# 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 | Politehnica University of Bucharest |
| 1.2 Faculty | Faculty of Electronics, Telecommunications and Information Technology |
| 1.3 Department | Dept. of Applied Electronics and Information Engineering |
| 1.4 Domain of studies | Computers and Information Technology |
| 1.5 Cycle of studies | Licence (engineering) |
| 1.6 Program of studies/Qualification | Information Engineering |

**2. Course identification information**

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| 2.1 Name of the course | | | | Interfete om-masina (IOM) | | | |
| 2.2 Lecturer | | | | Ș.L. Dr. Ing. Carmen PĂTRAȘCU | | | |
| 2.3 Instructor for practical activities | | | | Ș.L. Dr. Ing. Carmen PĂTRAȘCU | | | |
| 2.4 Year of studies | 4 | 2.5 Semester | 8 | 2.6 Evaluation type | Exam | 2.7 Course choice type | Optional |

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

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| 3.1 Number of hours per week, out of which | 3 | | 3.2 course | 2 | 3.3 practical activities | | 1 |
| 3.4 Total hours in the curricula, out of which | 42 | | 3.5 course | 28 | 3.6 practical activities | | 14 |
| Distribution of time | | | | | | | Hours |
| Study according to the manual, course support, bibliography and hand notes | | | | | | | 20 |
| Supplemental documentation (library, electronic access resources, in the field, etc) | | | | | | | 6 |
| Preparation for practical activities, homework, essays, portfolios, etc | | | | | | | 10 |
| Tutoring | | | | | | |  |
| Examinations | | | | | | | 10 |
| Other activities | | | | | | |  |
| 3.7 Total hours of individual study | | 36 | | | |  |  |
| 3.9 Total hours per semester | | 78 | | | |  |  |
| 3. 10 Number of ECTS credit points | | 4 | | | |  |  |

**4. Prerequisites (if applicable)**

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| 4.1 curricular | Digital signal processing, Decision and estimation in information processing, Information Theory |
| 4.2 competence-based | Programming skills |

**5. Requisites (if applicable)**

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| 5.1 for running the course | Not applicable |
| 5.2 for running of the applications | Compulsory presence at laboratory classes, according to current UPB regulations. |

**6. Specific competences**

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| Professional competences | The explanation of the role, interaction and functionality of the hardware system components, software for the man-machine communication.  Implementation of the software system components for the man-machine communication.  The use of interdisciplinary knowledge, solution patterns and tools, performing experiments and interpreting the results.  Application of solution patterns with the use of engineering tools and methods.  Comparative evaluation, including experimental, of the solution alternatives, for the performance optimisation.  Developing and implementing of software solutions for specific problems |
| Transversal  competences | Identification, description and running of project management processes, using different team roles and the clear and concise description, by creating group projects during the laboratory. |

**7. Obiectivele disciplinei (reieşind din grila de competenţe specifice acumulate)**

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| 7.1 General course objective | The study of the methods and principles of designing the man-machine interface  Creating the abilities for designing of multi-modal communication systems |
| 7.2 Specific objectives | The study of multi-modal man-machine interaction systems, with voice, image or cerebral signal command |

