# 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 | 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 Processing (PI)**  |
| 2.2 Lecturer | Lect. Dr. eng. Marta Maria Zamfir |
| 2.3 Instructor for practical activities | Lect. Dr. eng. Marta Maria Zamfir |
| 2.4 Year of studies | IV | 2.5 Semester | I | 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 | 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 | 35 |
| Supplemental documentation (library, electronic access resources, in the field, etc) | 14 |
| Preparation for practical activities, homeworks, essays, portfolios, etc. | 10 |
| Tutoring | 0 |
| Examinations | 3 |
| Other activities | 0 |
| 3.7 Total hours of individual study | 62 |  |  |
| 3.9 Total hours per semester | 104 |  |  |
| 3. 10 Number of ECTS credit points | 4 |  |  |

**4. Prerequisites (if applicable)**

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| 4.1 curricular | Decision and Estimation in Information ProcessingAlgorithms and Data Structures |
| 4.2 competence-based | General knowledge of 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 engineeringC4 Use of programming technologies and computing environments |
| Transversalcompetences | 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 | Theoretical understanding of general digital gray level image processing techniques.Developing in students the ability to implement the general digital gray level image processing techniques using Matlab.  |
| 4.2 Specific objectives | Developing in students the ability to identify and analyze the specific problems of the image processing systems and to propose solving approaches.Developing in students the ability to model and design software/hardware image processing systems for specific applications. |

**8. Content**

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| 8.1 Lectures | Teaching techniques | Remarks |
| Introduction. Image Fundamentals | 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. | 1h |
| Human Visual Sistem. Color Space | 2h |
| Point operations (image enhancement, geometrical transforms) | 4h |
| Linear and nonlinear filtering in spatial domain | 6 |
| Image morphology | 2 |
| Integral operation (unitary transform, filtering in frequency domain, image restoration) | 7 |
| Image compression | 4 |
| Applications | 2 |
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| Bibliography1) 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) http://alpha.imag.pub.ro/cursuri/4) K. R. Castleman: Digital Image Processing, Prentice Hall, 20055) R. Gonzales, R. Woods: Digital Image Processing, Addison Wesley, 2006 |
| 8.2 Practical applications | Teaching techniques | Remarks |
| Introduction in Matlab. Image representation in Matlab. Image processing functions in Matlab | 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 |
| Matlab: Point operations for image enhancement. Geometric transforms | 2 |
| Matlab: Linear and nonlinear filtering in spatial domain | 2 |
| Matlab: Image morphology | 2 |
| Matlab: Unitary transforms. Image filtering in frequency domain.  | 2 |
| Matlab: Image restoration. Image compression. | 2 |
| Final laboratory test |  | 2 |
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| Bibliography1) C. Vertan, M. Ciuc: Tehnici Fundamentale de Prelucrarea şi Analiza Imaginilor, Ed. MatrixRom, Bucureşti, 2007.2) Constantin Vertan, Mihai Ciuc, Marta Zamfir: Prelucrarea şi Analiza Imaginilor: Îndrumar de laborator. Ed. Printech, Bucureşti, 2001.3) M. Ciuc, C. Vertan: Prelucrarea statistică a semnalelor, Ed. MatrixROM, Bucureşti, 2005.4) 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. | Written tests during the semester at announced dates; ExamThe subjects cover the entire curricula, realizing a synthesis between the comparative theoretical knowledge and its application through exercises and practical problems. | 30%30% |
|  |  |  |  |
| 10.5 Practical applications | - knowing the design templates for image processing algorithms used for solving a given problem;- knowledge of the coding [in Matlab] of a image processing algorithm;- proof of function of an image processing 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. | 40% |
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| 10.6 Minimal performance standard |
| - modeling a real-life simple image processing problem and specification of the processing chain needed for solving the problem;- design, implementation and proof of functionality of a simple solution of a enhancement/filtering/restoration/compression problem. |

Date Lecturer Instructor for practical activities

01.10.2013 Lect. Dr. eng. Marta M. Zamfir Lect. Dr. eng. Marta M. Zamfir

Date of department approval Director of Department,

07.10.2013 Prof. Dr. Ing. S. Paşca