SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Electronics, Telecommunications and Information Technology
1.3	Department	Communications
1.4	Field of study	Electronics and Telecommunications Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/Qualification	Telecommunications Technologies and Systems, Applied Electronics
1.7	Form of education	Full time
1.8	Subject code	TST-E35.00, EA-E35.00

2. Data about the subject

2.1	Subject name					Information Theory and Coding					
2.2	Subject area					Electronics and Telecommunications Engineering					
2.3	Course responsible/lecturer					Professor Monica BORDA, PhD					
2.4	Teachers in charge of applications					Professor Monica BORDA, PhD Assoc. Prof. Raul MALUTAN, PhD Assist. Prof. Mihaela CISLARIU, PhD					
2.5	Year of study	III	2.6	Semester	1	2.7	Assessment	Exam	2.8	Subject category	DID/DOB

3. Estimated total time

Year/ Sem.	Subject name	No. of weeks	Course [hours/ week]	Applications [hours/ week]			Course [hours/ semester]	Applications [hours/ semester]			Indiv. study	TOTAL	Credits
				S	L	P		S	L	P			
III/1	Information Theory and Coding	14	2	1	2		28	14	28		60	130	5

3.1	Number of hours per week	5	3.2	of which, course	2	3.3	applications	3
3.4	Total hours in the curriculum	70	3.5	of which, course	28	3.6	applications	42

Individual study	Hours
Manual, lecture material and notes, bibliography	44
Supplementary study in the library, online and in the field	6
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	4
Tutoring	2
Exams and tests	3
Other activities	1

3.7	Total hours of individual study	60
3.8	Total hours per semester	130
3.9	Number of credit points	5

4. Pre-requisites (where appropriate)

4.1	Curriculum	NA
4.2	Competence	NA

5. Requirements (where appropriate)

5.1	For the course	Cluj-Napoca
5.2	For the applications	Cluj-Napoca

6. Specific competences

Professional competences	C2. To apply basic methods for signal acquisition and processing C3. To apply knowledge, concepts and basic methods regarding computing systems' architecture, microprocessors, microcontrollers, programming languages and techniques
Cross competences	N.A.

7. Discipline objectives (as results from the key competences gained)

7.1	General objectives	Development of professional abilities in the domain of information transmission, of source coding and channel coding.
7.2	Specific objectives	1. Gain of theoretical knowledge concerning the statistical and informational modeling of digital transmission systems. 2. Gain of theoretical knowledge concerning source coding for information representation and compression. 3. Gain of theoretical knowledge concerning channel coding for error control 4. Achievement of abilities and skills necessary for software and hardware implementation using MATLAB and LABVIEW tools

8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	Introduction. Information Transmission Systems (ITS).	Presentation, heuristic conversation exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of blackboard
2	Memory-less information sources. Quantitative measures for numerical information. Informational Entropy.		
3	Moments and moment rate. Information rate, decision rate. Discrete transmission channels. Probabilities and entropies in channels. Mutual information and trans-information. Relationships between entropies. Types of channels.		
4	Capacity of a channel given by bandwidth and SNR (Shannon's capacity formula). Shannon's limit. Capacity of a BSC		
5	Source coding: definition, aim, lossless compression. Codes for information representation. Compression efficiency. Compression ratio. Existence theorem of instantaneous codes, uniquely decodable cods. Shanon's first theorem (Lossless compression theorem)		
6	Compression algorithms: Shannon-Fano, Huffman. Conclusions concerning compression. Channel coding. Shannon's second theorem (noisy channel coding theorem). Error control strategies.		

	Classification of error control codes.		
7	Block codes: algebraic theory, definition, representation, error control matrix, generator matrix. Perfect and almost perfect codes. Error syndrome. Relationships between the columns of H matrix for error detection/ correction. Hamming group codes.		
8	Other block codes. Cyclic codes: definition and representation, algebraic coding. Elements of Galois fields for cyclic coding.		
9	BCH codes. Error syndrome and error detection. Algebraic decoding (Peterson algorithm)		
10	Reed-Solomon Codes. Coding and algebraically decoding		
11	Circuits for cyclic coding and decoding. LFSR for cyclic codes implementation. Cyclic code using LFSR for error detection and correction		
12	Convolutional codes: definition and representation. Comparison with block codes, algebraic coding, implementation with feed-forward SR		
13	Trellis representation. Code distance. Viterbi decoding		
14	Interleaving and concatenation: principles and applications. Review of the course concerning the exam.		

8.2. Applications (lab)		Teaching methods	Notes
1	Introduction and presentation of laboratory requirements.	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, computers, blackboard
2	Information representation codes		
3	Source coding		
4	Hamming group codes		
5	BCH and Reed-Solomon Codes		
6	LFSR. Application for cyclic coding		
7	Convolutional codes		

8.3. Seminary		Teaching methods	Notes
1	Statistical modeling of an ITS	Didactic and experimental proof, didactic exercise, team work	Use of computers, magnetic board
2	Informational modeling of an ITS		
3	Compression algorithms		
4	Linear group codes		
5	BCH and RS codes		
6	LFSR for cyclic codes implementation		
7	Convolutional codes		

Bibliography

1. M. Borda, Fundamentals in Information Theory and Coding – Springer 2011, ISBN 978-3-642-20346-6, 509p
2. Monica Borda – Information Theory and Coding, Ed. UT PRES, 2007
3. G. Wade – Signal coding and processing, Palgrave-McMillan, 2000
4. R. Gallagher –Information theory and reliable communication, Editura John Wiley and sons, 1968
5. B. Sklar – Digital communications, Prentice Hall, 2001
6. D. Salomon –A guide to data compression methods, Springer-Verlag, 2002
7. M. Borda, R. Terebeş, C. Văduva, S. Zăhan - Teoria Transmiterii Informaţiei, Litografia UTCN, 1997 – tradus în limba engleză format pdf
8. I.Sztojanov, I. Gavăt, I. Spânu, M. Bâtiu - Teoria Transmiterii Informaţiei- îndrumător de laborator, Litografia IPCN 1983, tradus în limba engleză format pdf

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

10. Evaluations

Activity type	10.1	Assessment criteria	10.2	Assessment methods	10.3	Weight in the final grade
Course		The level of acquired theoretical knowledge and practical skills		Written exam composed of 4-5 theoretical subjects and 3-4 problems		75%
Applications		The level of acquired abilities		- Continuous formative evaluation consisting of 6 written lab tests		25%
10.4 Minimum standard of performance						
Correct answer of at least 3 theoretical subjects and 2 problems, and at least an average of 5 (out of 10) at the laboratory tests.						

Date of filling in
01.10.2018

Course responsible
Professor
Monica BORDA, PhD

Teachers in charge of applications
Assoc.Prof. Raul MALUTAN, PhD
Assist.Prof. Mihaela CISLARIU, PhD