**Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti**
**Facultatea de Electronică, Telecomunicaţii şi**
**Tehnologia Informaţiei**

# COURSE DESCRIPTION

## 1. Program identification information

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|---|---|
| 1.1 Higher education institution | **National University of Science and Technology Politehnica 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 Information Technology |
| 1.5 Cycle of studies | Bachelor/Undergraduate |
| 1.6 Programme of studies | Technologies and Telecommunications Systems |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Teoria transmisiunii informaţiei<br>Information Transmission Theory | | | |
| 2.2 Course Lecturer | | | | Prof. dr. ing. Dan Alexandru Stoichescu | | | |
| 2.3 Instructor for practical activities | | | | Conf. dr. ing. Bogdan Cristian Florea | | | |
| 2.4 Year of studies | 3 | 2.5 Semester | I | 2.6. Evaluation type | E | 2.7 Course regime | Ob |
| 2.8 Course type | | D | 2.9 Course code | 04.D.05.O.002 | | 2.10 Tipul de notare | Nota |

## 3. Total estimated time (hours per semester for academic activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Number of hours per week | 4 | Out of which: 3.2 course | 2.00 | 3.3 seminary/laboratory | 2 |
| 3.4 Total hours in the curricula | 56.00 | Out of which: 3.5 course | 28 | 3.6 seminary/laboratory | 28 |
| Distribution of time: | | | | | hours |
| Study according to the manual, course support, bibliography and hand notes<br>Supplemental documentation (library, electronic access resources, in the field, etc)<br>Preparation for practical activities, homework, essays, portfolios, etc. | | | | | 51 |
| Tutoring | | | | | 0 |
| Examinations | | | | | 4 |
| Other activities (if any): | | | | | 0 |

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| 3.7 Total hours of individual study | 69.00 |
| 3.8 Total hours per semester | 125 |
| 3.9 Number of ECTS credit points | 5 |

## 4. Prerequisites (if applicable) (where applicable)

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| 4.1 Curriculum | Completion and/or passing of the following subjects:<br>Mathematical Analysis 1 and 2<br>Algebra and Geometry |

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| 4.2 Results of learning | Accumulation of the following knowledge:<br>Probability theory |

**5. Necessary conditions for the optimal development of teaching activities** (where applicable)

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| 5.1 Course | The course will take place in a room equipped with a video projector and computer, as well as a blackboard and chalk. |
| 5.2 Seminary/ Laboratory/Project | The laboratory will be held in a room with specific equipment, which must include:<br>Computers with specific software |

**6. General objective** *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

This discipline is studied within the field of Electronic Engineering, Telecommunications and Information Technologies and the field of Computers and Information Technology, within the Applied Electronics specialization of the Faculty of Electronics, Telecommunications and Information Technology and aims to familiarize students with the most important notions in code theory. It has an overwhelming role in the training of future electronics engineers, in transforming their way of thinking and approaching the universe of electronics and telecommunications.

The discipline addresses the following specific areas of knowledge: measurement of information contained in digital and continuous signals, the study of the characteristic quantities of transmission channels, coding of discrete information sources connected to channels without disturbances, error detection and correction codes, all of which contribute to the formation of an overview of the methodological and procedural benchmarks related to the field.

**7. Competences** *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

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| **Specific Competences** | Demonstrates basic and advanced knowledge in the field of coding theory, correlates and applies this knowledge in practice<br>Argues and analyzes coherently and correctly the context of application of basic knowledge of the field, using key concepts of the discipline and specific methodology.<br>Communicates orally and in writing in English: demonstrates understanding of the vocabulary related to the field, in English. |
| **Transversal (General) Competences** | Autonomie și gândire critică: abilitatea de a gândi în termeni științifici, de a căuta și analiza date în mod independent, precum și de a desprinde și prezenta concluzii și de a identifica soluții.<br>Capacitate de analiză și sinteză: prezintă în mod sintetic cunoştinţele dobândite, ca urmare a unui proces de analiză sistematică.<br>Analizează metodic problemele întâlnite în activitate, identificând elementele pentru care există soluții consacrate, asigurând astfel îndeplinirea sarcinilor profesionale |

**8. Learning outcomes** *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

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|---|---|
| **Knowledge** | *The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.*<br>Defines domain-specific concepts.<br>Describes/classifies concepts and processes related to the discipline<br>Highlights consequences and relationships. |
| **Skills** | *The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).*<br>Selects and groups relevant information in a given context.<br>Uses specific principles in an argumentative manner to solve problems specific to code theory<br>Verifies the solutions found with the help of a computer, using specific software.<br>Solves practical applications.<br>Interprets causal relationships appropriately.<br>Analyzes and compares possible solutions to problems.<br>Formulates conclusions from experiments performed.<br>Argues for the identified solutions/solution methods. |
| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br>Selects appropriate bibliographic sources and analyzes them.<br>Respects the principles of academic ethics, correctly citing the bibliographic sources used.<br>Demonstrates receptivity to new learning contexts.<br>Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities<br>Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved |

**9. Teaching techniques** *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Starting from the analysis of the students' learning characteristics and their specific needs, both expository (lecture, exposition) and conversational-interactive teaching methods are used, based on discovery learning models (experiment, demonstration, modeling), but also on action-based methods, such as exercise, practical activities and problem solving.

Lectures are used in the teaching activity, based on Power Point presentations. Each course begins with a recapitulation of the chapters covered in the last course.

