Syllabus

1. Information about study program

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Electronics, Telecommunication and Information Technology
1.3 Department	Basis of Electronics
1.4 Study domain	Electronics, Telecommunication and Information Technology Engineering
1.5 Study category	Master
1.6 Study program / Qualification	Integrated circuits and systems / MSc
1.7 Study form	IF – full-time education
1.8 Topics code	2.00

2. Information about the topic

2.1 Name of topic	Advanced processing of signals						
2.2 Content area	Methodological area						
2.3 Course	Prof. dr. ing. Ţopa Marina Dana Marina.Topa@bel.utcluj.ro						
2.4 Laboratory and project	Conf. dr. ing. Kirei Botond Sandor Botond.Kirei@bel.utcluj.ro						
2.5 Study year	I	2.6 Semester	I	2.7 Evaluation	E	2.8 Type	O/DD

3. Estimated total study time

3.1 Number of hours per week	4	From them: 3.2 lecture	4	3.3 laboratory and project classes	2
3.4 Total number of hours	56	From them: 3.5 lecture	28	3.6 laboratory and project classes	28

Distribution of study time	ore
Study time with course-books, course support, literature references and lecture	28
Additional bibliography at library, electronic platforms or in laboratory	8
Elaboration of laboratory classes, exercises, tasks, essays, projects	12
Tutorials	3
Exam	3
Other activities:	

3.7 Total number of individual study hours	54
3.8 Total number of hours per semester	110
3.9 Number of credits	5

4. Prerequisites (if necessary)

4.1 curriculum	Signals theory, systems theory, electronic devices and circuits, analog and digital integrated circuits, computer-assisted analysis of electronic circuits
4.2 competences	Use of Matlab, PSpice

5. Place

5.1. Lecture	Lecture hall, Cluj-Napoca

5.2. exercises / laboratory / project classes	Laboratory hall, Cluj-Napoca

6. Acquired competences

Professional competences	To choose the approximation type and find out the filter order for given specs; To choose scaling/unscaling, frequency transformations; To choose/synthesize a passive filter; To use functions in matlab/octave/python for filter approximation; To change (with the help of scaling, frequency transformation or topology change) a filter to fit other specs; To analyse/compare designed active filters; To design/verify an AO-RC or gm-C filter using different methods; To design a digital filter; To implement an adaptive filter.
Transversal competencies	To measure the frequency characteristics of filters; To simulate the filter behaviour in time or frequency, to compute the filter parameters; To change the values of the filter components to suit other specs; To change the weights of digital filters to suit other specs.

7. Objectives of the topic

7.1 General objective	Development of competences for analog and digital filters design
7.2 Specific objectives	1. Knowledge and understanding of fundamentals of electric filters and delay cells. 2. Development of skills and abilities for filter design and analysis.

8. Content

8.1 Lecture	Teaching method	Observations
1. Introduction.	Lecture, examples, problems, discussions.	Slides and Black board.
2. Scaling and unscaling. Frequency transformation. Transfer function of 1st and 2nd order.		
3. Approximation methods (Butterworth, Chebyshev, Cauer, Bessel).		
4. Electric circuits sensitivity.		
5. Synthesis and design of passive filters.		
6. Synthesis of active filters. Design methods.		
7. OA-RC active filters of 1st and 2nd order. Cascade realization of OA-RC filters.		
8. State-space design of OA-RC filters. Multiple feedback OA-RC filters.		
9. OA-RC filter design by element replacement.		
10. gm-C filters. Biquads. Higher order filter design.		
11. All-pass filters. Delay time equalization.		
12. Complex filters.		
13. Digital filters.		

14. Adaptive filters.		
Reference A. Mateescu, *Semnale şi sisteme.* Editura Teora, Bucureşti, 2001. S. Ştefănescu, *Filtre*, Editura tehnică, Bucureşti, 1987. Wai-Kai Chen (editor), *The Circuits and Filters Handbook,* ECRC Press, 2002.		
8.2 Laboratory	Teaching methods	Observations
1. Transfer function approximation for given specs. 2. Active Sallen-Key filters analysis. 3. Tow-Thomas filters analysis. 4. Active filters analysis and synthesis using state-space variables. 5. Analysis and synthesis of gm-C filters. 6. Analog filters applications (Band and channel filters for radio receivers). 7. Digital filters applications. Project 1. Specs. State-of-the-art literature. 2. Decision regarding the filter approximation and order. 3. Analog/ digital filter design. 4. Verification of the filter. Simulation. 5. Filter implementation on FPGA for digital/ analog on bread-board. 6. Elaboration of the written report. 7. Report defense.	Discusiions on theoretical issues, solution of simple problems, individual work	Use of OrCAD, Matlab platforms, black-board.
References: M. Ţopa, V. Popescu, C. Rusu, A. Burian, *Semnale, circuite şi sisteme. Îndrumător de laborator II,* Editura Casa Cărţii de Ştiinţă, Cluj-Napoca, 1997. A. Gogu, M. Ţopa, *Semnale, circuite şi sisteme. Îndrumător de laborator III,* Editura Casa Cărţii de Ştiinţă, Cluj-Napoca, 1999		

9. Corroborating of topic content with expectations of epistemic community representatives, professional associations and representative employers

The topic content, together with the acquired skills and abilities were agreed with professional organisations (e.g., ARIES), enterprises where the Master students are looking for or getting jobs, as well as quality assurance agencies (ARACIS).

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in final mark
10.4 Lecture	Level of acquired theoretical knowledge	Tasks solution (problems and essays) T	10%
10.5 Laboratory	Level of acquired abilities	Laboratory evaluation L	20%
10.5 Project	Level of acquired abilities	Project defense P	30%
Exam	Level of acquired knowledge and abilities.	Written exam E containing several problems	40%
Final mark = (T+L+P+E)/10			

10.6 Minimum performance level
L>4 and P>4

Fill-in data:	Teachers	Titel Name	Signature
15.09.2022	Lecture	Prof. dr. ing. Ţopa Marina Dana	
	Applications	Conf. dr. ing. Kirei Botond Sandor	

Data of Department Council approval 16.09.2022	Bases of Electronics Department Director Prof.dr.ing. Sorin Adrian HINTEA
Data of Faculty Concil approval 25.09.2022	Dean Prof.dr.ing. Ovidiu POP