Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și
Tehnologia Informației

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	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Applied Electronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Decizie şi estimare în prelucrarea informaţiilor Decision and Estimation in Information Processing			
2.2 Course Lecturer				Prof. Dr. Mihai CIUC			
2.3 Instructor for practical activities				Prof. Dr. Mihai CIUC			
2.4 Year of studies	3	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.06.O.008		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	3.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	70.00	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 Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					5
Tutoring					5
Examinations					20
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	Information transmission theory, special mathematics, linear algebra
4.2 Results of learning	Programming knowledge, general knowledge of Fourier decomposition of signals

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

5.1 Course	Does not apply
5.2 Seminary/ Laboratory/Project	Mandatory attendance at laboratories (according to the university studies regulations 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	Operating with scientific, engineering and informatics foundations Use of fundamentals related to electronic devices, circuits and instrumentation Applying, in typical situations, the basic methods of signal acquisition and processing
Transversal (General) Competences	

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.* The student must be able to master the mathematical apparatus of probability theory.
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).* The student must be able to apply the mathematical apparatus of probability theory to solve practical problems in the field of signal processing, artificial intelligence, etc.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* The student must be responsible and autonomous. If he is not, I don't think he can learn these concepts at the age at which he goes through the Decision, Estimation and Information Processing course.

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.)*

The teaching method is a combination between the classic version (chalk/marker and blackboard) for the mathematical part of the course and the modern version (powerpoint presentation) for the presentation of graphics that cannot be drawn on the blackboard.

10. Contents

COURSE

Chapter	Content	No. hours
1	Random variables: statistical characterization, moments, functions of a random variable	6
2	Pairs of random variables: statistical characterization, common moments, functions of two random variables, central limit theorem, regression line, correlation coefficient	6
3	Random signals: statistical characterization of the first and second order, stationarity, ergodicity, the theorem of ergodicity of the mean	6
4	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	6
5	Statistical decision; Bayes criterion.	3
6	Parameter estimation: MAP, quadratic and ML estimators	3
7	Stochastic models: discrete time stochastic signals, AR, MA, ARMA models, Yule-Walker equations	3
8	Optimal signal filtering (Wiener filters): orthogonality pricniple, Winere-Hopf equations (in general and for FIR filters)	3
9	Unitary transforms: the significance of a unitary transform, energy compaction, the Karhunen-Loeve transform, the Dicscrete-Cosine Transform	3
10	Optimal signal quantization: the Max-Lloyd quantizer.	3
	Total:	42

Bibliography:

M. Ciuc, C. Vertan: Prelucrarea statistică a semnalelor, Ed. MatrixROM, Bucureşti, 2005.
Al. Spătaru: Teoria transmisiunii informaţiei, Editura Tehnica şi Pedagogică, 1983
A. Papoulis: Probability, random variables and stochastic processes (third edition), McGraw-Hill, 1991

LABORATORY

Crt. no.	Content	No. hours

1	Random variables	2
2	Pairs of random variables	2
3	Stationary and ergodic stochastic signals	2
4	Wiener-Hincin theorem	2
5	Statistical decisions	2
6	Parameter estimation	2
7	Final lab test	2
	Total:	14

SEMINARY

Crt. no.	**Content**	**No. hours**
1	Random variables	2
2	Functions of one random variable	2
3	Pairs of RVs	2
4	Stationary signals	2
5	Wiener-Hincin theorem	2
6	Statistical decisions	2
7	Parameter estimation	2
	Total:	14

Bibliography:

C. Vertan, I. Gavăt, R. Stoian: Variabile şi procese aleatoare: principii şi aplicaţii, Ed. Printech, 1999
The course site: http://alpha.imag.pub.ro

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 answer a number of questions formulated in such a way as to test the fact that they have understood the notions they are handling; learning the concepts by heart is thus discouraged	Written exam	30%
	The student's ability to solve practical problems related to the concepts taught in the course.	Written exam	30%
11.5 Seminary/laboratory/project	The ability to solve problems related to random signals	Written test during the term	20%
	The ability to practically manipulate random signals	Lab test in front of the computer	20%
11.6 Passing conditions			
Obtaining at lest 50% from the total number of points.			

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 concepts learned in the DEPI course have an extremely varied practical applicability, being necessary in extremely different fields (data classification, shape recognition, image processing and computer vision, data compression, data communications, television, etc.). The course syllabus is prepared in such a way that the students are able to recognize any of the issues taught regardless of the field from which it originates and adapt it in the appropriate context. • In this way, the graduates are provided with adequate competences with the needs of the current qualifications and a modern, quality and competitive scientific and technical training, which will allow them to be employed quickly after graduation, being perfectly framed in the policy of the Politehnica University of Bucharest, both from the point of view of the content and structure, as well as from the point of view of the skills and international openness offered to students.

Date	Course lecturer	Instructor(s) for practical activities
	Prof. Dr. Mihai CIUC	Cosmin Danisor
		Andrei Racoviteanu

Date of department approval	Head of department
16.10.2024	Conf. Dr. Bogdan Cristian FLOREA

Date of approval in the Faculty Council	Dean
25.10.2024	Prof. Dr. Mihnea Udrea