# SYLLABUS

**1. Data about the program of study**

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|---|---|
| 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**

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|---|---|---|---|---|---|
| 2.1 Subject name | | | | ***Image processing*** | |
| 2.2 Course responsible/lecturer | | | | Prof dr. eng. Sergiu Nedevschi (Sergiu.Nedevschi@cs.utcluj.ro ) | |
| 2.3 Teachers in charge of seminars/ laboratory/ project | | | | Prof. Florin Oniga, Asoc. Prof. Ion Giosan, Asoc. Prof. Raluca Brehar, Assist. drd eng. Andra Petrovai {given-name.family_name}@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 – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară* | | | | DD |
| | *DI – Impusă, DOp – opțională, 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 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | | | | | 10 |
| (d) Tutoring | | | | | | | | | | 0 |
| (e) Exams and tests | | | | | | | | | | 3 |
| (f) Other activities: | | | | | | | | | | 0 |

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| 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)**

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

**5. Requirements (where appropriate)**

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| 5.1. For the course | Blackboard, video projector, computer |
| 5.2. For the applications | Workstations, specific software (Visual Studio, Diblook) |

**6. Specific competence**

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| 6.1 Professional competences | **C6 -** Designing intelligent systems<br>**C6.1 -** Describing the components of intelligent systems<br>**C6.2 -** Using domain-specific tools for explaining and understanding the functioning of intelligent systems<br>**C6.3 -** Applying the fundamental methods and principles for specifying solutions for typical problems using intelligent systems<br>**C6.4 -** Choosing criteria and methods for the evaluation of quality, |

| | |
|---|---|
| | performances and limitations of information systems<br>**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*)**

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| 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.<br>▪ Acquiring the capacity of finding optimal solutions for image processing algorithm implementation, taking into consideration time and hardware constraints.<br>▪ Acquiring the capacity of quantitative and qualitative assessement of results, algorithms and systems for image processing.<br>▪ Learning the use of programming tools and image processing frameworks (Diblook, MS MFC, OPEN CV) |

**8. Contents**

| 8.1 Lectures | Hours | Teaching methods | Notes |
|---|---|---|---|
| Computer vision and its applications. Structure and functionality of computer vision systems. Image acquisition systems. | 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, Polygonal Approximation | 2 | | |
| Binary image processing: Mathematical Morphology | 2 | | |
| Grayscale image processing. Statistical properties. Histogram processing; 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 | | |
| Grayscale image processing: Advanced methods for edge extraction; Linking and Contour Closing. | 2 | | |
| Region Based Images Segmentation | 2 | | |
| Stereo-vision | 2 | | |
| Pattern Recognition | 2 | | |

Bibliography


1. R. C. Gonzales, R. E. Woods, "Digital Image Processing-Second Edition",3rd Edition, *Prentice Hall, 2008*
2. R. C. Gonzalez, R. E. Woods, S. L. Eddins, “Digital Image Processing Using MATLAB”, 2nd ed., *Gatesmark Publishing*, 2009.
3. E. Trucco, A. Verri, “Introductory Techniques for 3-D Computer Vision”, *Prentice Hall, 1998*.
4. G. X.Ritter, J.N. Wilson, “Handbook of computer vision algorithms în image algebra”, *CRC Press*, 2001.
5. 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***

1. S. Nedevschi, “Prelucrarea imaginilor - Note de curs”, ftp.utcluj.ro/pub/users/nedevschi/IP_2016/


| 8.2 Applications – Seminars/Laboratory/Project | Hours | Teaching methods | Notes |
|---|---|---|---|
| **Laboratory** | | | |
| Getting started with the DIBLook framework | 2 | Presentation using the blackboard and | |
| The color model. Color-grayscale and grayscale-black&white | 2 | | |

| | | | |
|---|---|---|---|
| conversions | | multimedia tools. | |
| The histogram of intensity levels | 2 | | |
| Geometrical features of binary objects | 2 | Experiments and implementation using specific software tools (MS Visual Studio, Diblook) | |
| 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 | Evaluation of the design and implementation phases. | |
| Edge detection (1) | 2 | | |
| Edge detection (2) | 2 | | |
| Region-based image segmentation | 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
Online
http://users.utcluj.ro/~igiosan/teaching_ip.html

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

**9. 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.

**10. 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, 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

| Date of filling in: | Titulari | Titlu Prenume NUME | Semnătura |
|---|---|---|---|
| | Course | Prof. dr. ing. Sergiu Nedevschi | |
| | Applications | Prof. dr. ing. Florin Oniga | |
| | | Assoc. Prof. dr. ing. Ion Giosan | |
| | | Assoc. Prof. dr. ing. Raluca Brehar | |
| | | Assist. drd. ing. Andra Petrovai | |

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| **Date of approval in the department** | Head of department<br>Prof.dr.ing. Rodica Potolea |
| **Date of approval in the Faculty Council** | Dean<br>Prof.dr.ing. Liviu Miclea |