**8. Content**

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| 8.1 Lectures | Teaching techniques | Remarks |
| The structure of a man-machine system, Levels of human behaviour, Methods of presenting information, Types of man-machine interfaces, Multi-modal communication, General principles, The design process. | The systematic presentation, using the video projector and the blackboard, conversation and questioning  The course notes, lab materiales and applications are in electronic format and available to students. | 2h |
| The image interpretation model, The speech understanding and valorisation model, International human fluxes, I/O devices for man-machine systems | 2h |
| Short term parameters  Sonograms and Spectrograms  Spectre analyzers  Cestral analysis  Perceptive cepstral – mel cepstral  Mel cepstral and delta mel cepstral coefficients | 2h |
| LPC model  Linear-perceptual prediction  Applications of speech analysis  Vocal response systems  Vocoders (spectral, formantic, LPC, cepstral)  Vocoders’ performance  Text analysis systems | 3h |
| Speech recognition techniques  Statistical techniques based on hidden Markov models  Context dependent models  Connection of MMA states  Phonetic decision making trees  Neural models | 3h |
| Image applications in IOM  Image storing  Types of images  Image modelling  Image processing  Change detection – methods based on information technology | 2h |
| Image classification | 2h |
| Image improvement methods  Content indexation of images | 2h |
| Computer vision  Brain-computer interfaces | 2h |
| Bibliography  1. Adil Timofeev, Alexander Nechaev, Igor Gulenko, Vasily Andreev,  Svetlana Chernakova, Mikhail Litvinov, "MULTIMODAL MAN-MACHINE INTERFACE AND VIRTUAL REALITY FOR ASSISTIVE MEDICAL SYSTEMS", International Journal "Information Theories & Applications" Vol.14 / 2007, pp.133-138  2. Jens Rasmussen, "Skills, Rules and Knwoledge:Signals, Signs, and Symbols, and Other Distinctions in Human Performance", IEEE Transactions on Systems, Man and Cybernetics , vol smc - 13, No. 3, May 1983, pp.257-266  3. R. Hegde, "EE627 - Speech Signal Processing Lecture 5/6 : Short Term Spectral Analysis Techniques for Speech Recognition"  4. Introduction To Speech Processing, Jun. 2010, CSLU, OGI , OHSU (Oregon Health and Science University)  5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon "Spoken Language Processing, A guide to theory, algorithm, and system development", Prentice Hall PTR, Upper Saddle River, New Jersey 07458, 2001  6. Emil CEANGĂ, Iulian MUNTEANU, Antoneta BRATCU, Mihai CULEA, "Semnale circuite si sisteme", partea I: Analiza semnalelor", Editura Academica, Galati, 2001  7. Application Note 150, Spectrum Analysis Basics, HEWLETT PACKARD, 1989  8. Spectrum Analizer Basics - Agilent Technologies  9. Jeremy Bradbury, Linear Predictive Coding, December 5, 2000  10. A Simple LPC Vocoder Bob Beauchaine, EE586, Spring 2004  11. Daniela Faur, Inge Gavat, Mihai Datcu , "Mutual Information Based Measures for Image  Content Characterization",Current Topics in Artificial Intelligence, Lecture Notes in Computer Science Volume 4177, 2006, pp 342-349  12. James B. Pawley, " Points, Pixels, and Gray Levels: Digitizing Image Data", University of Wisconsin, Madison, Wisconsin 53706, Handbook of Biological Confocal Microscopy, Third Edition, edited by James B. Pawley, Springer Science+Business Media, LLC, New York, 2006.  13. C. Vertan " SISTEME DE CAUTARE A IMAGINILOR PRIN SIMILARITATEA CONTINUTULUI Content-based Image Retrieval (CBIR)" | | |
| 8.2 Practical applications | Teaching techniques | Remarks |
| 1. Application of the Fast Fourier Transform | Learning by discovering, questioning, modelling using a dedicated software (Matlab) | 2h |
| 2. Short term vocal signal analysis | 2h |
| 3. Spectral analysis - spectrogram | 2h |
| 4.Liniar predictive analysis | 2h |
| 5. Cepstral analysis | 2h |
| 6. Speech recognition | 2h |
| 7. Lab exam | 2h |
| Bibliography  1. Îndrumar de laborator - IOM, A. Popescu, C.Patrascu, M. Cotescu, I. Gavat - <http://ceospacetech.pub.ro/index.php/education/interfete-om-masina/iom-laborator> | | |

**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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| The Man-Machine Interface Course ensures both the accumulation and crystallisation of knowledge received in previous years during the Digital Signal Processing, Signals and Systems or Detection and Estimation in Information Processing courses, by offering an applicative framework, but at the same time certifies the competence and aptitude creation in a very current field, that of man-machine communication. Students are familiarised with the newest voice command systems as well as the content based big data search systems or with the brain-computer interfacing systems. The graduates are offered in this manner adequate competences regarding the current necessary qualifications and a modern, qualitative and competitive scientific and technical training, which will allow them a fast employment, while being perfectly integrated in the Politehnica University of Bucharest policy, both from the content and structure standpoint, as well as the aptitude and international horizon offered to students. |

**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 | knowledge of the fundamental theoretical notions; Students will answer a number of questions submitted in a manner meant to test their understanding of the notions used; the learning by heart of the notions is discouraged | Written test | 30% |
|  | The student’s capacity to solve practical problems related to the notions taught during the course. | Written test | 30% |
| 10.5 Practical applications |  | Practical test | 40% |
| 10.6 Minimal performance standard | | | |
| The understanding of the role, interaction and functionality of the components of the man-machine communication systems  The implementation of the software components of the voice based man-machine communication systems, running experiments and interpreting their results.  Comparative evaluation, including experimental, of the solving alternatives for the performance optimisation  Developing and implementation of information solutions for analysis and voice/image recognition problems | | | |

Date Lecturer Instructor for practical activities

....................... Ș.L. Dr. Ing. Carmen Pătrașcu Ș.L. Dr. Ing. Carmen Pătrașcu

Date of department approval Department Director,

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