Politehnica University of Bucharest
Faculty of Electronics, Telecommunications and Information Technology

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	University POLITEHNICA of Bucharest
1.2 Faculty	Electronics, Telecommunications and Information Technology
1.3 Department	Telecommunications
1.4 Domain of studies	Electrical Engineering and Telecommunications
1.5 Cycle of studies	License
1.6 Program of studies/Qualification	Technologies and Systems for Telecommunications

2. Course identification information

2.1 Name of the course				Analog and Digital Communications			
2.2 Lecturer				Prof. PhD. Eng. Simona Halunga,			
2.3 Instructor for practical activities				Prof. PhD. Eng. Simona Halunga.			
2.4 Year of studies	III	2.5 Semester	6	2.6 Evaluation type	Verification	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	4	3.2 course	3	3.3 practical activities	1
3.4 Total hours in the curricula, out of which	56	3.5 course	42	3.6 practical activities	14

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	10
Supplemental documentation (library, electronic access resources, in the field, etc)	2
Preparation for practical activities, homework, essays, portfolios, etc.	5
Tutoring	0
Examinations	5
Other activities	0

3.7 Total hours of individual study	22
3.9 Total hours per semester	78
3. 10 Number of ECTS credit points	3

4. Prerequisites (if applicable)

4.1 curricular	Signals and Systems Analysis and Synthesis of Circuits
4.2 competence-based	general knowledge regarding signals, systems, modulation, analysis of discrete systems.

5. Requisites (if applicable)

5.1 for running the course	Not applicable
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	C4 Design, implementation and operation of data, voice, video and multimedia services, based on understanding and applying the fundamentals of communications and information transmission C5 Selection, installation and operation of fixed and mobile telecommunication equipment, and the design of the site ensuring a common telecommunications network.
Transversal competences	-

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

7.1 General objective of the course	The students have to become familiar with the main aspects regarding analogue communication techniques (modulation, demodulation, SNR) and also the steps performed to convert an analogue signal into a digital one. A number of specific time / frequency analysis techniques are presented, as well as specific methods to modulate / demodulate for each specific type of modulation. Regarding performance evaluation, For each type of modulation is determined the SNR. According G1 – competencies C4/ C5
4.2 Specific objectives	The main fundamental aspects concerning data analogue communications are presented. The main amplitude / frequency / phase modulation techniques are introduced and analyzed with respect to their shape in time, frequency spectra, bandwidth and power requirements, as well as modulation and demodulation techniques used, and SNR. The steps performed to convert an analogue signal into a digital one, represented on a finite number of bits are presented, as well as a number of baseband techniques used to transmit digital data. According G1 – competencies C2.1 / C4.1./ C5.1. / C4.2 / C6.2

8. Content

8.1 Lectures	Teaching techniques	Remarks
Analogue Communication systems – generalities. Definitions, main concepts, brief history. Communication chain, signals, signal-to-noise ratio. Classification.	Teaching is performed using an overhead projector, that covers the communication and demonstration activities.	1 hours
Linear modulated signals. General expression for linear modulated (LM) signals. Amplitude Modulation (AM). Double Sideband Modulation (DSB). Single Sideband Modulation (SSB). Vestiginal Sideband Modulation (VSB)	The oral communication methods are he expository one and the problem solving method. All the class notes, solved problems, proposed	2 hours

