SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	Communications
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Telecommunications Technologies and Systems/ Engineer Applied Electronics/Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E33.00/EA-E33.00

2. Data about the subject

2.1 Subject name	Information and Coding Theory						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Professor Monica BORDA, Ph.D. - monica.borda@com.utcluj.ro						
2.4 Teacher in charge with seminar/ laboratory	Professor Monica BORDA, Ph.D. - monica.borda@com.utcluj.ro Assoc. Prof. Raul MALUTAN, Ph.D. raul.malutan@com.utcluj.ro Assist. Prof. Stefania BENEA, Ph.D. - stefania.barburiceanu@com.utcluj.ro						
2.5 Year of study	III	2.6 Semester	5	2.7 Assessment	E	2.8 Subject category	DD/DI

3. Estimated total time

3.1 Number of hours per week	5	of which: 3.2 course	2	3.3 seminar / laboratory	3
3.4 To Total hours in the curriculum	70	of which: 3.5 course	28	3.6 seminar / laboratory	42

Distribution of time	hours
Manual, lecture material and notes, bibliography	39
Supplementary study in the library, online specialized platforms and in the field	6
Preparation for seminars / laboratories, homework, reports, portfolios and essays	4
Tutoring	2
Exams and tests	3
Other activities	1

3.7 Total hours of individual study	55
3.8 Total hours per semester	125
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	
5.2. for the seminars / laboratories / projects	Mandatory presence

6. Specific competences

Professional competences	C2. Applying the basic methods for the acquisition and processing of signals C3. Application of the basic knowledge, concepts and methods regarding the architecture of computer systems, microprocessors, microcontrollers, languages and programming techniques
Transversal competences	N/A

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

7.1 General objective	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. Shannon'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. Laboratory		Teaching methods	Notes
1	Introduction and presentation of laboratory requirements.	Didactic and experimental proof, didactic exercise, team work	Use of computers, magnetic board
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 Seminar		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 – translated in English (.pdf format)
8. I.Sztojanov, I. Gavăt, I. Spânu, M. Bâtiu - Teoria Transmiterii Informaţiei- îndrumător de laborator, Litografia IPCN 1983, translated in English (.pdf format)

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

The discipline content and the acquired skills are in agreement with the expectations of the professional 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. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Written exam composed of 4-5 theoretical subjects and 3-4 problems	75%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Continuous formative evaluation consisting of 6 written lab tests	25%
10.6 Minimum standard of performance			

Qualitative point of view

Minimal theoretical and practical knowledge:

- ✓ Understanding the statistical and informational modeling of digital transmission systems.
- ✓ Understanding the concepts of source coding for information representation and compression
- ✓ Understanding the concepts of channel coding for error control

Minimal acquired competences:

- ✓ Ability to solve problems related to information theory
- ✓ Ability to design codes for error control

Quantitative point of view

- ✓ Correct answer of at least 3 theoretical subjects and 2 problems
- ✓ Minimal mean at the exam 5
- ✓ Final mark = 0.75xExam+ 0.25x Mean of the marks at the lab tests

Date of filling in:	Responsible	Title First name SURNAME	Signature
20.06.2023	Course	Professor Monica BORDA, Ph.D.	
	Applications	Assoc. Prof. Raul MALUTAN, Ph.D.	
		Assist. Prof. Stefania BENEA, Ph.D.	

Date of approval in the Council of the Communications Department 11.07.2023	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 12.07.2023	Dean Prof. Ovidiu POP, Ph.D.