SYLLABUS

1. Program information

1.1 Higher education 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 Study program / Qualification	Electronic engineering, telecommunications and information technologies/ Engineer
1.7 Form of education	IF – full-time education

2. Course information

2.1 Course title	Analog integrated circuits				Course code	26.00
2.2 Course coordinator	*Assist.prof. Csipkes Gabor, Ph.D. – gabor.csipkes@bel.utcluj.ro*					
2.3 Seminar/ laboratory/ project/ practical activity coordinator	*Assist.prof. Csipkes Gabor, Ph.D. – gabor.csipkes@bel.utcluj.ro*					
2.4 Year of study	II	2.5 Semester	2	2.6 Type of assessment		E
2.7 Course status	Formative category					DD
	Optionality					DOB

3. Estimated total time

3.1 Hours per week	4	of which:	3.2 Lecture	2	3.3 Seminar	1	3.3 Laboratory	1	3.3 Project	0	3.3 Practical training	0
3.4 Hours per semester	56	of which:	3.5 Lecture	28	3.6 Seminar	14	3.6 Laboratory	14	3.6 Project	0	3.3 Practical training	0

3.7 Time distribution (hours per semester) for individual study and assessment:	
(a) Assessment	3
(b) Study using textbook, course materials, bibliography, and notes	14
(c) Additional documentation in the library, on specialized electronic platforms, and in the field	7
(d) Preparation for seminars/laboratories, assignments, reports, portfolios and essays	14
(e) Tutoring	6
(f) Other activities	-

3.8 Total hours of individual study and assessment (sum of (3.7(a)...3.7(f))	44
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credits	4.0

4. Prerequisites (where applicable)

4.1 curriculum	Passive electronic devices and circuits, Electronic devices Electronic circuit theory, Signal theory Fundamental electronic circuits
4.2 competencies	Computer operation, basic skills in computer aided design of electronic circuits.

5. Requirements (where applicable)

5.1. for the development of the lecture	Board and beamer.
5.2. for the development of the seminar/ laboratory/ project	Board, beamer and computers.

6. Specific competencies acquired

Professional competencies	C1 Use of fundamental elements related to electronic devices, circuits, systems, instrumentation and technology C1.1 Description of the operation of electronic devices and circuits and of the fundamental methods for measuring electrical quantities C1.2 Analysis of low-/medium-complexity electronic circuits and systems for their design and measurement C1.4 Use of electronic instruments and specific methods to characterize and evaluate the performance of electronic circuits and systems C1.5 Design and implementation of low-/medium-complexity electronic circuits using CAD-CAM technologies and standards in the field C2 Application of basic methods for signal acquisition and processing C2.1 Time-domain, spectral and statistical characterization of signals C2.2 Explanation and interpretation of signal acquisition and processing methods C2.3 Use of simulation environments for signal analysis and processing C2.4 Use of specific methods and instruments for signal analysis C2.5 Design of elementary functional blocks for digital signal processing with hardware and software implementation C4 Design and use of low-complexity hardware and software applications specific to applied electronics C4.1 Definition of the concepts, principles and methods used in: computer programming, high-level and specific languages, CAD techniques for creating electronic modules, microcontrollers, computer-system architecture, programmable electronic systems, graphics and reconfigurable hardware architectures C4.2 Explanation and interpretation of the requirements specific to hardware and software structures in the fields of: computer programming, high-level and specific languages, CAD techniques for creating electronic modules, microcontrollers, computer-system architecture, programmable electronic systems, graphics and reconfigurable hardware architectures C4.4 Use of appropriate performance criteria to evaluate, including by simulation, the hardware and software of dedicated systems or service activities using microcontrollers or low-/medium-complexity computer systems C4.5 Design of dedicated equipment in the fields of applied electronics, using microcontrollers, programmable circuits or computer systems with a simple architecture, including the related programs

Transversal competencie	

7. Expected learning outcomes

Knowledge	- The student/graduate describes, identifies and summarizes elementary concepts and methods related to electronic devices, circuits and instrumentation, as well as their application in concrete problems.
Skills	- The student/graduate uses fundamental methods for measuring electrical quantities and assesses electronic devices and circuits, as well as linear and digital integrated circuits of low/medium complexity. - The student/graduate designs, measures, evaluates performance, diagnoses and troubleshoots functional blocks composed of low/medium-complexity electronic devices and/or circuits.
Responsibility and autonomy	- The student/graduate carries out project management processes in electronics, telecommunications and information technologies, taking on different team roles and clearly and concisely describing the results, both orally and in writing.

