# Politehnica University of Bucharest

# Faculty of Electronics, Telecommunications and Information Technology

**COURSE DESCRIPTION**

**1. Program identification information**

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| 1.1 Higher education institution | University “Politehnica” of Bucharest |
| 1.2 Faculty | Electronics, Telecommunications and Information Technology |
| 1.3 Department | Applied Electronics and Information Engineering |
| 1.4 Domain of studies | Computers and Information Technology |
| 1.5 Cycle of studies | Licence |
| 1.6 Program of studies/Qualification | Information Engineering |

**2. Course identification information**

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| 2.1 Name of the course | | | | Decision and estimation in information processing | | | |
| 2.2 Lecturer | | | | Conf. dr. eng. Mihai Ciuc | | | |
| 2.3 Instructor for practical activities | | | | Lect. Dr. eng. Marta Zamfir | | | |
| 2.4 Year of studies | II | 2.5 Semester | II | 2.6 Evaluation type | Exam | 2.7 Course choice type | Mandatory |

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

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| 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 | | | | | | | 60 |
| Supplemental documentation (library, electronic access resources, in the field, etc) | | | | | | | 5 |
| Preparation for practical activities, homeworks, essays, portfolios, etc. | | | | | | | 5 |
| Tutoring | | | | | | | 0 |
| Examinations | | | | | | | 20 |
| Other activities | | | | | | | 0 |
| 3.7 Total hours of individual study | | 60 | | | |  |  |
| 3.9 Total hours per semester | | 80 | | | |  |  |
| 3. 10 Number of ECTS credit points | | 5 | | | |  |  |

**4. Prerequisites (if applicable)**

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| 4.1 curricular | Information theory, Linear algebra, probability theory |
| 4.2 competence-based | Programming languages, Fourier series decompositioon |

**5. Requisites (if applicable)**

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| 5.1 for running the course | Does not apply |
| 5.2 for running of the applications | Lab presence mandatory |

**6. Specific competences**

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| Professional competences | Dealing with scientific, engineering and informatics fundamentals.  Dealing with fundamentals of devices, circuits and electronic instrumentation  Applying basic signal acquisition and processing methods in typical situations. |  |
| Transversal  competences | - | . |

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

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| 7.1 General objective of the course | Study of basic principles of information processing in random processes.  Forming the abilities of measuring and evaluating random processes towards achieving reliable information transmission chains. Basics of random signal processing in the presence of noise, e.g., statistical decision, parameter estimation, linear filtering of random processes.  Applications aim at students getting a hands-on understanding of taught theoretical notions. Students are also guided towards understanding of practical importance of statistical signal processing, by pointing out the practical applications of presented methods. |
| 4.2 Specific objectives | Developing in students the ability of using random processes knowledge in designing specific signal processing hardware, towards retrieving information in the presence of strong perturbations. Developing in students the ability to apply characteristic procedures for statistical decision, parameter estimation, optimal signal filtering |

**8. Content**

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| 8.1 Lectures | | Teaching techniques | Remarks |
| Random variables: statistical characterization, moments, functions of one random variables | | Teaching techniques are classical, chalk-and-blackboard based. | 6h |
| Characterization of a pair of random variables: joint moments, functions of two random variables, central limit theorem, regression, correlation coefficient. | | 6h |
| Stochastic processes: statistical characterizaton of order I and II, stationarity, ergodicity, mean ergodicity theorem | | 6h |
| Spectral characterization of random processes: power spectral density, Wiener-Hincin theorem, linear filtering of random processes, adapted filter. | | 6h |
| Statistical decision: Bayes criterion | | 3h |
| Parameter estimation: maximum a posteriori and square estimator, maximum-likelihood estimator, estimator quality | | 3h |
| Stochastic models: discrete-time signals, AR, MA, ARMA models, Yule-Walker equations | | 3h |
| Optimal signal filtering (Wiener filters): problem posing, orthogonality principle, Wiener-Hopf equations, FIR filters case; application: prediction, noise cancelling | | 3h |
| Unitary transforms:  physical interpretation, optimal Karhunen-Loève transform, discrete cosine transform | | 3h |
| Signal quantization: uniform quantization, optimal Lloyd-Max quantizer, compandation | | 3h |
| Bibliography:   1. M. Ciuc, C. Vertan: Prelucrarea statistică a semnalelor, Ed. MatrixROM, Bucureşti, 2005. 2. Al. Spătaru: Teoria transmisiunii informaţiei, Editura Tehnica şi Pedagogică, 1983 3. A. Papoulis: Probability, random variables and stochastic processes (third edition), McGraw-Hill, 1991 4. Course site: http://alpha.imag.pub.ro | | | |
| 8.2 Practical applications | Teaching techniques | | Remarks |
| Random variables | All labs are held using Matlab simmulations. | | 2h |
| Pairs of random variables | 2h |
| Stochastic processes | 2h |
| Wiener-Hincin theorem | 2h |
| Statistical decision | 2h |
| Parameter estimation | 2h |
| Final lab exam | 2h |
| 8.3 Tutorial | Teaching techniques | | Remarks |
| Random variables | Teaching techniques are classical, chalk-and-blackboard based. | | 2h |
| Functions of one random variable | 2h |
| Pairs of random variables | 2h |
| Stochastic processes: stationarity, autocorrelation function | 2h |
| Wiener-Hincin theorem, linear filtering of stochastic processes | 2h |
| Statistical decision | 2h |
| Parameter Estimation | 2h |
| Bibliography   1. C. Vertan, I. Gavăt, R. Stoian: Variabile şi procese aleatoare: principii şi aplicaţii, Ed. Printech, 1999 2. Course site: http://alpha.imag.pub.ro | | | |

**9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program**

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| Notions taught at DEPI course have a wide variety of applications, being used in extremely different domains (data classification, pattern recognition, image processing and computer vision, data compression, data communications, television etc.)  The course curriculum is thought such as to allow students recognize any of the taught problems regardless of the domain where it has been encountered and adapt it to its context.  Thus graduates are given competences which are tightly related to the necessities of current qualifications and also modern technical and scientific training which enables them to find good jobs after graduation. |

**10. Evaluation**

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| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Weight in the final mark |
| 10.4 Lectures | We aim to test students’ acquiring basic notions; to this end, students will answer a number of questions formulated specifically to test students’ understanding and to discourage undigested memorization. | Witten exam | 30% |
|  | We test students’ capacity of working out real practical problems related to taught topics. | Written exam | 30% |
| 10.5 Practical applications | Students’ capability of solving random-processes related problems are tested. | Written mid-term exam | 20% |
|  | Students’ ability of practically manipulating random processes. aleatoare | Lab test at the end of the term. | 20% |
| 10.6 Minimal performance standard | | | |
| The ability to identify a statistical signal processing issue (decision, estimation, filtering etc.) in a given practical problem and to identify possible workable solutions. | | | |

Date Lecturer Instructor for practical activities

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Date of department approval Director of Department,

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