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 Telecommunication
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				Signals and systems			
2.2 Lecturer				Prof. Dr. Eng. Cristian Negrescu			
2.3 Instructor for practical activities				As. Victor POPA As. Drd. Eng. Robert DOBRE			
2.4 Year of studies	II	2.5 Semester	I	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	6	3.2 course	3	3.3 practical activities	3
3.4 Total hours in the curricula, out of which	84	3.5 course	42	3.6 practical activities	42

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	33
Supplemental documentation (library, electronic access resources, in the field, etc)	6
Preparation for practical activities, homework, essays, portfolios, etc.	30
Tutoring	0
Examinations	6
Other activities	0

3.7 Total hours of individual study	72
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, Electrical Engineering Fundamentals
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 C4. Designing, implementing and operating of data, voice, video and multimedia services based on the understanding and applying of fundamental concepts from communications and information technology domains
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	The course defines the basic notions and concepts of signal and system theory. Continuous-time and discrete-time signals and systems are analyzed. The course gives the basic notions of the signal theory and also the systems and associated general concepts are presented. The main purpose of this course is to create abilities to apply the fundamental notions concerning the concepts of signal and system and also to apply signal processing methods to realize specific functions in electronics.
7.2 Specific objectives	Fourier analysis of the continuous-time periodic and non-periodic signals is given. Distribution theory elements connected with signals and systems are presented. The Hilbert transform for continuous-time signals is introduced. Convolution and correlation of the continuous-time signals and the representation of the continuous-time signals by the Laplace transform are presented. Sampling theorem is studied. Harmonic carrier modulations: amplitude modulation, frequency modulation, phase modulation are described and also frequency division multiplexing is exposed. Amplitude pulse modulation and time division multiplexing are treated. General concepts of the continuous –time system theory are presented and the transfer function for the continuous-time linear-time invariant system is introduced. Fourier analysis of the periodic and non-periodic discrete-time signals is given. Discrete time representation by z-transform is given, as well as discrete Fourier transform. Convolution and correlation of the discrete-time signals are presented. General concepts of the discrete-time systems are studied and the transfer function of the discrete-time linear-time invariant systems is defined.

8. Content

8.1 Lectures	Teaching techniques	Remarks
Introduction. Objectives. Definitions. Classifications. Elementary signals.	Teaching is performed using an overhead projector and classical methods, that covers the communication and demonstration activities. The oral communication methods are the expository one and the problem-solving method.	1 hour
Analog Signals. Periodic signals. Fourier Series. Spectrum of periodic signals. Non-periodic signals. Distributions as generalized signals and operations with distributions. Fourier Transform. Hilbert Transform. Spectral structure of non-periodic signals. Convolution and Correlation of analog signals. Laplace transform of analog signals		10 hours
Sampled Signals. Sampling theorem. Spectrum of a sampled analog signal. Nyquist condition. Reconstruction		3 hours

of sampled signals.		
Modulated Signals. Definitions and classifications. Modulation with a harmonic carrier. Amplitude modulation. Frequency modulation. Phase modulation. Principles of frequency multiplexing. Principles of time multiplexing.. Basis of amplitude, width and position modulation of periodic impulses.		9 hours
Discrete Time Signals. Periodic discrete time signals. Fourier series and spectral diagrams. Non-periodic discrete time signals. Fourier transform of discrete time signals. Frequency domain representations of discrete time signals. Convolution and correlation of discrete time signals. Z transform. Discrete Fourier transform and fast Fourier transform.		10 hours
Systems and General Concepts and Properties. Introduction and classifications. General properties of analog and of discrete systems. Input output description of systems. Weighting functions of analog and discrete systems. General properties of weighting functions. The class of Linear Time Invariant Systems (LTIS). Operational and spectral description of LTIS. Physical realizability of system functions.		9 hours

Bibliography0)

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 Laboratory	Teaching techniques	Remarks
1. Spectral analysis of the continuous-time periodical signals.	The students measure independently the spectrum of the signals, using apparatuses of the laboratory.	4 hours
2. Spectral analysis of the harmonic carrier signals and amplitude modulation.		4 hours
3. Spectral analysis of the harmonic carrier signals and frequency modulation.		4 hours
4. Laboratory assessment.		2 hours
8.2 Seminar	Teaching techniques	Remarks

1. General properties of the signals. Continuous-time periodical signals.	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.	2 hours
2. Fourier analysis of the non-periodical signals. Distributions		2 hours
3. Convolution and correlation of the continuous-time signals.		2 hours
4. Signal analysis by Laplace transformation.		2 hours
5. Sampled signals and reconstruction of the continuous-time signals.		2 hours
6. Modulated signals with harmonic carrier.		2 hours
7. Pulse carrier modulated signals.		2 hours
8. Fourier analysis of the discrete-time periodical signals.		2 hours
9. Fourier analysis of the discrete-time non-periodical signals.		2 hours
10. Convolution and correlation of the discrete-time signals.		2 hours
11. Discrete-time signals analysis by z-transform.		2 hours
12. General properties of the continuous-time systems.		2 hours
13. General properties of the discrete-time systems.		2 hours
14. Synthesis problems.		2 hours

Bibliography:0)

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.

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

The innovation and development are possible by a solid understanding of the basic principles. The theory of the signals and systems is one fundament for the future development and researches. It is not simple to give lectures of signals and systems, because of the combination between the mathematical abstraction and the engineering applications. It is important that the

lecture of signals and systems to increase the interest of the students for applications and to appreciate the mathematical instrumentation.

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 for the signals and systems; - application methodology knowledge of the methods in signals and systems analysis.	-control paper sustained in the week fixed at the beginning of the semester; – session exam.	70%
10.5 Seminar	- individual independent solving of the proposed problems, verified with a control paper and a homework assignment; -understanding fundamental concepts in signals and systems.	- appreciation for solving seminar problems; - appreciation for solving homework problems; - appreciation for solving control paper.	10%
10.6 Laboratory	- measurement methodology knowledge of the spectrum for periodical signals and modulated signals with harmonic carrier; - 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 spectrum for a signal. The theoretical component is appreciated by the calculus abilities for the verification of the measured spectrum for a signal.	20%
10.7 Minimal standard performance			
- - modeling of a simple problem of signals and systems analysis and specification of the chain to solve the problem; - implementation and demonstration of a simple solution to solve a fundamental problem of signals and systems analysis.			

Date
25.09.2017

Lecturer
Prof. Dr. Eng. C. Negrescu

Instructor for practical activities
As. Drd. Ing. Vicot POPA

As. Drd. Ing. Robert DOBRE

Date of department approval
28.09.2017

Director of Department,
Prof. Dr. Eng. E. Popovici