

# SYLLABUS

<b>Discipline name</b>	Analog Integrated Circuits
<b>Profile</b>	Electronics and Telecommunications Engineering
<b>Specialization</b>	Telecommunications Technologies and Systems
<b>Code</b>	51322709
<b>Course leader</b>	Prof. Lelia FEȘTILĂ, Ph.D. <a href="mailto:Lelia.Festila@bel.utcluj.ro">Lelia.Festila@bel.utcluj.ro</a>
<b>Collaborators</b>	Assist. Prof. Gabor Csipkes, <a href="mailto:Gabor.Csipkes@bel.utcluj.ro">Gabor.Csipkes@bel.utcluj.ro</a> , Assistant Robert Groza, <a href="mailto:Robert.Groza@bel.utcluj.ro">Robert.Groza@bel.utcluj.ro</a>
<b>Department</b>	Basis of Electronics
<b>Faculty</b>	Electronics, Telecommunications and Information Technology

Sem.	Type of discipline	Course	Applications			Course	Applications			Ind. study	TOTAL	Credits	Form of assessment
		[hours/week]				[hours/sem.]							
			S	L	P		S	L	P				
<b>4</b>	<b>Engineering</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>-</b>	<b>28</b>	<b>14</b>	<b>14</b>	<b>-</b>	<b>64</b>	<b>120</b>	<b>4</b>	<b>Exam</b>

## Acquired competences :

### Acquired skills (what the student is able to do):

- Understanding basic operation principles of integrated components and devices.
- Identifying basic building blocks in complex integrated circuits.
- Defining specific parameters and performance of basic circuits.
- Analyzing component circuits of an OA.
- Combining elementary building blocks to implement more complex circuits.
- Analyzing circuit performance.
- Abilities to propose methods for improving performance based on the performance analysis.

### Acquired abilities: (what type of equipment/instruments/software the student is able to handle)

- Abilities in simulating circuits for proving the theoretical concepts
- Analyze and design some simple analog systems.
- gather and analyze data obtained by simulation
- experimentally determine the parameters of several circuits (gain, input-output resistance, pass band)

## Prerequisites ( if necessary)

Fundamentals of electrical and electronic circuits, electronic devices (BJ Transistors, MOSFETs, diodes , passive components), circuit theory (transfer functions, stability criteria)

## A. Course/Lecture (course/lecture titles)

1	- Microelectronics. Classification of Integrated Circuits. Terminology associated to CI design. An introduction
2	- Microdevices. Bipolar transistors, MOSFETs. Regions of operation. Large signal models
3	- Small signal models. Parasitic effects. Latch up in CMOS structures. Integrated Resistors and capacitors
4	- Current sources and sinks. Current mirrors. Parameters and basic configuration.
5	- Increasing output resistance of CSs. Cascode, regulated cascode. Lowering minimal CS output voltage.
6	- Current and voltage references. Parameters. Methods for compensating the effects of thermal and power supply voltage variation.
7	- $V_{Th}/R$ , Widlar, $V_{BE}/R$ , $V_T/R$ , PTAT references. Self biasing circuits. Examples of integrated current and voltage references.
8	- Band-gap reference. Basic and very low voltage circuits. Applications
9	- One stage single input - single output v/v and i/v amplifiers. Small signal h.f. models. Parameters and basic integrated configurations.
10	- One stage differential amplifiers. Basic configurations. Applications.
11	- Improving DA performance: increasing gain, output swing, dynamic range
12	- Operational Amplifiers. Frequency characteristic compensation for OA stabilization /increasing BW and speed.
13	- Two stage Op Amps. Miller's compensation.
14	- Two or three stage Op Amps. Feed Forward compensation H. f. performance.

## B1. Applications – Laboratory (list of laboratories), B2. Seminar (contents), Project (project contents)

1	- Current sources and sinks Output stages
2	- Current mirrors,
3	- Current references

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4	– Voltage references
5	– Amplifier stages
6	– Op Amps architectures
7	– Revision and evaluation Tests.
<b>B2. Seminar (contents)</b>	
1	– Bipolar transistor and MOSFET. Active resistance.
2	– Current mirrors. Current sources and sinks
3	– Current references. Design examples
4	– Voltage references. Design examples
5	– Analysis of various amplifier configurations. Part I
6	– Analysis of various amplifier configurations. Part II
7	– Analysis and design of OA circuits

<b>C. Individual study</b> (reference study contents, synthesis materials, projects, applications etc.)						
7 sets of problems (the preparation part in every laboratory)						
7 sets of problems (homework)						
Individual study structure	Course study	Problem solving, laboratory	Applications preparation	Examination time	Additional reference study	Total no. of individual study hours
Hours	28	20	8	4	4	64

<b>References</b> ( Textbooks, courses, laboratory manual, exercise book)	
1.	Hans Camenzind Design Analog Chips 2005 (text book). <a href="http://www.designinganalogchip.com">www.designinganalogchip.com</a>
2.	Lelia Feștilă, Analog Integrated Circuits, UT PRES 2003
3.	Lelia Feștilă, Circuite integrate analogice I, Ed. C.C.Știință , 1997
4.	Lelia Feștilă, Circuite integrate analogice II, Ed. C.C.Știință , 1999
5.	Lelia Feștilă, Doris Lupea, Circuite integrate analogice – Culegere de probleme, Ed. Lito. UTCN, 2000.
6.	P. E. Allen, D. Hollberg – CMOS analog circuit design, Oxford Press 2003
7.	<a href="http://www.bel.utcluj.ro/ci/rom/cia1.html">www.bel.utcluj.ro/ci/rom/cia1.html</a>
8.	<a href="http://www.HowtomakeanICappliedmaterials.com/HTMAC/animated.html">www.HowtomakeanICappliedmaterials.com/HTMAC/animated.html</a>

<b>Final evaluation</b>	
Evaluation method	Written exam consisting in problem solving and describing some theoretical subjects
Mark components	Laboratory: tests (grade T); Exam (grade E)
Mark computation	$N=0.2T+0.8E$

**Course leader,**

Prof. Lelia FEȘTILĂ, Ph.D.