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	Electronic Engineering, Telecommunications and Informational Technologies
1.5 Cycle of studies	License
1.6 Program of studies/Qualification	Technologies and Systems of Telecommunications (TSTeng)

2. Course identification information

2.1 Name of the course			Data Communications				
2.2 Lecturer			Prof. PhD. Eng. Octavian FRATU				
2.3 Instructor for practical activities			Prof. PhD. Eng. Octavian FRATU				
2.4 Year of studies	IV	2.5 Semester	7	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	55
Supplemental documentation (library, electronic access resources, in the field, etc)	4
Preparation for practical activities, homework, essays, portfolios, etc.	10
Tutoring	0
Examinations	5
Other activities	0

3.7 Total hours of individual study	74
3.9 Total hours per semester	130
3. 10 Number of ECTS credit points	5

4. Prerequisites (if applicable)

4.1 curricular	Signals and Systems Analog and Digital Communications Digital Signal Processing Decision and Estimation in Signal Processing
4.2 competence-based	general knowledge regarding signals, systems, modulation, discrete signals and systems analysis

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	Design, implementation and operation of data, voice, video, multimedia services, based on understanding and applying the fundamental concepts of communication and information transmission. Selection, installation and operation of fixed and mobile telecommunication equipment and network design to ensure a common telecommunication site.
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 data communications. A number of specific time / frequency analysis techniques are presented, as well as specific methods to modulate / demodulate the signals. The main performance evaluation parameters are presented and a number of specific methods to increase those performances are introduced.
7.2 Specific objectives	The main fundamental aspects concerning data communications are presented. The classical modulation schemes used in data communications re introduced and the signals are compared one another with respect to their shape in time, occupied bandwidth, possibilities to produce and demodulate the signals and error probability. It is also presented the matched filter as an optimum receiver for binary transmissions and its applications. A number of specific methods to evaluate the power spectral density of the baseband and of the pass-band signals. The baseband and pass-band systems design principles in ordetr to eliminate or reduce the inter-symbol interference are presented. Finally several techniques for carrier and timing recovery are introduced.

8. Content

8.1 Lectures	Teaching techniques	Remarks
Communication systems – generalities. Introduction, concepts, models. Digital communication chain model. Hierarchy of protocols. The OSI model.	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. All the class notes, solved problems, proposed problems, computer problems or other helpful materials are available on the course site.	4 hours
Binary signals detection in white Additive Gaussian Noise. The optimal receiver. Optimization criteria. Matched filter. Correlator implementation. Application of the matched filter to binary detection.		10 hours
Digital Modulation Techniques. Modulators and Demodulators. Binary Phase Shift Keying **(BPSK).** Differential Phase Shift Keying (DPSK) and Differential Encoding Phase Shift Keying (DEPSK). (Offset) Quadrature Phase Shift Keying (OQPSK/QPSK). M-ary Phase Shift Keying (MPSK). Quadrature Amplitude Shift Keying Binary Frequency Shift Keying (BFSK). M-ary Frequency Shift Keying (MFSK). Minimum Shift Keying (MSK). Orthogonal Frequency Division Modulation (OFDM).		10 hours
Power Spectral Density evaluation. Stationarity, cyclostationarity, Mean Power Spectral Density (m-PSD). m-PSD evaluation for ASK modulation in the baseband. The Bennet method for binary signals in the baseband. m-PSD for pass-band modulated signals.		6 hours
Baseband transmissions. Introduction. Definitions. Linear model for baseband transmissions. Nyquist criteria for global transfer function, with minimum and non-minimum bandwidth. Global transfer function repartition between transmitter and receiver. Partial response systems: duobinary encoding, modified duobinary encoding, general binary encoding. Precoding techniques to reduce error propagation.		10 hours
Carrier and timing recovery techniques.		2 hours

Bibliography
1) S. Halunga. O. Fratu „Data transmissions and multiple access techniques" (2009) Editura Electronica 2000, Bucureşti, 290 pag., ISBN 978-973-7860-17-0, Editură recunoscută CNCSIS.
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) I. Constantin, "Principiile transmisiunilor de date", Editura Politehnica Press, Bucureşti, 2002.
4) H.Taub, Schilling, " Principles of communication systems" 3rd edition, Mc Graw Hill, 2007
5) J. Proakis, M. Salehi, Digital Communications, 5th Edition, Mc Graw Hill, 2007
6) R. E. Ziemer, W. H. Tranter, " Principles of Communications") I. Bănică, "Comunicaţii de date", Litografia UPB, Bucuresti, 2000.
8) Class notes available online.

8.2 Practical applications	Teaching techniques	Remarks
Matched Filter. Correlator implementation.	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 exercises may be checked by simulating them in Matlab / Simulink environment.	2 hours
BPSK, DPSK, DEPSK, QASK signals analysis.		2 hours
QASK, BFSK,MFSK, MSK signals analysis.		2 hours
m-PSD of baseband signals		2 hours
m-PSD of pass-band signals		2 hours
Baseband transmissions. Nyquist I criterion. Global transfer function repartition between the transmitter and receiver.		2 hours
Partial response systems. Precoding.		2 hours

Bibliography
Bibliografie:
1) S. Halunga. O. Fratu „Data transmissions and multiple access techniques" (2009) Editura Electronica 2000, Bucureşti, 290 pag., ISBN 978-973-7860-17-0, Editură recunoscută CNCSIS.
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3) 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

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,

02.10.2017   Prof. PhD. Eng. Octavian FRATu   Prof. PhD. Eng. Octavian FRATU

Date of department approval   Director of Department,

05.10.2017   Assoc. Prof. PhD. Eng. Eduard POPOVICI