COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	Politehnica University of Bucharest
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Dept. of Telecommunications
1.4 Domain of studies	Electronic Engineering, Telecommunications and Informational Technologies
1.5 Cycle of studies	Licence (engineering)
1.6 Program of studies/Qualification	Technologies and Telecommunication Systems

2. Course identification information

2.1 Name of the course				Circuits Analysis and Synthesis			
2.2 Lecturer				Prof. Dr. Eng. Cristian NEGRESCU			
2.3 Instructor for practical activities				As. Drd. Ing.Valentin Niţă As. Drd. Ing.Robert Dobre			
2.4 Year of studies	II	2.5 Semester	II	2.6 Evaluation type	Exam	2.7 Course choice type	Compulsory

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week, out of which	7	3.2 course	3	3.3 practical activities	4
3.4 Total hours in the curricula, out of which	98	3.5 course	42	3.6 practical activities	56

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	27
Supplemental documentation (library, electronic access resources, in the field, etc)	4
Preparation for practical activities, homework, essays, portfolios, etc.	27
Tutoring	0
Examinations	6
Other activities	0

3.7 Total hours of individual study	58
3.9 Total hours per semester	156
3. 10 Number of ECTS credit points	6

4. Prerequisites (if applicable)

4.1 curricular	Mathematical Analysis, Special Mathematics, Electrotechnics Fundamentals, Signals and systems.
4.2 competence-based	Knowledge of the basic notions for: electric and electronic circuits theory, electrical signal processing

5. Requisites (if applicable)

5.1 for running the course	Amphitheatre multimedia equipped (video projector)
5.2 for running of the applications	Compulsory attendance at laboratories (in accordance with the regulations for license university studies in UPB)

6. Specific competences

Professional competences	C1. Usage of the fundamental elements referring to the devices, circuits and electronic instruments C2. Applying, in typical situations, of the basic methods for acquiring and processing signals. Implementing some procedures of medium

	complexity on signal processors C6. Solving problems specific to wide bandwith communications: propagation through different transmission media, ultrahigh frequency circuits and equipments (microwaves and optical).
Transversal competences	It is not the case

7. Course objectives (as implied by the grid of specific competences)

7.1 General objective of the course	Time domain and frequency domain analysis methods for continuous-time, linear-time, invariant systems are presented. Time domain and frequency domain analysis methods for discrete time linear, time invariant systems are given. Matrix analysis of the two-ports is made. Ideal models for two-ports are analyzed. Two-port inter-connecting is presented. Image parameters and effective parameters for two-ports are studied. Realizability and synthesis of the passive one-ports are studied and also the algebraic relations between the parts of a system function. Taylor, Butterworth, Bessel and Chebyshev approximation methods of the transfer functions are presented. Signal flow graphs with applications to circuits and systems are studied. LC filters design based on effective parameters is presented. Active filters are analyzed and second order transfer functions for active filter sections, sensitivity functions, active filter realizations with operational amplifiers, resistors and capacitors are presented.
4.2 Specific objectives	The target of the course is the students to assimilate the engineering methods of circuit analysis and synthesis. The specific methods of the two-ports analysis and the main concepts connected with its description are given. Fundamental knowledge of physical realisability and its applications at the electrical circuit synthesis are presented. One of the purposes of the course is that the students to assimilate the main approximation methods with applications to the filters and correctors. Some methods of design for the attenuators, electrical filters and correctors are given.

8. Content

8.1 Lectures	Teaching techniques	Remarks
Analysis general methods of the continuous time systems. Time domain analysis methods: convolution methods**,** method of linear differential equations with constant coefficients. Methods of frequency domain analysis: Fourier transform method, Laplace transforms method, harmonic method, low frequency equivalent method. Compact method to calculate the response to the continuous time periodical signals.	Teaching is performed using an overhead projector, that covers the communication and demonstration activities. The oral communication methods are he expository one and the problem solving method.	5 hours
Analysis general methods of the discrete time systems. Time domain analysis methods: convolution methods**,** method of finite difference equations with constant coefficients. Methods of frequency domain analysis: harmonic method, analysis		4 hours

methods using the z-transform. Implementation methods of the discrete time systems.		
Two-port analysis. Matriceal analysis. Ideal models of two-ports. Passive two-port analysis: image parameters, effective parameters.		8 hours
Linear circuits realisability and synthesis. Physical realisability of the circuits. LC, RC, RLC one-port synthesis. Positive real function getting from its real part. Transfer function getting from the magnitude, respectively from the phase.		6 hours
Signal flow graphs. Signal flow graph elements. Definitions and graph reduction methods. MASON rule. Applications to the linear, time invariant, continuous time and discrete time systems.		3 hours
Approximation methods for the linear circuits and systems. Introduction. Approximation elements. Approximation criterions: maximum plate approximation, Butterworth approximation, Bessel approximation, Chebyshev approximation. Approximation usage to the linear circuits and systems theory.		8 hours
Electrical filters. Low-pass, high-pass, pass-band and stop-band LC filters obtained by frequency transformations. LC filters synthesis using effective parameters. Active filters: signal flow graph analysis, active filter realization principles, elementary transfer functions, active filter sensitivity, realization structures.		8 hours

Bibliography

1) I. Constantin, "Semnale şi răspunsul circuitelor", Bucureşti, Editura BREN, 1999

2) Ad. Mateescu, N. Dumitriu, L. Stanciu, “Semnale şi sisteme. Aplicaţii în filtrarea semnalelor”, Editura Teora, 2001.

