SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Computer science / Engineer
1.7 Form of education	Full time
1.8 Subject code	40.

2. Data about the subject

2.1 Subject name	***Image processing***				
2.2 Course responsible/lecturer	Prof. dr. eng. Florin Oniga - Florin.Oniga@cs.utcluj.ro - english Prof. dr. eng. Radu Dănescu - Radu.Danescu@cs.utcluj.ro - romanian Assoc. prof. dr. eng. Tiberiu Mariţa - Tiberiu.Marita@cs.utcluj.ro – romanian				
2.3 Teachers in charge of seminars/ laboratory/ project	Prof. dr. eng. Florin Oniga - Florin.Oniga@cs.utcluj.ro Conf. dr. eng. Tiberiu Mariţa - Tiberiu.Marita@cs.utcluj.ro Conf. dr. eng. Delia Mitrea - Delia.Mitrea@cs.utcluj.ro Conf. dr. eng. Raluca Brehar - Raluca.Brehar@cs.utcluj.ro Conf. dr. eng. Ion Giosan - Ion.Giosan@cs.utcluj.ro S.l. dr. eng. Cristian Vancea - Cristian.Vancea@cs.utcluj.ro S.l. dr. eng. Robert Varga - Robert.VARGA@cs.utcluj.ro S.l. dr. eng. Cristian Vicas - Cristian.Vicas@cs.utcluj.ro Asist. drd. eng. Mircea Muresan - Mircea.Muresan@cs.utcluj.ro Asist. drd. eng. Ana Rednic - Ana.Rednic@cs.utcluj.ro				
2.4 Year of study	III	2.5 Semester	2	2.6 Type of assessment (E – exam, C – colloquium, V – verification)	E
2.7 Subject category	*DF – 1undamental, DD – în domeniu, DS – de specialitate, DC – complementară*				DD
	DI – Impusă, Dop – opţională, Dfac – facultativă				DI

3. Estimated total time

3.1 Number of hours per week	5	of which:	Course	2	Seminars		Laboratory	2	Project	1
3.2 Number of hours per semester	70	of which:	Course	28	Seminars		Laboratory	28	Project	14
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										14
(b) Supplementary study in the library, online and in the field										3
I Preparation for seminars/laboratory works, homework, reports, portfolios, essays										10
(d) Tutoring										0
I Exams and tests										3
(f) Other activities:										0
3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))										30
3.5 Total hours per semester (3.2+3.4)										100
3.6 Number of credit points										4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Computer programming (C/C++), Data structures and algorithms
4.2 Competence	Linear Algebra, Numerical methods, Special mathematics, Physics (optics).

5. Requirements (where appropriate)

5.1. For the course	Blackboard, video projector, computer

5.2. For the applications	Workstations, specific software (Visual Studio, OpenCV, OpenCVApplication), e-learning platforms

6. Specific competence

6.1 Professional competences	**C6 –** Designing intelligent systems **C6.1 –** Describing the components of intelligent systems **C6.2 –** Using domain-specific tools for explaining and understanding the functioning of intelligent systems **C6.3 –** Applying the fundamental methods and principles for specifying solutions for typical problems using intelligent systems **C6.4 –** Choosing criteria and methods for the evaluation of quality, performances and limitations of information systems **C6.5 –** Developing and implementing professional projects for intelligent systems
6.2 Cross competences	N/A

7. Discipline objective (as results from the *key competences gained*)

7.1 General objective	Understanding the concepts related to digital images, computer vision and image processing. Learning and applying image processing methods, and designing specific applications.
7.2 Specific objectives	▪ Learning, evaluation and use of image processing specific concepts, algorithms and methods: digital image formats, camera model, statistical analysis, image filtering, image enhancing and restauration, segmentation, measurement. ▪ Acquiring the capacity of finding optimal solutions for image processing algorithm implementation, taking into consideration time and hardware constraints. ▪ Acquiring the capacity of quantitative and qualitative assessment of results, algorithms and systems for image processing. ▪ Learning the use of programming tools and image processing frameworks (Diblook, MS MFC, OPEN CV)

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
Introduction	2	Interactive teaching, using oral presentations supported by multimedia tools, consultations, involving students in research and development activities.	
Camera model, the image formation process, coordinate transforms, calibration.	2		
Binary image processing: Tresholding; Simple Geometric Properties	2		
Binary image processing: Labeling, Contour Tracing	2		
Binary image processing: Mathematical Morphology	2		
Grayscale image processing: Statistical properties, Image quality enhancement.	2		
Grayscale image processing: Convolution and Fourier Transform	2		
Grayscale image processing: Noise in images	2		
Grayscale image processing: Digital filtering.	2		
Grayscale image segmentation: Edge based segmentation	2		
Monocular and stereovision	2		
Color spaces. Color image processing	2		
Image Segmentation	2		
Problem solving	2		

Bibliography

1. R. C. Gonzales, R. E. Woods, "Digital Image Processing",3rd Edition, *Prentice Hall, 2008*
2. E. Trucco, A. Verri, "Introductory Techniques for 3-D Computer Vision", *Prentice Hall, 1998*.
3. W.K. Pratt, *Digital Image Processing: PIKS Inside, 3-rd Edition,* Wiley & Sons 2001.
4. G. X.Ritter, J.N. Wilson, "Handbook of computer vision algorithms în image algebra", *CRC Press*, 2001.

