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

# COURSE DESCRIPTION

## 1. Program identification information

| | |
|---|---|
| 1.1 Higher education institution | **National University of Science and Technology Politehnica Bucharest** |
| 1.2 Faculty | **Electronics, Telecommunications and Information Technology** |
| 1.3 Department | **Electronic Devices, Circuits and Architectures** |
| 1.4 Domain of studies | Electronic Engineering, Telecommunications and Information Technology |
| 1.5 Cycle of studies | Bachelor/Undergraduate |
| 1.6 Programme of studies | Microelectronics, Optoelectronics and Nanotechnologies |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Decizie şi estimare în prelucrarea informaţiilor | | | |
| 2.2 Course Lecturer | | | | Prof. Dr. Corneliu Nicolae FLOREA | | | |
| 2.3 Instructor for practical activities | | | | Prof. Dr. Corneliu Nicolae FLOREA | | | |
| 2.4 Year of studies | 3 | 2.5 Semester | 2 | 2.6. Evaluation type | E | 2.7 Course regime | Ob |
| 2.8 Course type | | D | 2.9 Course code | 04.D.06.O.007 | | 2.10 Tipul de notare | Nota |

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

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Number of hours per week | 5 | Out of which: 3.2 course | 3 | 3.3 seminary/laboratory | 2 |
| 3.4 Total hours in the curricula | 70 | Out of which: 3.5 course | 42 | 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. | | | | | 25.5 |
| Tutoring | | | | | 0 |
| Examinations | | | | | 5 |
| Other activities (if any): | | | | | 0 |

| | |
|---|---|
| 3.7 Total hours of individual study | 30.00 |
| 3.8 Total hours per semester | 100 |
| 3.9 Number of ECTS credit points | 4 |

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

| | |
|---|---|
| 4.1 Curriculum | Theory of information transmission, Special mathematics (Theory probabilities), |
| 4.2 Results of learning | Programming knowledge |

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

| | |
|---|---|
| 5.1 Course | None |

| | |
|---|---|
| 5.2 Seminary/ Laboratory/Project | Mandatory attendance at laboratories (according to the regulations of university studies in UPB) |

**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)*

The study of the basic principles of information processing in random processes. Training skills for measuring and evaluating random processes in order to create reliable information transmission chains. Introduction of basic methods for processing random signals in noisy conditions, such as signal detection, parameter estimation and signal shape estimation.

The applications aim to deepen the student's understanding of the concepts taught in the course. Also, the application classes aim at students' understanding of the practical importance of statistical signal processing, by specifying the practical applications of the discussed methods

**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.)*

| | |
|---|---|
| **Specific Competences** | • C1 Use of fundamentals related to electronic devices, circuits and instrumentation<br>• C1.2 The ability to interpret, design, execute and measure electronic circuits of low/medium complexity<br>• C2 Application, in typical situations, of the basic methods of signal acquisition and processing<br>• C2.1 Signal characterization in the time domain and in the frequency domain<br>• C2.2 Methods of acquisition and digital processing of analog signals<br>• C2.3 The use of simulation environments (Python) for the analysis and digital processing of signals<br>• C3 Application of basic knowledge, concepts and methods regarding the architecture of computing systems, microcontrollers, programming languages and techniques<br>• C3.3 Solving concrete practical problems that include elements of data structures and algorithms, programming and use of microprocessors or microcontrollers |
| **Transversal (General) Competences** | Methodical analysis of the problems encountered in the activity, identifying the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks |

**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.)*

| | |
|---|---|
| **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><br>• Defines domain-specific notions: random variable, correlation, stationary signal, statistical decision, estimator<br>• Describes the process of statistical analysis of information for particular problems.<br>• Uses principled approaches (based on mathematical concepts and structures) for the statistical analysis of data.<br>• Highlights relationships between the nature of the problem and performance, between computing capacity and performance, etc |
| **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><br>• Selects and groups relevant information in a context of decision and estimation in information processing.<br>• Uses specific principles in order to identify algorithmically solvable problems for the statistical analysis of data.<br>• Works productively in a team.<br>• Elaborates a scientific report, on the occasion of the laboratory assignments.<br>• Checks experimentally and comparatively different practical solutions.<br>• Solves practical applications in the seminar and laboratory Interpret causal relationships appropriately.<br>• Formulates conclusions to the experiments carried out.<br>• Argues the identified solutions/workarounds |
| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br><br>• Selects appropriate bibliographic sources and analyze them.<br>• Respects the principles of academic ethics, correctly citing the bibliographic sources used.<br>• Demonstrates responsiveness to new learning contexts.<br>• Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities<br>• Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved<br>• Demonstrates social responsibility through active involvement in student social life/involvement in academic community events<br>• Promotes/contributes through new solutions related to the specialized field to improve the quality of social life.<br>• Realizes the value of his contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility).<br>• Apply principles of professional ethics/deontology in the analysis of the technological impact of the solutions proposed in the specialized field on the environment |

**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 students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct exploration and indirect of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving.