3) I. Constantin, "Semnale", Tipografia Institutului Politehnic Bucureşti, 1992

4) D. Stanomir, "Semnale şi sisteme analogice", Editura Politehnica Press, 2005.

5) D. Stanomir, "Semnale şi sisteme discrete", Editura Athena, 1997.

6) Ad. Mateescu, Al. Şerbănescu, N. Dumitriu, L. Stanciu, "Semnale, circuite şi sisteme-probleme", Editura Militară, Bucureşti, 1998.

7) I. Constantin, S. Halunga, I. Marcu, "Semnale şi sisteme-probleme", Editura Electronica 2000, Bucureşti, 2007.

8) M. Săvescu, T. Petrescu, S. Ciochină, "Semnale, circuite şi sisteme-probleme", Editura Didactică şi Pedagogică, Bucureşti,1981.

9) C. Negrescu, D. Stanomir, Semnale şi sisteme-Probleme şi soluţii, Ed. Politehnica, 2013, Bucureşti.

8.2 Seminar	Teaching techniques	Remarks
Analysis general methods of the continuous time systems.	Teaching is based on problem expository by the teaching assistant and their solving by all students with his / her explanations and help. The students will solve the problem on their own, and confront their results with the ones provided by the teaching assistant.	4 hours
Analysis general methods of the discrete time systems.		2 hours
Matriceal parameters of the two-ports.		2 hours
Image parameters and effective parameters of the two-ports.		2 hours
Symmetrical two-ports. Attenuators. Bisection theorem.		2 hours
Positive real functions. Reactance functions. RCZ and RCY functions. Testing methods.		2 hours
LC, RC and RLC one-port synthesis.		2 hours
Positive real function getting from its real part. Transfer function getting from the magnitude, respectively from the phase.		2 hours
Passive and active linear circuit analysis using signal flow graphs.		2 hours
Butterworth and Chebyshev filter synthesis.		4 hours
Active filters: realization structures, stability, active filter sensitivity.		4 hours
8.3 Laboratory	**Teaching techniques**	**Remarks**
1. Selective circuits amplifiers	The students measure independently two-ports parameters, amplitude and phase responses of the circuits using apparatuses of the laboratory.	4 ore
2. Two-ports parameters		4 ore
3. Bandpass amplifiers response to AM signals		4 ore
4. RC active filters		4 ore
5. LC filters designed by using effective parameters		4 ore
6. Measurement of the elementary second order functions by using active filters		4 ore
7. Laboratory assessment		4 ore

Bibliography:0)

1) I. Constantin, "Semnale şi răspunsul circuitelor", Bucureşti, Editura BREN, 1999
2) Ad. Mateescu, Al. Şerbănescu, N. Dumitriu, L. Stanciu, "Semnale, circuite şi sisteme-probleme", Editura Militară, Bucureşti, 1998.
3) I. Constantin, S. Halunga, I. Marcu, "Semnale şi sisteme-probleme", Editura Electronica 2000, Bucureşti, 2007.
4) M. Săvescu, T. Petrescu, S. Ciochină, "Semnale, circuite şi sisteme-probleme", Editura Didactică şi Pedagogică, Bucureşti,1981.
5) C. Negrescu, D. Stanomir, Semnale şi sisteme-Probleme şi soluţii, Ed. Politehnica, 2013, Buc.

9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

These lectures present the theory of the continuous and discrete time systems, from the perspective of the signal processing, but includes and the design of the analog passive and active filters. First time the theory is presented and in the second time an implementation is realized, which represents a fascinating confirmation of the theory value.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	- knowledge of the basic theoretical knowledge of the analysis and synthesis of the electrical circuits; - application methodology knowledge of the methods in circuit analysis and synthesis; - design methods knowledge of the electrical filters.	-control paper sustained in the week fixed at the begining of the semester; – session exams.	70%
10.5 Seminar	- individual / independent solving of the proposed problems, verified with a control paper and a homework assignment; -understanding fundamental concepts in circuit analysis and synthesis.	- appreciation for solving seminar problems; - appreciation for solving homework problems; - appreciation for solving control paper.	10%
10.6 Laboratory	- measurement methodology knowledge of the parameters and the circuits characteristics; - knowledge of the methodology to compare experimental and theoretical results.	Laboratory final test with practical and theoretical components. The practical component is appreciated by the measurement abilities of the parameters and the circuits characteristics. The theoretical component is appreciated by the calculus abilities for the verification of the experimental results.	20%
10.6 Minimal performance standard			
- modeling of a real simple problem of circuit analysis and synthesis and specification of the chain to solve the problem; - implementation and demonstration of a simple solution to solve a fundamental problem of circuit analysis and of electrical filter design .			

Date	Lecturer	Instructor for practical activities
25.09.2017	Prof. Dr. Eng. C. Negrescu	As. Drd. Eng.Valentin Niţă
		As. Drd. Eng.Robert Dobre

Date of department approval

28.09.2017

Director of Department,

Prof. Dr. Ing. E. Popovici