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

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	Politehnica University of Bucharest
1.2 Faculty	Electronics, Telecommunications and Information Technology
1.3 Department	Applied Electronics and Information Engineering
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				Information Transmission Theory			
2.2 Lecturer				Prof. PhD Eng. Dan Alexandru Stoichescu			
2.3 Instructor for practical activities				Lect. PhD Eng. Bogdan Cristian Florea			
2.4 Year of studies	III	2.5 Semester	5	2.6 Evaluation type	Examination	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	5	3.2 course	3	3.3 practical activities	2
3.4 Total hours in the curricula, out of which	70	3.5 course	42	3.6 practical activities	28

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	50
Supplemental documentation (library, electronic access resources, in the field, etc)	4
Preparation for practical activities, homework, essays, portfolios, etc.	4
Tutoring	0
Examinations	2
Other activities	0

3.7 Total hours of individual study	60
3.9 Total hours per semester	130
3. 10 Number of ECTS credit points	5

4. Prerequisites (if applicable)

4.1 curricular	Mathematical analysis 1 and 2; Algebra and Geometry; Foreign Language 1 and 2.
4.2 competence-based	

5. Requisites (if applicable)

5.1 for running the course	None
5.2 for running of the applications	The students have to be present during practical activities hours according to the PUB regulations.

6. Specific competences

Professional competences	The students must be able to apply, in typical situations, the basic methods of acquisition and signal processing. The design, the implementation and the operation of services of data, voice, video, multimedia, based on understanding and applying the fundamental concepts of communication and information transmission
Transversal competences	

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

7.1 General objective of the course	The thorough knowledge and understanding of the fundamentals and applications of the quantity of information, source and channel information entropies, source coding for noiseless and noisy channels.
7.2 Specific objectives	-understanding of the concept of information and ability to calculate the quantity of information; - knowledge of definitions and mathematical methods concerning source and channel information entropies; -knowledge of source encoding for noiseless channels fundamentals: encoding by means of Shanon-Fano and Huffman procedures; - understanding of error detection and error correction philosophy; encoding and decoding of group, cyclic and recurrent codes methods; analysis and design of shift registers for encodind and decoding; - general knowledge of digital cryptography.

8. Content

8.1 Lectures	Teaching techniques	Remarks
1.Generals: information and quantity of information; fundamental concepts in information transmission theory; fidelity criteria.	The blackboard and the video projector, when necessary, are mostly used in classroom. For oral communication, the exposure, concept understanding by solving problems and conversation methods are used. For learning, the students have, at their disposal, note courses and the recommended books.	2 hours
2. **Information Measurement in Discrete Signals**: quantity of information units.		2 hours
3. Information Sources - discrete information sources; - entropy, rate of information, redundancy and efficiency of discrete information sources; example; - Markov sources.		5 hours

4. Information Communication Channels - discrete memoryless channels; - discrete channel characteristic entropies; - mutual information, discrete channel capacity, redundancy and efficiency; example. - information transmission continuous channel; continuous channel capacity.		5 hours
5. Discrete information sources encoding for noiseless channels - uniquely decodable codes, instantaneous codes: definitions, examples; - mean length of a code word, efficiency and redundancy of codes; - absolutely optimal codes; - noiseless channel coding theorem; -symbol by symbol encoding: Shannon-Fano technique, binary encoding procedure of Huffman.		6 hours
6. Discrete information sources encoding for noisy channels (Error correcting and error detecting codes) - error detection and correction; - error correcting and error detecting code classification; - characteristic features of block codes; - noisy channel Shannon theorem.		1 hour
7. Group codes - code words specification; code words as elements of cosets; - Hamming distance, minimum distance decision, decision regions; - error detection and correction algorithm: error word, parity check matrix; - group code encoding and decoding with the check matrix H; relations between the columns of an e errors detecting or e errors		5 hours

correcting code; - the generator matrix G; group code encoding and decoding with the generator matrix; - the Hamming group codes; - the iterated codes.		
8. Cyclic codes - polynomial residue classes; - code words specification; - cyclic code encoding and decoding with the generator polynomial; - G and H matrices of a cyclic code; - cyclic codes encoding and decoding for error detection with dividing shift registers; - cyclic codes encoding and decoding for error correction with feedback shift registers; - cyclic Hamming codes; - multiple errors correcting codes: cyclic codes specification in terms of the roots of the generator polynomial; Bose Chaudhuri Hocquenghem codes and Golay codes.		10 hours
9. Recurrent codes - recurrent codes structure; - recurrent code encoding with the check matrix H; - recurrent codes decoding by means of the majority logic method.		4 hours
10. Cryptographic systems - encrypting with random key; - encrypting with pseudorandom key.		2 hours

