts, principles and methods used in CAD supported realization of electronic modules, programmable electronic systems and reconfigurable hardware. C4.2 Description and evaluation of specifications in CAD supported design of electronic modules, programmable electronic systems and reconfigurable hardware. C4.3 Identification and optimization of optimal solutions for problems concerning industrial and medical electronic systems. C4.4 Using adequate performance criteria for simulation and evaluation of complex electronic hardware.
Transversal ompetences	**CT1.** Methodical analysis of practical design problems and the identification of traditional and new solutions insuring the fulfillment of professional duties in electronic design activities. **CT2.** Planning design activities and delegating individual tasks to team members based on skills and experience, insuring efficient exchange of information and interaction. **CT3.** Adaptation of new technologies, professional and personal development by continuous learning with focus on printed documentation, specialized software and electronic resources

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

7.1 General objective	Developing competences in advanced circuit analysis and design.
7.2 Specific objectives	1. Acquiring theoretical knowledge concerning analog circuit and systems for signal conditioning applications. 2. Acquiring skills for analysis and design of amplifiers, filters, oscillators, translinear computation circuits and low voltage, low power modules starting with a given set of specifications.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Modern tendencies in CMOS technologies and analog VLSI circuit design.	Lecture with interactive discussions	Face-to-face lectures and Microsoft Teams (Board and video projector)
2. Switched capacitor circuits.		
3. Analysis of fundamental switched capacitor circuits.		
4. The CMOS switch. Resistors implemented with switched capacitors.		
5. Switched capacitor integrators and amplifiers – structures, design performances and derivation of specific parameters.		
6. switched capacitor filters – design approaches based on fundamental continuous time configurations with operational amplifiers or LC ladder prototypes.		
7. Linearized transconductance amplifiers – theoretical principles.		

8. Linearized transconductance amplifier examples in bipolar and CMOS technologies.		
9. Translinear circuits. Static and dynamic translinear networks.		
10. Translinear analog computations circuits.		
11. Circuits with MOS transistor biased in subthreshold region.		
12. Fundamental cells with subthreshold MOS transistors – applications.		
13. Design example of a complete system based on subthreshold MOS transistors.		
14. Very low voltage and low power circuits.		

1. Lecture notes in electronic format, 2019;
2. D. Csipkes, G. Csipkes – Elemente constructive utilizate în proiectarea circuitelor analogice complexe – Casa Cărții de Știință, 2004;
3. L. Feștilă – Analog integrated circuits. Translinear network. UTPRES, 2003.
4. D. Johns, K. Martin – Analog Integrated Circuit Design, Wiley & Sons, 1997
5. W.M.C. Sansen – Analog Design Essentials, Springer, 2006
6. P.R. Gray, P.J. Hurst, S.H. Lewis, R.G. Meyer – Analysis and Design of Analog Integrated Circuits, 5th edition, Wiley, 2009

Electronic materials
http://www.bel.utcluj.ro/ci/

8.2 Laboratory	Teaching methods	Notes
Applications with switched capacitor circuits: resistors, amplifiers and integrators.	Lecture and applications, learning by discovery, hands-on exercises, simulations and CAD tools.	Face-to-face lectures and Microsoft Teams (Computer, and specific CAD software)
Design of filters with operational amplifiers.		
Design of switched capacitor filters.		
Implementation of translinear circuits with bipolar transistors.		
Implementation of translinear circuits with MOS transistors.		
Linearization of tranconductance amplifiers. Applications in GmC filters.		
Very low voltage, low power functional cells		

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

Acquired skills are necessary for future employees in the electronics design areas defined in COR: electronic design engineers, research engineers in microelectronics, electronic technology engineers, information technology managers, computer systems design engineers, communications systems design engineers and IT specialists.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Lecture	Solving exercises/quiz	Written exam or Microsoft Forms quiz	60%
10.5 Laboratory/Projects	Solving design exercises and verifying the results through simulation/measurement	Evealuation of activities throughout the semester and submission of a final project with individual specifications for each student	40%
10.6 Minimum required performance criteria:			

Qualitative level:
Minimal skills:
- design combinations of functional electronic modules for implementation of complex analog systems;
- propose improvements and performance enhancements based on the evaluated set of parameters.

Minimal competence:

- determine the parameters of circuits through simulation (gain, input/output impedance, badwidth, slew rate, harmonic and intermodulation distortion);
- use the specific industrial CAD tool together with technology data provided by a semiconductor manufacturer

Quantitative level:

- ✓ Work through all the laboratory exercises
- ✓ The exam mark cummulated wth the laboratory evaluation must be at least 4.5

The final mark is calculated with the formula: 0.6*Exam+0.4*Laboratory/Project

Date of filling in:	**Responsible**	**Title Surname NAME**	**Signature**
25.02.2023	Course	Conf.Dr.Ing. Doris Csipkes	
	Application	S.L. Dr. Ing. Groza Robert	

Date of approval in the Department of ……..

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Head of Department
Prof. Sorin HINTEA, PhD eng

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

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Dean
Prof. Ovidiu-Aurel POP, PhD eng