# 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 | 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 | | | | Image Analysis | | | |
| 2.2 Lecturer | | | | Prof. Dr. Ing. Constantin Vertan | | | |
| 2.3 Instructor for practical activities | | | | S.l. Dr. Ing, Laura Maria Florea | | | |
| 2.4 Year of studies | IV | 2.5 Semester | II | 2.6 Evaluation type | Verification | 2.7 Course choice type | Compulsory |

**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 | | | | | | | 25 |
| Supplemental documentation (library, electronic access resources, in the field, etc) | | | | | | | 3 |
| Preparation for practical activities, homeworks, essays, portfolios, etc. | | | | | | | 5 |
| Tutoring | | | | | | | 0 |
| Examinations | | | | | | | 3 |
| Other activities | | | | | | | 0 |
| 3.7 Total hours of individual study | | 36 | | | |  |  |
| 3.9 Total hours per semester | | 78 | | | |  |  |
| 3. 10 Number of ECTS credit points | | 3 | | | |  |  |

**4. Prerequisites (if applicable)**

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| 4.1 curricular | Image Processing  Decision and Estimation in Information Processing  Algorithms and Data Structures |
| 4.2 competence-based | General knowledge of digital image and signal processing, decision and estimation, as well as programming (Matlab proficiency) |

**5. Requisites (if applicable)**

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| 5.1 for running the course | Not applicable |
| 5.2 for running of the applications | Presence at all lab sessions (as required by the UPB regulations for licence studies). |

**6. Specific competences**

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| Professional competences | C3. Solving problems using the instruments of computer science and engineering:  - identification of problem classes and methods of solving that are specific to informatic systems;  - usage of interdisciplinary knowledge, solution templates and tools, experimentation and interpretation of test results. |
| Transversal  competences | Honorable, responsible and ethic behavior, as required by law, in order to insure the reputation of the profession. |

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

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| 7.1 General objective of the course | The course introduces the students to general digital gray level image analysis techniques (the chain of operations that enable feature extraction from visual data in order to make decisions) and their implementation in general software environments (C, C++) or dedicated software (Matlab). Fundamental operations and techniques are presented for image segmentation and parametric description of the components in real scenes, with examples of systems and typical applications. |
| 4.2 Specific objectives | The laboratory introduces the students to the implementation of general digital gray level image analysis techniques in Matlab. The key points are:  - object extraction and object characterization;  - contour extraction and object characterization  - texture extraction and object characterization. |

**8. Content**

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| 8.1 Lectures | Teaching techniques | Remarks |
| Region-oriented segmentation in the feature space (histogram-based segmentation, clustering) | Teaching is based on videoprojection of slides (as communication and demonstration function); the oral communication method is the frontal problematization.  The course materials are: course notes, course slides, proposed exercises (theoretical and for computer-solving). All materials are available in electronic form on the course website. | 8 hours |
| Region-oriented segmentation in the image space: region growing, labeling. | 4 hours |
| Contour extraction (linear and nonlinear methods) | 4 hours |
| Texture extraction and description (description in the spatial domain, description in the frequency domain) | 4 hours |
| Object description techniques (region description, contour description) | 6 hours |
| Typical image analysis applications | 2 hours |
| Bibliography  1) C. Vertan, M. Ciuc: Tehnici Fundamentale de Prelucrarea şi Analiza Imaginilor, Ed. MatrixRom, Bucureşti, 2007.  2) M. Ciuc, C. Vertan: Prelucrarea statistică a semnalelor, Ed. MatrixROM, Bucureşti, 2005.  3) situl cursului http://alpha.imag.pub.ro/cursuri/  4) K. R. Castleman: Digital Image Processing, Prentice Hall, 2005  5) R. Gonzales, R. Woods: Digital Image Processing, Addison Wesley, 2006 | | |
| 8.2 Practical applications | Teaching techniques | Remarks |
| Matlab: Region-oriented segmentation | Teaching is based on videoprojection of slides (as communication and demonstration function); the oral communication method is the frontal problematization. Students simulate, implement, test and evaluate in an independent manner the same problems by the continuous use of the computer with Matlab software. The teaching materials are available in the lab guide, printed and on-line. | 2 hours |
| Matlab: Image labeling | 2 hours |
| Matlab: Contour extraction | 2 hours |
| Matlab: Region description | 2 hours |
| Matlab: Tecture description | 2 hours |
| Matlab: Contour description | 2 hours |
| Final laboratory test | 2 hours |
| Bibliography  1) C. Vertan, M. Ciuc: Tehnici Fundamentale de Prelucrarea şi Analiza Imaginilor, Ed. MatrixRom, Bucureşti, 2007.  2) Constantin Vertan, Mihai Ciuc, Marta Zamfir: Analiza Imaginilor: Îndrumar de laborator. Ed. Printech, Bucureşti, 2001.  3) M. Ciuc, C. Vertan: Prelucrarea statistică a semnalelor, Ed. MatrixROM, Bucureşti, 2005.  4) Situl cursului: http://alpha.imag.pub.ro/cursuri/ | | |

**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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| Digital imaging has become a mature, fast-growing market. The consumer transition to digital imaging is complete, the industry closely following the trend. The industry has a growing demand for skilled, digital image savvy engineers, with a strong background in electronics, embedded systems and information technology in order to keep the momentum of producing new hardware and software applications.  This curricula is adapted to the current developments and evolutions from the european economy of services in the ICT domain. With the current progress of electronic technology, the target applications are unlimited, spanning all areas from “consumer technologies” (digital cameras, tablets and smartphones), medical markets (medical image analysis and processing), military applications (remote sensing based applications), general security (surveillance and biometry), industrial automatization (quality control, product handling), robotics (man-machine interfaces) and many more.  The graduates will be empowered with the competences adapted to the requirements of the current qualifications as well as a modern, competitive scientific and technical training, that facilitate a fast employment after graduation. This approach is perfectly fitted to the general policies of the Politehnica University of Bucharest, from the points of view of content, structure, offered abilities and international opening. |

**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 constructions of the domain;  - knowledge of the application of the theory to specific practical situations;  - differential analysis of theoretical methods and algorithms. | Two written tests with equal weights, during the semester at announced dates; the subjects cover the entire curricula, realizing a synthesis between the comparative theoretical knowledge and its application through exercises and practical problems. | 80% |
| 10.5 Practical applications | - knowing the design templates for image analysis algorithms used for solving a given problem;  - knowledge of the coding [in Matlab] of a image analysis algorithm;  - proof of function of an image analysis algorithm implemented by the student. | Final lab examination, with a theoretical part and a practical part. The theoretical part is checked by a questionnaire; the practical part requires the solving by the student (implementation, testing, functioning) of a solution to a practical problem. | 20% |
| 10.6 Minimal performance standard | | | |
| - modeling a real-life simple image analysis problem and specification of the processing chain needed for solving the problem;  - design, implementation and proof of functionality of a simple solution of a segmentation problem with the subsequent characterization of the extracted objects of interest. | | | |

Date Lecturer Instructor for practical activities

01.10.2013 Prof. Dr. Ing. C. Vertan Ş.l. Dr. Ing. Laura Maria Florea

Date of department approval Director of Department,

07.10.2013 Prof. Dr. Ing. S. Paşca