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

COURSE DESCRIPTION

1. Program identification information

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	Computers and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Intelligent Systems and Artificial Vision

2. Date despre disciplină

2.1 Course name (ro) (en)				Computer Vision I - Fundamente Computer Vision I - Fundamentals			
2.2 Course Lecturer				Prof. Dr. Bogdan Emanuel IONESCU			
2.3 Instructor for practical activities				S.l./Lect. Dr. Serban CARATĂ			
2.4 Year of studies	1	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	2		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	14
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					39
Tutoring					0
Examinations					5
Other activities (if any):					0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	General knowledge of digital signal processing and computer programming
4.2 Results of learning	Not applicable.

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

5.1 Course	The course will take place in a room equipped with a video projector and computer.
5.2 Seminary/ Laboratory/Project	The laboratory will be held in a room with specific equipment, which must include: individual computer, specific software such as Matlab, Python and C++ compiler.

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)*

The course aims to provide students with basic knowledge on understanding the fundamental concepts related to image acquisition systems and the automatic analysis and processing of their content, as well as the acquisition and use of fundamental image processing methods in the design of specific applications for computer vision in real, practical systems. The laboratory applications aim at the practical acquisition of the main concepts taught in the course, using various programming environments, through the development of concrete, practical 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.)*

Specific Competences	Demonstrates basic/advanced knowledge in the field of image analysis and processing techniques. Correlates knowledge of computer system programming with that of implementing specific vision algorithms. Applies knowledge in practice to design, develop and implement systems that solve concrete problems in fields such as security, medicine, etc. Analyzes and interprets the results of image processing and content analysis systems. Uses scientific vocabulary specific to the field, in order to communicate effectively, in writing and orally. Demonstrates understanding of the vocabulary related to the field in English.
Transversal (General) Competences	They work in a team and communicate effectively, coordinating their efforts with others to solve problems of medium complexity. They have the ability to think in scientific terms, to search for and analyze data independently, as well as to capture and present conclusions/identify solutions. They have the ability to analyze and synthesize knowledge and information for a specific topic. They respect the principles of academic ethics by respecting intellectual property.

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.)*

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.* Defines the main concepts of the field. Knows the basic notions of image pre-processing specific to vision systems. Knows the basic notions of the operation of image content processing and analysis systems. Knows the principles of evaluating the performance of image analysis systems.
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).* Uses programming languages to implement image processing systems. Identifies solutions, designs, develops and implements vision systems that solve concrete problems of multi-modal information processing. Uses specific concepts to evaluate the performance of a vision system. Develops a scientific text presenting methods and results. Interprets adequately the results obtained from the analysis of vision systems.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Selects appropriate bibliographic sources and analyzes them. Respects the principles of academic ethics by respecting intellectual property. Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities. Recognizes the value of his contribution in the field of engineering to identifying viable/sustainable solutions to solve problems in social and economic life (social responsibility).

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 courses are taught in an interactive manner, encouraging active student participation and teamwork. Multimedia tools and techniques (video projector) are used. Course materials are available in electronic format on the Internet and in the classroom. In the laboratory, teaching is based on oral communication and detailed explanation of the methods used and the results obtained; students design and experiment with a series of data processing and information classification systems. Laboratory materials are available to students in printed and electronic form on the Internet and in the laboratory.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction (generalities, main problems of image processing, image classification, image display, discrete image representation)	2
2	Color representation (color representation spaces; applications)	4
3	Geometric transformations (affine transformations, compound transformations, data interpolation; applications)	4
4	Point-to-point image transformations (point operations, histogram operations, color palette modification; applications)	4

5	Linear filtering (neighborhood operations, smoothing filters, derivation filters; applications)	4
6	Nonlinear filtering (intrinsically nonlinear filters, median filter, adaptive filtering, filtering quality assessment; applications)	4
7	Mathematical morphology (operations for binary images, for grayscale images, vector morphology; applications)	4
8	Unitary transforms (Fourier transform, discrete cosine and sine; applications)	2
	Total:	28
Bibliography:		

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Introductory notions of image processing.	1
2	Changing the color palette of images. Practical applications.	1
3	Geometric transformations. Practical applications.	1
4	Specific image enhancement techniques. Practical applications.	1
5	Linear image enhancement techniques. Practical applications.	2
6	Nonlinear image enhancement techniques. Practical applications.	2
7	Morphological techniques for image content analysis. Practical applications.	1
8	Frequency filtering techniques for image enhancement. Practical applications.	2
9	Image segmentation and content analysis techniques. Practical applications.	1
10	Lab colloquim.	2
	Total:	14
Bibliography:		

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 concepts related to image processing and analysis. - knowledge of how to apply theory to specific implementation problems. - differential analysis of theoretical principles and methods.	Written exam in the exam session corresponding to the semester; the topics cover the entire subject, achieving a synthesis between the comparative theoretical review of the discipline and the explanation of the application models through exercises and examples.	20
	- knowledge of how to apply theory to specific implementation problems. - differential analysis of theoretical principles and methods.	Written exam in the exam session corresponding to the semester; the topics cover the entire subject, achieving a synthesis between the comparative theoretical review of the discipline and the explanation of the application models through exercises and examples.	20
	- differential analysis of theoretical principles and methods.	Written exam in the exam session corresponding to the semester; the topics cover the entire subject, achieving a synthesis between the comparative theoretical review of the discipline and the explanation of the application models through exercises and examples.	10
11.5 Seminary/laboratory/project	- understanding the principles of image processing and analysis; - knowledge and practical implementation of content analysis techniques for vision applications; - the ability to evaluate the performance of a processing system through tests	Final laboratory colloquium consisting of the evaluation of an individual project - the full realization of a processing and analysis system for a specific concrete requirement; both the understanding of theoretical aspects and the ability to implement and test a practical problem are evaluated	50
11.6 Passing conditions			

Obtaining 50% of the total score.

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)

Computer Vision has become a mature market with a fast growth rate. The transition of consumers to Computer Vision applications is complete, the industry closely following this trend. The industry has a significant demand for qualified engineers, with specializations related to Computer Vision and with a solid foundation in information technology, so that the pace of development of new hardware products and software applications can be maintained. The course curriculum responds specifically to these current development and evolution requirements, subscribed to the European economy of services in the field of Computers and Information Technology (CTI). In the context of current technological progress, the targeted areas of activity are numerous, including “consumer” applications (the automotive industry), military applications (products and technologies of “remote sensing” type of satellite image processing), cadastre monitoring, robotics and others. This ensures that graduates have skills appropriate to the needs of current qualifications and a modern, quality and competitive scientific and technical training, which will allow them to be quickly employed after graduation, the course being perfectly aligned with the policy of the Politehnica University of Bucharest, both in terms of content and structure, as well as in terms of the skills and international openness offered to students.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025		

Date of department approval	Head of department
	Conf. Bogdan Florea

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