**Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti**
**Facultatea de Electronică, Telecomunicaţii şi**
**Tehnologia Informaţiei**

# COURSE DESCRIPTION

## 1. Program identification information

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|---|---|
| 1.1 Higher education institution | **National University of Science and Technology Politehnica Bucharest** |
| 1.2 Faculty | **Electronics, Telecommunications and Information Technology** |
| 1.3 Department | **Applied Electronics and Information Engineering** |
| 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

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|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Imagistică medicală | | | |
| 2.2 Course Lecturer | | | | Conf. Dr. Alina Elena SULTANA | | | |
| 2.3 Instructor for practical activities | | | | Conf. Dr. Alina Elena SULTANA | | | |
| 2.4 Year of studies | 4 | 2.5 Semester | 1 | 2.6. Evaluation type | E | 2.7 Course regime | Ob |
| 2.8 Course type | | S | 2.9 Course code | 04.S.07.O.103 | | 2.10 Tipul de notare | Nota |

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

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|---|---|---|---|---|---|
| 3.1 Number of hours per week | 4 | Out of which: 3.2 course | 2 | 3.3 seminary/laboratory | 2 |
| 3.4 Total hours in the curricula | 56 | Out of which: 3.5 course | 28 | 3.6 seminary/laboratory | 28 |
| Distribution of time: | | | | | hours |
| Study according to the manual, course support, bibliography and hand notes<br>Supplemental documentation (library, electronic access resources, in the field, etc)<br>Preparation for practical activities, homework, essays, portfolios, etc. | | | | | 41 |
| Tutoring | | | | | 0 |
| Examinations | | | | | 3 |
| Other activities (if any): | | | | | 0 |

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| 3.7 Total hours of individual study | 44.00 |
| 3.8 Total hours per semester | 100 |
| 3.9 Number of ECTS credit points | 4 |

## 4. Prerequisites (if applicable) (where applicable)

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|---|---|
| 4.1 Curriculum | General knowledge of Signal Processing notions |
| 4.2 Results of learning | General knowledge of physics and programming (high level know-how of the Python programming environment) |

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

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|---|---|
| 5.1 Course | The course will be held in a room equipped with video projector and computer and blackboard for exemplifying theoretical applications. |
| 5.2 Seminary/ Laboratory/Project | Mandatory attendance at laboratories (according to the regulation of university undergraduate studies 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)*

Presentation of the physical principles used in medical imaging techniques, the methods of obtaining and reconstructing medical images and the operating principles of the main imaging systems.
Presentation of specific processing and standards for digital medical images. Students get to know some specialized programs for visualization, processing and analysis of medical images. Mini-projects will be made with concrete software applications.

**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.)*

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|---|---|
| **Specific Competences** | C4 - The design and use of low-complexity hardware and software applications specific to applied electronics<br>C5 - Application of basic knowledge, concepts and methods from: power electronics, automatic systems, electrical energy management, electromagnetic compatibility |
| **Transversal (General) Competences** | CT1 - Methodical analysis of the problems encountered in the activity, identifying the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks<br>CT3 - Adaptation to new technologies, professional and personal development, through continuous training using printed documentation sources, specialized software and electronic resources in Romanian and, at least, in one language of international circulation. |

**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.)*

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|---|---|
| **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.*<br>List the most important stages that marked the development of the field of medical imaging.<br>Defines notions specific to the field of medical imaging.<br>Describes/classifies notions and fundamental concepts that are the basis of the formation of medical images.<br>Apply theoretical concepts to solve theoretical applications. |

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|---|---|
| **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).*<br>Work productively in a team.<br>• Experimentally verifies identified solutions.<br>• Solve practical applications based on the theoretical concepts studied.<br>• Adequately interprets relations and theoretical equations of the principles of formation of different types of medical images.<br>• Analyzes and compares different techniques for obtaining medical images.<br>• Identifies solutions and develops plans to solve some theoretical applications.<br>Formulates conclusions to the experiments and methods implemented in the laboratory. |
| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br>Select appropriate bibliographic sources and analyze them.<br>Respect the principles of academic ethics, correctly citing the bibliographic sources used.<br>Demonstrates responsiveness to new learning contexts.<br>Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities<br>Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved<br>Promotes/contributes through new solutions related to the specialized field to improve the quality of social life.<br>Realizes the value of his contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility).<br>Apply principles of professional ethics/deontology in the analysis of the technological impact of the proposed solutions in the specialized field on the environment. |

**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 presentation of the course lectures is done with multimedia facilities (interactive whiteboard, powerpoint presentations, examples run on PC) and include free discussions and interactive presentations based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling) , but also on action-based methods such as exercise, practical activities and problem solving.
Lecture presentations are available to students in electronic format. Laboratory:
The presentation is made with multimedia facilities (interactive whiteboard, powerpoint presentations, examples run on the PC) and includes free discussions and interactive presentations.
Labs are designed for individual and team work, including mini-projects and homework.
Lab platform sheets are available to students in electronic format.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | Introduction to Medical Imaging | 2 |
| 2 | Introduction to Medical Imaging | 2 |
| 3 | Medical Imaging methods<br>Digital Image Representation | 4 |
| 4 | Medical Imaging methods<br>Digital Image Representation | 6 |

| | | |
|---|---|---|
| 5 | Medical Image Quality Factors | 4 |
| 6 | Medical Image Quality Factors | 2 |
| 7 | X-Rays | 2 |
| 8 | X-Rays | 2 |
| 9 | Computed Tomography | 2 |
| 10 | Magnetic Resonance Imaging | 2 |
| 11 | Ultrasounds | 0 |
| 12 | Nuclear Medicine | 0 |
| 13 | Complementary Medical Imaging Techniques | 0 |
| 14 | Complementary Medical Imaging Techniques | 0 |
| 15 | Future trends in Medical Imaging | 0 |
| 16 | Future trends in Medical Imaging | 0 |
| | **Total:** | 28 |

