

SYLLABUS

1. Information about the program

1.1 Higher education institution	UNIVERSITY POLITEHNICA OF TIMISOARA
1.2 Faculty ¹ / Department ²	ELECTRONICS, TELECOMUNICATON AND INFORMATION TECHNOLOGIES/EA
1.3 Field of study (name/code ³)	ELECTRONIC ENGINEERING, TELECOMUNICATION AND INFORMATION TECHNOLOGIES
1.4 Study cycle	License
1.5 Study program (name/code/qualification)	TST-ENG/20/20/10/100/10/TST-ENG

2. Information about the discipline

2.1 Name of discipline/ formative category ⁴	Analog Integrated Circuits/DD						
2.2 Coordinator (holder) of course activities	Conf. univ. dr. ing. Ioana-Monica POP-CALIMANU						
2.3 Coordinator (holder) of applied activities ⁵	Conf. univ. dr. ing. Ioana-Monica POP-CALIMANU						
2.4 Year of study ⁶	2	2.5 Semester	4	2.6 Type of evaluation	E	2.7 Regime of discipline ⁷	DI

3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted) ⁸

3.1 Number of fully assisted hours / week	5 of which:	3.2 course	3	3.3 seminar / laboratory / project	1/1/0
3.1* Total number of fully assisted hours / semester	70 of which:	3.2* course	42	3.3* seminar / laboratory / project	14/14/0
3.4 Number of hours partially assisted / week	of which:	3.5 training		3.6 hours for diploma project elaboration	
3.4* Total number of hours partially assisted / semester	of which:	3.5* training		3.6* hours for diploma project elaboration	
3.7 Number of hours of unassisted activities / week	3.93 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			1.5
		hours of individual study after manual, course support, bibliography and notes			1.2
		training seminars / laboratories, homework and papers, portfolios and essays			1.23
3.7* Number of hours of unassisted activities / semester	55 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			21
		hours of individual study after manual, course support, bibliography and notes			16.8
		training seminars / laboratories, homework and papers, portfolios and essays			17.2
3.8 Total hours / week ⁹	8.93				
3.8* Total hours /semester	125				
3.9 Number of credits	5				

4. Prerequisites (where applicable)

¹ The name of the faculty which manages the educational curriculum to which the discipline belongs

² The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.

³ The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.

⁴ Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).

⁵ Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).

⁶ Year of studies in which the discipline is provided in the curriculum.

⁷ Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT, optional discipline (DO) or optional discipline (Df).

⁸ The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.

⁹ The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

4.1 Curriculum	<ul style="list-style-type: none"> Electrical Circuits, Electronic Devices, Electronic Circuits Fundamentals, Measurements in Electronics and Telecommunications
4.2 Competencies	<ul style="list-style-type: none"> The use of standard laboratory equipment: DC power supply, multimeter, function generator, oscilloscope.

5. Conditions (where applicable)

5.1 of the course	<ul style="list-style-type: none"> Classroom with video projector, whiteboard and internet connection.
5.2 to conduct practical activities	<ul style="list-style-type: none"> Dedicated laboratory with necessary equipment/apparatus/computers for practical experiments and simulations

6. Specific competencies acquired through this discipline

Specific competencies	<ul style="list-style-type: none"> Hardware applications for analog integrated circuits using test boards. Analyse the operation of many complex analog circuits using simulations. Design and test analog systems using analog integrated circuits.
Professional competencies ascribed to the specific competencies	<ul style="list-style-type: none"> Use of fundamentals in terms of devices, circuits, systems, instrumentation and electronics technology
Transversal competencies ascribed to the specific competencies	<ul style="list-style-type: none"> Definition of activity stages and their distribution to subordinates in terms of responsibilities, providing effective exchange of information and interpersonal communication.

7. Objectives of the discipline (based on the grid of specific competencies acquired - pct.6)

7.1 The general objective of the discipline	<ul style="list-style-type: none"> Develop the skills to analyze analog ICs building blocks and linear and non-linear operational amplifier applications. Develop a better understanding of the theory of analog integrated circuits through practical examples and testing as well as interpret experimental results
7.2 Specific objectives	<ul style="list-style-type: none"> During experiments in laboratory classes, the student will gain experience designing and implementing current sources, differential stages and op amp applications by comparing the operation with simulated performance using the OrCad-Pspice program.

8. Content ¹⁰

8.1 Course	Number of hours	Teaching methods ¹¹
Introduction. Analog IC development, classification and technologies	1	
Multiple-Transistor Amplifier Stages. The CC-CE, CC-CC, Darlington and cascode configurations	2	

¹⁰ It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".