The presentations use images and diagrams, so that the information presented is easy to understand and assimilate.

The aim is to practice active listening and assertive communication skills, as well as feedback construction mechanisms, as ways of adapting the pedagogical approach to the students' learning needs.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | Generals: information and quantity of information; fundamental concepts in information transmission theory; fidelity criteria. | 2 |
| 2 | Information Measurement in Discrete Signals:<br>Discrete signal information units;<br>Discrete sources of information, discrete source entropy, efficiency and redundancy ;<br>Markov sources;<br>Discrete transmission channels – discrete channel characteristic entropies, channel capacity, redundancy, efficiency. | 4 |
| 3 | Information Measuring in Continuous Channels:<br>Mutual information of a continuous transmission channel;<br>Continuous channel capacity. | 4 |
| 4 | Source Encoding for Noiseless Channels:<br>- uniquely decodable codes, instantaneous codes: definitions, examples; - mean length of a code word, efficiency and redundancy of codes; - absolutely optimal codes;<br>- noiseless channel coding theorem;<br>- symbol by symbol encoding: Shannon-Fano technique, binary encoding procedure of Huffman | 4 |
| 5 | Source Encoding for Noisy Channels (Error Detecting and Correcting Codes):<br>error detection and correction; error correcting and error detecting code classification; characteristic features of block codes; noisy channel Shannon theorem;<br>Group codes – code word specification, code words as elements of cosets, Hamming distance, minimum distance decision, error detection and correction algorithm, error word, parity check matrix, group code encoding and decoding with the check matrix H, relations between the H columns of an e errors detecting or e errors correcting code, the generator matrix G, group code encoding and decoding with the generator matrix, Hamming group codes, iterated codes;<br>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;<br>Recurrent codes - recurrent codes structure; recurrent code encoding with the check matrix H; recurrent codes decoding by means of the majority logic method. | 10 |
| 6 | Cryptographic Systems:<br>Encrypting with random key<br>Encrypting with pseudorandom key | 4 |
| | **Total:** | 28 |

**Bibliography:**

Dan Alexandru Stoichescu: Information Transmission Theory, suport de curs în format electronic pe Moodle

| **LABORATORY** | | |
|---|---|---|
| **Crt. no.** | **Content** | **No. hours** |
| 1 | Elements of probability theory and information theory | 2 |
| 2 | Discrete memoryless sources; first-order discrete Markov sources | 2 |
| 3 | Discreet channels | 2 |
| 4 | Huffman codes | 2 |
| 5 | Hamming group codes | 2 |
| 6 | Hamming cyclic codes | 2 |
| 7 | Laboratory test | 2 |
| | **Total:** | 14 |
| **SEMINARY** | | |
| **Crt. no.** | **Content** | **No. hours** |
| 1 | Elements of probability theory and information theory | 2 |
| 2 | Discrete memoryless sources; first-order discrete Markov sources | 2 |
| 3 | Discreet channels | 2 |
| 4 | Huffman codes | 2 |
| 5 | Hamming group codes | 2 |
| 6 | Hamming cyclic codes | 2 |
| 7 | Seminary test | 2 |
| | **Total:** | 14 |

**Bibliography:**

Dan Alexandru Stoichescu: Information Transmission Theory, suport de curs pe Moodle
Rodica Stoian, Lucian Andrei Perișoară: Teoria informației și a codurilor – Aplicații, Editura Politehnica Press, 2010
Bogdan Cristian Florea, Anamaria Rădoi, Dan Alexandru Stoichescu: Information Transmission Theory - Laboratory, Editura Printech, 2014

## 11. Evaluation

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|
| 11.4 Course | Knowledge of concepts related to information measurement and the characteristic quantities of discrete information sources and information transmission channels | Partial exam with exemption | 20% |
| | Knowledge of source coding procedures used for information transmission channels | Oral exam | 40% |

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|---|---|---|---|
| 11.5 Seminary/laboratory/project | Understanding the experiments performed in the laboratory, including the software used | A colloquium at the end of the laboratory activity and short questions during the semester | 20% |
| | The correctness of the results obtained in solving problems during the seminar activity | Verification test | 20% |
| 11.6 Passing conditions | | | |
| Obţinerea a 50% din punctajul total.<br>Obţinerea a 50% din punctajul aferent activităţii la laborator | | | |

**12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)**

Information, as a measurable physical quantity and the quantity of information are indispensable notions for any specialist in signal processing and transmission and in computer science. The evaluation of information sources and information transmission channels using statistical quantities is necessary for those working in telecommunications. For the correct, efficient and reliable use of transmission channels and computing techniques, knowledge of coding and decoding procedures, with or without protection against errors, is required; in the early period of distance communications, from one human being to another, errors introduced by disturbances were not critical due to the intrinsic redundancy of speech, but today, when communication is carried out from machine to machine, error correction and detection are required not only in distance communications but also within computer systems. Those who promoted the theory of information transmission will be able to solve problems of error detection and correction by adapting to the particular the knowledge in the field acquired within this discipline.

| Date | Course lecturer | Instructor(s) for practical activities |
|---|---|---|
| 16.09.2025 | Prof. dr. ing. Dan Alexandru Stoichescu | Conf. dr. ing. Bogdan Cristian Florea |

| Date of department approval | Head of department |
|---|---|
| | Conf. dr. ing. Bogdan Cristian Florea |

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Date of approval in the Faculty Council

Dean

Prof. dr. ing. Radu Mihnea Udrea