**Bibliography:**

1.Sultana Alina Elena, Medical Imaging, https://curs.upb.ro/2021/mod/folder/view.php?id=155940
2.https://curs.upb.ro/2021/mod/folder/view.php?id=203636
3.Medical Imaging Signals and Systems, 2nd Edition. Jerry L. Prince, John Hopkins University. Jonathan Links, Johns Hopkins University; ISBN-13: 9780132669955; http://iacl.ece.jhu.edu/images/0/06/Medical_Imaging_Signals_and_Systems_Pearson_2014.pdf

**LABORATORY**

| Crt. no. | Content | No. hours |
|---|---|---|
| 1 | Introductory elements in medical image analysis applied on ImageJ platform. | 4 |
| 2 | Introductory elements in medical image analysis applied on ImageJ platform. | 4 |
| 3 | Medical image processing using Python. | 4 |
| 4 | Medical image processing using Python. | 4 |
| 5 | Implementing mammography image processing algorithms using Python. | 4 |
| 6 | Implementing mammography image processing algorithms using Python. | 4 |
| 7 | Implementing mammography image processing algorithms using Python. | 4 |
| 8 | Implementing morphology and filters on medical images using Python. | 0 |
| 9 | Implementing morphology and filters on medical images using Python. | 0 |
| 10 | DICOM standard, specifications and applications. | 0 |
| 11 | DICOM standard, specifications and applications. | 0 |
| 12 | DICOM Viewers | 0 |
| 13 | DICOM Viewers | 0 |
| 14 | Lab exam | 0 |
| | **Total:** | 28 |

**Bibliography:**

1.Sultana Alina, Imagistica medicala, suport de curs electronic, https://curs.upb.ro/2021/mod/folder/view.php?id=155940
3.A. Sultana, S. Pasca, „Imagistica medicala: Indrumar de laborator”, Editura POLITEHNICA PRESS, Bucureşti, 2013, ISBN 978-606-515-478-0
4.Introduction to Python Programming, https://www.udacity.com/course/introduction-to-python--ud1110

**11. Evaluation**

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|
| 11.4 Course | - knowledge of fundamental theoretical notions; - knowledge of how to apply the theory to specific problems | A written exam, during the session; the subjects cover the entire subject, achieving a synthesis between the comparative theoretical course of the subject and the application of theoretical methods and techniques to the solution of some application problems. | 50% |
| | - knowledge of fundamental theoretical notions; - knowledge of how to apply the theory to specific problems | A written exam, during the session; the subjects cover the entire subject, achieving a synthesis between the comparative theoretical course of the subject and the application of theoretical methods and techniques to the solution of some application problems. | |
| | - knowledge of fundamental theoretical notions; - knowledge of how to apply the theory to specific problems | | |
| | - knowledge of how to apply the theory to specific problems | | |

| | | | |
|---|---|---|---|
| 11.5<br>Seminary/laboratory/project | Differential analysis of theoretical techniques and methods. Understanding a theoretical problem and anticipating a practical implementation solution<br>- knowing how to design an image analysis algorithm to solve a given problem; | Final laboratory exam, including a theoretical component and a practical component. The theoretical component is verified by grid test; the practical component is evaluated by checking the solution method (implementation, testing, operation on the computer) by the student of a practical problem. | 50% |
| | Differential analysis of theoretical techniques and methods. Understanding a theoretical problem and anticipating a practical implementation solution<br>- knowing how to design an image analysis algorithm to solve a given problem; | Final laboratory exam, including a theoretical component and a practical component. The theoretical component is verified by grid test; the practical component is evaluated by checking the solution method (implementation, testing, operation on the computer) by the student of a practical problem. | |
| 11.6 Passing conditions | | | |
| • Attendance at the final exam is mandatory according to the undergraduate university study rules.<br>• Obtaining 50% of the score related to the laboratory activity.<br>**Atenţie la Regulamentul de studii aplicabil, se pot include aici referinţe în acest sens!** | | | |

**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)**

• Medical imaging has become a mature market with a fast growth rate. Medicine has included medical imaging techniques in the package of current medical investigations, with industry closely following this trend. The industry has a strong demand for qualified engineers with specializations related to medical imaging and a solid foundation in electronics, systems and information technology, so that the pace of development of new hardware products and software applications can be maintained.
• The course curriculum responds concretely to these current development and evolution requirements, subscribed to the European economy of services in the field of Electronic Engineering, Telecommunications and Information Technologies.
• In the context of the current technological progress of electronic devices, the fields of activity targeted are practically unlimited, from the medical field (diagnosis and therapy based or aided by imaging investigations, acquisition products and technologies, analysis and processing of medical images, new methods of investigation medical imaging), the military field (products and technologies for non-destructive

testing of product quality), the security field (surveillance systems), the industrial field (non-destructive product inspection systems) and others.

• 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 |
|---|---|---|
| 25.09.2025 | Conf. Dr. Alina Elena SULTANA | Conf. Dr. Alina Elena SULTANA |

| Date of department approval | Head of department |
|---|---|
| 26.09.2025 | Conf. Dr. Bogdan Cristian Florea |

| Date of approval in the Faculty Council | Dean |
|---|---|
| 26.09.2025 | Prof. Dr. Mihnea Udrea |