¹¹ Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).

Differential Pairs. Large-Signal and Small-Signal Analysis of Differential Amplifiers.	3	
Device Mismatch Effects in Differential Amplifiers.	1	
Current Mirrors. Current sources.	3	
Active Loads. Differential Pair with Current-Mirror Load	2	
Op Amp with Single-Ended Outputs, linear applications and typical parameters of Operational Amplifiers.	4	
Op amp nonlinear applications. Precision Rectification. Precision Peak Rectifiers	3	
Filters	3	
Voltage references and Band-Gap-Referenced Bias Circuits in Bipolar Technology.	2	
Instrumentation amplifiers.	1	
Comparators.	1	
DC regulated power supply	2	
<p>Bibliography ¹² In electronic format:</p> <ol style="list-style-type: none"> 1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and design of analog integrated circuits, fourth edition , JOHN WILEY & SONS, INC. 2. Isar Dorina – lecture notes and slides, course presentation in pdf format on UPT Virtual Campus 3. A. Sedra, K. Smith, Microelectronic Circuits 7th edition, Oxford University Press, ISBN 0-19-514252-7 4. Design With Operational Amplifiers And Analog Integrated Circuits - S. Franco, Third edition, McGraw-Hill, ISBN 0-07-232084-2 <p>In print:</p> <ol style="list-style-type: none"> 1. P. Gray, P. Hurst, S. Lewis, R. Meyer, Analysis and Design of Analog Integrated Circuits 4th edition, John Wiley & Sons, Inc, ISBN 0-471-32168-0 2. Lucian Jurca, Mircea Ciugudean, Circuite integrate analogice, Editura "Politehnica", Timișoara, 2007, 2014 3. Paul R. Gray, Robert G. Meyer, Circuite integrate analogice. Analiza si proiectare. Traducere - prof. Mircea Bodea, Ed. Tehnica Bucuresti, 1983, 1993, 1999 		
8.2 Applied activities ¹³	Number of hours	Teaching methods
Using OrCAD–PSPICE. BJT differential amplifier	4	Laboratory experiments
Current mirrors.	2	provide opportunities for
Operational amplifier basics. Dynamic behavior of operational amplifiers.	4	students to learn through
The precision rectifier with operational amplifier.	2	hands-on use of
Multiple feedback band-pass filter.	2	disciplinary tools and
Seminar revision. Problems related to current sources, differential stages, op amp linear and nonlinear applications.	10	techniques.
Problems related to Band-Gap-Referenced Bias Circuits.	2	
Quiz	2	
<p>Bibliography ¹⁴ 1. Analog Integrated Circuits lab guide - in pdf format, available on the Virtual Campus. 2. Collection of solved problems – in pdf format, available on the Virtual Campus.</p>		

¹² At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.

¹³ Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".

¹⁴ At least one title must belong to the discipline team.

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

- The content of the discipline was discussed and agreed with the companies in the field.
- In the interview tests of various companies, there are questions about simple circuits with operational amplifiers, with applications of analog integrated circuits.

10. Evaluation

Type of activity	10.1 Evaluation criteria ¹⁵	10.2 Evaluation methods	10.3 Share of the final grade
10.4 Course	Written examination consisting of 2 sections: theory questions (T) and problems (P). Each section has the same weight in the final grade, 50%. The final mark for the written exam is the mean, only if $T \geq 5$ and $P \geq 5$.	Written exam.	0.66
10.5 Applied activities	S: Degree of understanding of the problems encountered in the design of analog integrated circuits.	Individual test.	0.17
	L: The level of understanding of practical applications in analog electronics. The student must record all the results and experiments in its lab notebook. At the end of each lab, the student must be able to explain the operation of the tested circuit.	The student's progress will be evaluated through an individual test related to practical measurements and circuits which the student completed during the semester at the AIC laboratory, the mark is denoted as L and must be ≥ 5 .	0.17
	P¹⁶:		
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified ¹⁷)			
<ul style="list-style-type: none"> • Minimum performance standard is when the mean(S,L) is 5 and the mean(T,P) is 5. 			

Date of completion

08.07.2023

**Course coordinator
(signature)**

**Coordinator of applied activities
(signature)**

**Head of Department
(signature)**

Date of approval in the Faculty Council ¹⁸

14.09.2023

**Dean
(signature)**

¹⁵ Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)

¹⁶ In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.

¹⁷ It will not explain how the promotion mark is awarded.

¹⁸ The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.