5. Frank Y. Shih, *Image Processing And Pattern Recognition – Fundamentals and Techniques*, Wiley & Sons, Hoboken, New Jersey, 2010.
6. A. Koschan, M. Abidi, *Digital Color Image Processing*, Wiley & Sons, 2008.
7. L. G. Shapiro, G. C. Stockman, *Computer Vision*, Prentice Hall, 2000
8. S.Nedevschi, *"Prelucrarea imaginilor si recunoasterea formelor", Ed. Microinformatica, 1997.*
9. S. Nedevschi, T. Marita, R. Danescu, F. Oniga, R. Brehar, I. Giosan, S. Bota, A. Ciurte, V. Andrei, Image Processing – Laboratory Guide, *UTPRES*, Cluj-Napoca, 2016

Online

10. T. Marita, R. Danescu, F. Oniga, S. Nedevschi, "Prelucrarea imaginilor – Note de curs", http://users.utcluj.ro/~tmarita/IPL/IPCurs.htm, http://users.utcluj.ro/~rdanescu/teaching_pi.html https://users.utcluj.ro/~onigaf/files/IP.html, Ms Teams

8.2 Applications – Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Laboratory			
Introduction to the OpenCV library	2	Presentation using the blackboard and multimedia tools, e-learning. Experiments and implementation using specific software tools (MS Visual Studio, OpenCV) Evaluation of the design and implementation phases.	
Color spaces	2		
The histogram of intensity levels	2		
Geometrical features of binary objects	2		
Binary objects labeling	2		
Border tracing algorithm.	2		
Morphological operations on binary images	2		
Statistical properties of grayscale images	2		
Image filtering in the spatial and frequency domains	2		
Noise modeling and digital image filtering	2		
Edge detection (1)	2		
Edge detection (2)	2		
Evaluation	2		
Evaluation	2		
Project			
Choosing and discussing the project subject (weeks 1 and 2).	1		
Discussing the literature study and the work schedule (weeks 3 and 4).	1		
Algorithm design (weeks 5 and 6)	1		
Presentation of algorithm implementation. Intermediary evaluation (weeks 7 and 8).	1		
Algorithm testing and validation. Quantitative and qualitative evaluation (weeks 9 and 10).	1		
Algorithm optimization (weeks 11 and 12).	1		
Final project assessment (weeks 13 and 14).	1		

Bibliography

1. S. Nedevschi, T. Marita, R. Danescu, F. Oniga, R. Brehar, I. Giosan, S. Bota, A. Ciurte, V. Andrei, "Image Processing – Laboratory Guide", *UTPRES*, Cluj-Napoca, 2016
2. S. Nedevschi, T. Mariță, R. Dănescu, F. Oniga, R. Brehar, I. Giosan, C. Vicaș, *Procesarea Imaginilor – Îndrumător de laborator,* Editura U.T. Press, Cluj-Napoca, 2013.

1. M. Tiberiu, R. Danescu, Florin Oniga si colectivul IPPRG: laboratoy, http://users.utcluj.ro/~tmarita/IPL/IPLAB.htm, http://users.utcluj.ro/~rdanescu/teaching_pi.html, http://users.utcluj.ro/~igiosan/teaching_ip.html

**Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

11. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The subject is part of the Computer Science and Information Technology curriculum, its contents combining fundamental and practical aspects used in the field of visual information processing (an ever growing domain). The subject content is correlated with the specific curricula of other Universities, in Romania and abroad, and is evaluated by government agencies (CNEAA and ARACIS). The subject's activities are meant to make the students

familiar with the applications and the research directions of the image processing field, helped by the internationally renowned experience of the teachers.

12. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Testing the theoretical knowledge acquired, and the practical abilities of problem solving.	Written exam	50%
Seminar	-		
Laboratory	Testing the practical abilities of designing and implementing solutions to specific problems. Attendance and activity.	Lab assessment (continuous evaluation of activity, written and oral verification), project assessment	50%
Project			
Minimum standard of performance: Modeling and implementation of solutions to specific engineering problems, using the domain's formal apparatus. Grade calculus: 25% laboratory + 25% project + 50% final exam Conditions for participating in the final exam: Laboratory ≥ 5, Project ≥ 5 Conditions for promotion: final exam ≥ 5			

	Teachers	**Name**	**Semnătura**
Date of filling in: 16.06.2023	Lecture	Prof. dr. eng. Florin Oniga	
		Prof. dr. eng. Radu Danescu	
		Conf. dr. eng. Tiberiu Marita	
	Applications	Prof. dr. eng. Florin Oniga	
		Conf. dr. eng. Delia Mitrea	
		Conf. dr. eng. Raluca Brehar	
		Conf. dr. eng. Ion Giosan	
		S.l. dr. eng. Robert Varga	
		S.l. dr. eng. Cristian Vancea	
		S.l. dr. eng. Cristian Vicas	
		Asist. dr. eng. Mircea Muresan	
		Asist. dr. eng. Ana Rednic	

Date of approval in the department	Head of department, Prof. dr. eng. Rodica Potolea
Date of approval in the Faculty Council	Dean, Prof. dr. eng. Liviu Miclea