Being a theoretical discipline, the teaching activity will be focused on developing the subject with chalk on the blackboard. Each exposition is framed by an exposition of the practical necessity and a discussion on the applicability of the results.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | Summary notions of the theory of probabilities: Probability, Random variables. Practical applications and approximations | 6 |
| 2 | Pairs of random variables: statistical characterization, common moments, functions of two random variables, central limit theorem, regression line, correlation coefficient | 5 |
| 3 | Random signals: statistical characterization of the first and second order, stationarity, ergodicity, the theorem of ergodicity of the mean<br><br>Spectral characterization of random signals: power spectral density, th. Wiener-Hincin, passage of random signals through time-invariant linear systems, filter adapted to the signal | 10 |
| 4 | Numerical optimization algorithms | 4 |
| 5 | Signal detection: the Bayesian decision criterion | 5 |
| 6 | Parameter estimation: maximum posterior estimate, quadratic estimate, maximum likelihood estimate, quality of an estimator | 4 |
| 7 | Random signals in discrete time:<br>Specific parameters, Autocorrelation matrix | 2 |
| 8 | Unitary transforms: the physical meaning of a unitary transformation. Principal component analysis | 3 |
| 9 | Signals quantization : uniform quantization, Lloyd-Max optimal quantizer, companding | 3 |
| | **Total:** | 42 |

**Bibliography:**


- Digital notes and video lecture available on Moodle https://curs.upb.ro/2024/course/view.php?id=8715
- M. Ciuc, C. Vertan: Prelucrarea statistică a semnalelor, Ed. MatrixROM, Bucureşti, 2005.
- Al. Spătaru: Teoria transmisiunii informaţiei, Editura Tehnica şi Pedagogică, 1983

| **LABORATORY** | | |
|---|---|---|
| **Crt. no.** | **Content** | **No. hours** |
| 1 | Introduction to Python. Recapitulation of notions of probability theory | 2 |
| 2 | Random variables. Pairs | 2 |
| 3 | Random Signals | 2 |
| 4 | Numerical Optimization | 2 |
| 5 | Signal Detection | 2 |
| 6 | Parameter estimation | 2 |
| 7 | Final evaluation | 2 |
| | **Total:** | 14 |
| **SEMINARY** | | |
| **Crt. no.** | **Content** | **No. hours** |
| 1 | Random variables. | 2 |
| 2 | Functions of random variables. | 2 |
| 3 | Pairs of random variables. | 2 |
| 4 | Random signals. Stationary, Autocorrelation | 2 |
| 5 | Wiener Hinchin theorem. Filtering Random signals | 2 |
| 6 | Signal Detection | 2 |
| 7 | Parameter estimation | 2 |
| | **Total:** | 14 |

**Bibliography:**

- Laura Florea, Corneliu Florea „Statistică în prelucrarea informației. Aplicații științifice în Python”, Editura Politehnica Press 2022, 91 pag. ISBN: 978-606-9608-30-2, available at https://curs.upb.ro/2024/course/view.php?id=8715
C. Vertan, I. Gavăt, R. Stoian: Variabile şi procese aleatoare: principii şi aplicaţii, Ed. Printech, 1999

**11. Evaluation**

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|
| 11.4 Course | Acquisition of fundamental theoretical notions; students will solve a number of requirements formulated in such a way as to test their understanding of the fundamental notions and concepts specific to the field of random signal processing. | Written exam - middterm | 20% |
| | The student's ability to solve problems practices related to the concepts taught in the course. | Written exam - final | 40% |

| | | | |
|---|---|---|---|
| 11.5 Seminary/laboratory/project | The ability to solve problems related to random signals | 2 Written tests during the semester | 20% |
| | The ability to manipulate from a point of view practically random signals | Evaluation of the activity along the way. Laboratory test | 20% |
| 11.6 Passing conditions | | | |
| 1. Total score **at least or equal to 50** | | | |

**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)**

The course is periodically updated to reflect changes in the field

| Date | Course lecturer | Instructor(s) for practical activities |
|---|---|---|
| 21.09.2026 | Prof. Dr. Corneliu Nicolae FLOREA | Prof. Dr. Corneliu Nicolae FLOREA |

| Date of department approval | Head of department |
|---|---|
| 22.09.2026 | Prof. Dr. Claudius Dan |

| Date of approval in the Faculty Council | Dean |
|---|---|
| 22.09.2026 | Prof. Dr. Mihnea Udrea |