Generation of LM Signals. Implementation of the product operator. Generation of AM and DSB signals. USB signals generation.	problems, computer problems or other helpful materials are available on the course site.	5 hours
Demodulation of LM signals. Sinchronous demodulation using and adder and a product operator. Phase and frequency error effects on AM, DSB and SSB signals demodulation. LM demodulators using product operator and low-pass filter. Mean value rectifiers. Peak detectors.		4 hours
Signal-to-Noise Ratio (SNR) at LM signals. SNR determination for AM signals. SNR determination for DSB signals. SNR determination for SSB signals. Performance comparison.		4 hours
Exponential modulated signals. Frequency modulated (FM) signals. Phase modulated (PM) signals.		2 hours
FM signals generation. Integro-differential equation of generation for FM signals and implementation. Quasi-sationarity conditions. Implementation of FM modulators in quasi-sationarity conditions. The square wave FM generator. The Armstrong method.		4 hours
FM signals demodulation. Principles of FM demodulators. Direct demodulation. Clarke-Hess demodulator. Demodulation using circuits that approximates the derivation in frequency domain. Demodulation using circuits that approximates the derivation using delay circuits.		4 hours
Signal-to-Noise Ratio (SNR) at FM signals. SNR for FM signals. Caption phenomenon. Emphasizing and deemphasizing of FM signals.		4 hours
Transforming analogue signals into digital ones. Analogue signal sampling in the baseband. Analogue pass-band signals sampling. Quantizing sampled signals. Uniform / non-uniform quantization. Non-uniform quantization rules.		4 hours
Digital baseband signals modulation. Pulse Coded Modulation (PCM). Pulse Amplitude Modulation (PAM). Pulse Pozition Modulation (PPM). Differential PCM. Delta PCM. Adaptive Delta PCM. Line codes.		4 hours
PLL Circuits – Principles. Linear model for PLL. The transient response of synchronized PLLs. PLL analysis in the presence of noise. FM Demodulator implemented with PLLs		4 hours

Bibliography
1) Constantin, I. Marghescu, „Transmisiuni analogice şi digitale”, Ed. Tehnică, Bucureşti, 1995.
2) V. Croitoru (coordonator), „Comunicaţii digitale. Teorie şi experiment”, Ediţia a II –a, Ed. Printech, Bucureşti, 2003.
3) H.Taub, Schilling, ” Principles of communication systems” 3rd edition, Mc Graw Hill, 2007
4) R. E. Ziemer, W. H. Tranter, ” Principles of Communications” 2nd edition, John Wiley & Sons, 2007.6) Class notes available online.

8.2 Practical applications	Teaching techniques	Remarks
LM signals. Examples.	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. All the teaching materials are available on the course site. Parts of the exetrcises may be checked by simulating them in Matlab / Simlink environment.	2 hours
LM signal generation. Product operators implementation. SSB signals generation.		2 hours
LM signals demodulation. Specific implementations for DSB, SSB.		2 hours
Demodulators for AM signals. Rectifiers. Peak demodulators.		2 hours
FM signals generation		2 hours
FM signals demodulation		2 hours
Sampling, quantizing and coding.		2 hours

Bibliography
1) I. Constantin, S. Halunga, I. Marcu, „Transmisiuni analogice şi digitale – culegere de probleme”, editura Electronica 2000, 2010
2) S. Halunga, O. Fratu “Simularea sistemelor de transmisiune analogice şi digitale folosind mediul Matlab/Simulink ”(Simulation of analog and digital communication systems using Matlab)- Editura Matrix Rom, Bucureşti, 2004
3) V. Croitoru (coordonator), „Comunicaţii digitale. Teorie şi experiment”, Ediţia a II –a, Ed. Printech, Bucureşti, 2003
4) Grahame Smillie and Graham Smillie, Analogue and Digital Communication Techniques 1st Edition, Butterworth-Heinemann; 1 edition (April 2, 1999)
5) Jerry D. Gibson, Principles of Digital and Analogue Communications, Macmillan USA; First Edition edition (March 1989)
4) Class notes in Electronic format
5) Solved / Proposed problems in electronic format.

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

The course curriculum answers the trends regarding the developments and evolution requirements, demanded by the general framework of the European economy of services in the IC&T domain.
This provides graduates with the appropriate skills and training requirements according to current qualifications, and a modern, high quality and competitive scientific and technical training, enabling them acquiring a working place after the graduation. The course fits therefore perfectly to the Bucharest Polytechnic University policy, considering both its content and

structure, and the skills and international openness it offers to students.

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; - knowledge to apply the theoretical aspects to solve specific problems; - differential analysis and comparison of different theoretical methods.		70%
10.5 Practical applications	- individual / independent solving of the proposed problems, verified with a control paper and a homework assignment; - understanding fundamental concepts in data communication systems.		30%
10.6 Minimal performance standard			
- capacity to solve standard problems connected to the material presented in class and seminars; - capacity to model an end to end communication chain and to demonstrate its functionality.			

Date	Lecturer	Instructor for practical activities
20.09.2017	Prof. PhD. Eng Simona Halunga	Prof. PhD. Eng. Simona Halunga

Date of department approval

25.09.2017

Director of Department,

Assoc. Prof. PhD. Eng. Eduard POPOVICI