Bibliography

1. Al. Spătaru, *Teoria Transmisiunii Informaţiei*, Editura Didactică şi Pedagogică, Bucureşti, 1983.
2. A.T. Murgan, *Principiile Teoriei Informaţiei în Ingineria Informaţiei şi a Comunicaţiilor,* Editura Academiei Romane, Bucureşti, 1998.
3. Thomas M. Cover, Joy A. Thomas, *Elements of Information Theory* 2nd Edition, Wiley-Interscience, 2006
4. Rodica Stoian, Lucian Andrei Perişoară, *Teoria Informaţiei şi a Codurilor – Aplicaţii*, Editura Politehnica Press, 2010

8.2 Practical applications	Teaching techniques	Remarks
1 Discrete first order Markov information sources	• Computer applications • Matlab applications for efficient computation of specific performance parameters • Examples of practical applications • Team work (2 students) • Filling application reports by students for each laboratory Handouts containing the homework after each laboratory class	2 hours
2. Discrete and continuous channels		2 hours
3. Compact codes using Huffman method		2 hours
4. Hamming group codes		2 hours
5 Hamming cyclic codes		2 hours
6. Convolutional codes		2 hours
7. Final laboratory verification		2 hours
Bibliography 1. Al. Spătaru, *Teoria Transmisiunii Informaţiei*, Editura Didactică şi Pedagogică, Bucureşti, 1983. 2. A.T. Murgan, *Principiile Teoriei Informaţiei în Ingineria Informaţiei şi a Comunicaţiilor*, Editura Academiei Romane, Bucureşti, 1998. 3. R. Rădescu, Rodica Stoian, *Teoria Informaţiei şi a Codurilor - îndrumar de laborator*, Ed. Printech, 1998. 4. Thomas M. Cover, Joy A. Thomas, *Elements of Information Theory 2nd Edition*, Wiley-Interscience, 2006 5. Rodica Stoian, Lucian Andrei Perişoară, *Teoria Informaţiei şi a Codurilor* – Aplicaţii, Editura Politehnica Press, 2010 6. Bogdan Cristian Florea, Anamaria Radoi, Dan Alexandru Stoichescu, *Information Transmission Theory – Laboratory,* Editura Printech, 2014		

8.3 Seminary	Teaching techniques	Remarks
1. Elements of probability theory and information theory	• Brief presentation of the theoretical aspects regarding the exercise session • Solving exercises under each studied topic Individual handing evaluation at each 2 – 3 exercise sessions	2 hours
2. Memoryless discrete sources. Discrete first order Markov information sources		2 hours
3. Discrete channels		2 hours
4. Compact codes using Shannon-Fano and Huffman methods		2hours
5.Hamming group codes		2hours
6.Hamming cyclic codes		2 hours
7.Convolutional codes		2 hours
Bibliography 1.Al. Spătaru, Teoria Transmisiunii Informaţiei, Editura Didactică şi Pedagogică, Bucureşti, 1983. 2.A.T. Murgan, Principiile Teoriei Informaţiei în Ingineria Informaţiei şi a Comunicaţiilor, Editura Academiei Romane, Bucureşti, 1998.		

3.Thomas M. Cover, Joy A. Thomas, Elements of Information Theory 2nd Edition, Wiley-Interscience, 2006
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9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

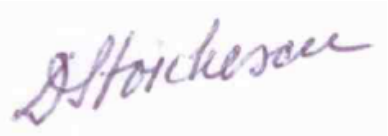
The information considered a measurable item is an essential concept, necessary to any specialist in signal processing, signal transmission and informatics. Information sources and transmission channels evaluation by means of statistical variables is necessary to communication specialists. The recent increasing demand for reliable digital data systems asks thorough knowlwdges in the field of error detecting and correcting codes. The former remarks are undeniable arguments for the study of this discipline, the concepts taught being expected by employers and the epistemic community representatives.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	- thorough knowledge of the fundamental concepts of the discipline and of the methods to operate with these concepts; -ability to solve problems concerning the sources and transmission channels, source encoding for noiseless and noisy channels; - capacity to select the optimum solutions in applications.	- a test during the semester	30%
		-oral examination at the end of the semester	30%
10.5Practical applications	- understanding the experiments performed including sofware; - correct interpretation of experimental results according to the theory	-examination at the end of the semester	20%
10.6 Seminary	- ability to solve ITT problems	-examination during the semester	20%

10.7 Minimal performance standard
-Knowledge and correct interpretation of fundamental concepts definitions in the fields of discrete information sources and transmission channels, noiseless and noisy channels codes; -development of optimal solutions for problems in the fields of information sources and channel statistics, source encoding for noiseless channels and error detecting and error correcting codes (in this case, the mathematical solutions have to be implemented with shift registers, too).

Date	Lecturer	Instructor for practical activities
07.09.2017	Prof. PhD Eng. Dan A. Stoichescu. Lect.	PhD Eng. Bogdan Cristian Florea



Date of department approval
25.09.2017

Director of Department,
Prof. PhD Eng. Sever Pașca