SYLLABUS

Discipline name	Data Transmissions
Profile	Electronics and Telecommunications Engineering
Specialization	Telecommunications Technologies and Systems
Code	51324909-1
Course leader	Professor Vasile Bota, Ph.D. – Vasile.Bota@com.utcluj.ro
Collaborators	Eng. Anghel Botos, M.Sc, Ph.D. student – Anghel.Botos@com.utcluj.ro
Department	Communications
Faculty	Electronics, Telecommunications and Information Technology

Sem.	Type of discipline	Course	Applications			Course	Applications			Ind. study	TOTAL	Credits	Form of assessment
		[hours/week]				[hours/semester]							
			S	L	P		S	L	P				
7	**Speciality, Optional**	**2**	**-**	**2**	**-**	**28**	**-**	**28**	**-**	**64**	**120**	**4**	**Exam**

Acquired competences : Basic notions of coded digital modulations; Basic notions of multicarrier modulations; Basic notions of adaptive modulations; Basic notions of spread spectrum modulations; Basic notions regarding the performance evaluation of the studied modulations; Basic knowledge about the employment of the studied modulations in transmission systems

Acquired skills (what the student is able to do):

- To know the TCM and CMEB modulations
- To know the structures of the TCM transmitter and receiver including the encoding and decoding blocks
- To have basic knowledge of the GMSK modulation
- To have the basic knowledge about the DS-SS and FH-SS modulations
- To know the block structures of transmitters and receivers of the studied modulations
- To evaluate the performance of the studied modulations on transmission channels
- To evaluate the performance of transmission equipments
- To configure the main parameters of transmission systems that employ these modulations
- To have elementary notions regarding the implementation of the studied modulations

Acquired abilities (what type of equipment/ instruments/ software the student is able to handle):

- To select transmission equipments according to the requirements of a specific application
- To configure transmission equipments
- To evaluate the performance of a transmission equipment

Prerequisites (if necessary):

Notions of modulation techniques, error-correcting codes and signal theory

A. Course/Lecture (course/lecture titles)	
1	A+PSK modulation I. A+PSK constellations employed on radio channels with HPRF amplifiers; demodulation with the Hilbert transform;
2	A+PSK modulation II. Symbol-clock synchronization; Carrier recovery
3	Orthogonal Frequency Division Multiplex (OFDM) I Parameters of the radio channels (fixed or mobile). Necessity of multicarrier approach. Definition. Digital modulation-demodulation by IFFT-FFT.
4	Orthogonal Frequency Division Multiplex (OFDM) II. Guard Interval. Bit-mapping and bit-rate computation. Translation on the carrier frequency. Frequency band and spectral considerations. Spectral efficiency. Performances. Applications.
5	Discrete MultiTone (DMT) Modulation. DMT - a particular case of OFDM for cable transmissions. Bit-mapping and bit-rate computation. Performances. Applications.
6	Coded Modulations I: Types of CM; Systematical and recursive convolutional codes; Trellis Coded Modulation (TCM); Coding gain
7	Coded Modulations II: TCM of rate m/(m+1); Mapping by Set partitioning; TCM with non-coded bits
8	Coded Modulations III: Viterbi algorithm with d_E. Soft-decoding of the non-coded bits. Applications of TCM
9	Coded Modulations IV: Coded Modulations with Extended Bandwidth (CMEB). Principles; 2-level Gray mapping. Applications
10	Adaptive Coded Modulations (ACM). Parameters of a coded configuration. Criteria of selecting the ACM set. Computation of the average throughput. Applications.
11	Gaussian Minimum Shift Keying (GMSK) Modulation I. Reasons for the employment of this modulation in the GSM system; Defining the MSK modulation; Frequency computation and frequency bandwidth. Gaussian filtering characteristic.

SYLLABUS

12	Gaussian Minimum Shift Keying (GMSK) Modulation II. GMSK modulation; modulation-demodulation methods, carrier and symbol clock recovery. Performances. Application in the GSM system.
13	Auxiliary blocks of data modems. Automat Gain Control. Scrambler-descrambler.
14	Spread Spectrum Modulations. The DS-SS and FH-SS modulations.

B. Applications – **Laboratory** (list of laboratories), **Seminar** (contents), **Project** (project contents)	
1	A+PSK modulations. Structure, particular constellations, performances
2	RRC shapping filters. Digital implementation. Characteristics
3	Measurement of the modem's performances. Stucture of the test bench. Parameters and performance indicators. Performance measurements of the FSK modems
4	Parameters of the radio channels. Laboratory test 1.
5	OFDM. Applications to 802.11 a and g
6	DMT. Applications to ADSL
7	DMT. Applications to VDSL. Laboratory test 2
8	The Viterbi decoding algorithm with d_E. Implementation, variants and performances.
9	Performances of the convolutional codes. Effects of the constraint length and puncturing.
10	TCM1. Implementation and performances. The V.32bis modem.
11	TCM2. Seminar (problems)
12	Adaptive Coded Modulations. Applications in WiFi
13	Adaptive Coded Modulations. Applications in ADSL technologies.
14	Redo of laboratory works

C. Individual study (reference study contents, synthesis materials, projects, applications etc.)

2 synthesis reports
12 sets of problems (the preparation part in every laboratory)
3 sets of problems (course homework)

Individual study structure	Course study	Problem solving, laboratory, project	Applications preparation	Examination time	Additional reference study	Total no. of individual study hours
Hours	28	14	14	3	5	64

References (Textbooks, courses, laboratory manual, exercise book)

1. Bota V. – Transmisiuni de date, Modulații necodate monopurtător, Funcții uuxiliare, Editura Risoprint, 2004, ISBN 973-656-714-1
2. Polgar Zs., Bota V., Varga M., "Transmisiuni de date. Aplicații practice. Îndrumar de laborator", UTPres, Ianuarie, 2004.
3. Rappaport, Th., „Wireless Communications. Principles and Practice", Prentice Hall, 2001

3. Proakis, G. „Digital Communications", Prentice Hall, 2001

On – line references

1. Bota V., "Data Transmissions", lecture notes, http://users.utcluj.ro/~dtl
2. Bota V., Varga, M., Seturi de probleme, http://users.utcluj.ro/~dtl

Final evaluation	
Evaluation method	Written exam, 4-5 subjects – problems + theory (3 hours). Two laboratory tests after laboratory classes 4, 7.
Mark components	Exam (E): Laboratory ; each 1…10 points
Mark computation	M=0,8E+0,2L; Pass if: E≥5 and M≥5;

Course leader,

Professor Professor Vasile Bota , Ph.D.

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