8. Course objectives (based on the grid of specific competencies acquired)

8.1 General objective of the course	
8.2 Specific objectives	

9. Contents

9.1 Lecture	**No. of hours**	**Teaching methods**	**Remarks**
Integrated semiconductor devices. MOS and bipolar trasistors.	2	Lecture, discussions, interactive teaching.	
Small signal device models and parameters. Biasing techniques. Latch-up in CMOS technologies.	2		
Current sources and sinks. Advanced current source architecures. Increasing the output resistance and decreasing the minimum required bias voltage.	2		
Bipolar and CMOS current mirrors. Parameters. Methods to reduce gain errors.	2		
Integrated voltage and current references. Sensitivity and temperature coefficient. Vth/R, Vbe/R, Widlar and PTAT references.	2		

9.1 Lecture	No. of hours	Teaching methods	Remarks
References with supply voltage and temperature compensation (bootstrap, band gap).	2		
Elementary bipolar and CMOS voltage amplifiers. Principles of operation. Frequency response. Performance enhancements.	2		
Improved elementary amplifier structures. Asymmetrical, symmetrical and folded cascode amplifiers. Operating principles. Frequency response.	2		
Differential amplifiers. Fundamental configurations. Parameters. Frequency response.	2		
Linearisation of the fundamental differential amplifier. Emitter – source degeneration and the effect of negative feedback.	2		
The fundamental opamp with Miller compensation. Principles of operation. Small signal model. Frequency response. Design algorithm based on a given set of specification.	2		
The cascode and folded cascode opamps. Comparison with the Miller compensated opamp. Small signal models. Frequency responses. The design algorithm.	2		
Transconductance amplifiers. Fundamental linear OTA arcitectures. Applications.	2		
Stability of feedback amplifiers. Stability criteria based on the loop gain. Stability indicators. Stability conditions for the amplifier on the forward signal path..	2		

Bibliography:

1. D. Csipkes – Circuite Integrate Analogice. Circuite fundamentale – Casa Cărții de Știință, 2007;
2. D. Csipkes, G. Csipkes – Elemente constructive utilizate în proiectarea circuitelor analogice complexe – Casa Cărții de Știință, 2004;
3. L. Feştilă – Circuite integrate analogice 1 – Casa Cărții de Știință, 1997;
4. L. Feştilă – Circuite integrate analogice 2 – Casa Cărții de Știință, 1999.

9.2 Seminar /laboratory /project /practical training	No. of hours	Teaching methods	Remarks
Laboratory		Applications, learning through errors and discovery, validation by simulations, computer aided design.	
Transistors – biasing, characteristics, operating regions, setting the operating point.	2		
Design and analysis of electronic current sources.	2		
Current mirrors.	2		
Voltage and current references.	2		
Elementary voltage amplifier stages.	2		
Differential amplifiers.	2		
Miller compensated and folded cascode opamp architectures.	2		
Seminar		Problem solving, learning	
Current sources and sinks.	2		

9.2 Seminar /laboratory /project /practical training	No. of hours	Teaching methods	Remarks
Current mirrors.	2	by cooperation, case studies and explanations, demonstrations.	
Voltage and current references.	2		
Elementary and differential voltage amplifier stages.	2		
Opamp internal sructures. Analysis.	2		
Opamp design algorithms.	2		
Stability analysis of the opamps. Frequency compensation.	2		

Bibliography:

1. D. Csipkes – Circuite Integrate Analogice. Circuite fundamentale – Casa Cărţii de Ştiinţă, 2007;
2. D. Csipkes, G. Csipkes – Elemente constructive utilizate în proiectarea circuitelor analogice complexe – Casa Cărţii de Ştiinţă, 2004;
3. L. Feştilă – Circuite integrate analogice 1 – Casa Cărţii de Ştiinţă, 1997;
4. L. Feştilă – Circuite integrate analogice 2 – Casa Cărţii de Ştiinţă, 1999;
5. P.E. Allen, D. Holberg – CMOS Analog Circuit Design, Second Edition, Oxford Press, 2002;
6. Doris Csipkes, Gabor Csipkes, Robert Groza, *CIRCUITE INTEGRATE ANALOGICE. Culegere de probleme*, Editura UTPRESS, Cluj-Napoca, 2022, ISBN 978-606-737-600-5, 172;
7. D. Csipkes, G. Csipkes – Fundamental Analog Circuits. Practical Simulation Exercises – UTPres, 2004;
8. Robert Groza, Gabor Csipkes, Doris Csipkes,Circuite integrate analogice. Indrumator de laborator, Editura U.T.PRESS, Cluj-Napoca, 2015.

10. Alignment of the course contents with the expectations of the epistemic community, professional associations, and representative employers in the field related to the program

The course content and the teaching-learning-assessment methods are aligned with the current requirements of the Electronics, Telecommunications, and Information Technology Engineering field, considering the expectations of the academic and professional community, representative employers, as well as the national quality assurance standards in higher education. The course helps prepare students in line with employer expectations and the quality requirements set for engineering study programs.

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods (and type of assessment: continuous/ summative)	11.3 Weight in final grade
11.4 Lecture	Exercise solving	Written exam and quiz	80%
11.5 Seminar/ Laboratory/ Project /Practical activity	Laboratory related exercises	Quiz	20%
11.6 Minimum performance standard: ✓ Passing examination grade (≥ 4.5) ✓ All laboratory participations ✓ Final grade ≥ 5			

Completion date:	Course coordinators	teaching rank, title First name LAST NAME	Signature
23.06.2026	Lecture	Assist.prof. Gabor CSIPKES, Ph.D.	
	Applications	Assist.prof. Gabor CSIPKES, Ph.D.	

Approval of the Head of the Department coordinating the course, only if this differs from the department organizing the study program	Head of the Department

Date of approval by the Council of the Department of Bases of Electronics 26.06.2026	Head of the Bases of Electronics Department Prof. Sorin HINTEA, Ph.D.
Date of approval by the Council of the Faculty of Electronics, Telecommunications and Information Technology 30.06.2026	Dean, Prof. Ovidiu-Aurel POP, Ph.D.