SYLLABUS

1. Data about the study program

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Communications
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Telecommunications Technologies and Systems/ Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E55.10

2. Data about the subject

2.1 Subject name	Digital Techniques for Video Analysis						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Assist. Prof. Camelia FLOREA, Ph.D. Camelia.Florea@com.utcluj.ro						
2.4 Teacher in charge with laboratory / project	Assist. Prof. Camelia FLOREA, Ph.D. Camelia.Florea@com.utcluj.ro						
2.5 Year of study	IV	2.6 Semester	2	2.7 Assessment	V	2.8 Subject category	DS/DO

3. Estimated total time

3.1 Number of hours per week	4	of which: 3.2 course	2	3.3 seminar / laboratory	2
3.4 To Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar / laboratory	28

Distribution of time	Hours
Manual, lecture material and notes, bibliography	30
Supplementary study in the library, online specialized platforms and in the field	19
Preparation for seminars / laboratories, homework, reports, portfolios and essays	14
Tutoring	2
Exams and tests	4
Other activities:	

3.7 Total hours of individual study	69
3.8 Total hours per semester	125
3.9 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 curriculum	Knowledge of digital signal processing and software development
4.2 competence	Programming skills

5. Requirements (where appropriate)

5.1. for the course	
5.2. for the seminars / laboratories / projects	

6. Specific competences

Professional competences	C4. Design, implementation and operation of data, voice, video and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks
Transversal competences	N / A

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

7.1 General objective	Acquire theoretical knowledge and practical skills in video analysis using both classical methods and modern techniques from machine learning and deep learning, with applications in classification, object detection and tracking, as well as image segmentation.
7.2 Specific objectives	1. To understand the fundamental principles of video processing and visual data classification, including dataset preparation, performance metrics, and neural network architecture. 1. To develop practical competencies through projects and periodical assessments, integrating theoretical concepts into functional solutions for real-world video analysis problems.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Introduction to Video Analysis.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, whiteboard
2. Basic concepts of Classification and Regression.		
3. Dataset preparation, and performance evaluation metrics.		
4. Artificial and Convolutional Neural Networks.		
5. Feature Extraction with Filters and Convolution.		
6. Pattern Recognition, Correlation, Convolution, and Pooling		
7. Midterm Assessment		
8. Training Neural Networks.		
9. Loss Functions and Activation Functions.		
10. Autoencoders and Unsupervised Feature Learning.		
11. Object Detection Techniques.		
12. Image Segmentation - semantic, instance, and panoptic segmentation.		
13. Motion Detection and Object Tracking		

14. Final Assessment		
References: 1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, 2018 (4th Edition), Pearson. 2. Deep Learning for Vision Systems, Mohamed Elgendy, 2020, Manning Publications 3. Computer Vision: Algorithms and Applications (2nd Edition), Richard Szeliski, 2023, Springer. 4. Dive into Deep Learning, Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola, 2023 (https://arxiv.org/abs/2106.11342) Course SLIDES		
8.2 Laboratory	Teaching methods	Notes
1. Introduction to video signal processing in Python.	Didactic and experimental proof, didactic exercise, teamwork	Use of laboratory instrumentation, experimental boards, computers, multimedia board
2. Filters and Template Matching.		
3. Convolutional Neural Networks (CNNs) for Classification.		
4. Object Detection. Using deep learning models to detect and localize objects.		
5. Image Segmentation. Implementing segmentation techniques to distinguish regions and objects in images.		
6. Object Tracking across video frames.		
7. Labs Remake.		
8.3 Project		
1. Introduction. Projects presentation and allocation.		
2. Analysis of the project. Theoretical fundamentals.		
3. Implementation of the project.		
4. Program testing.		
5. Program testing and report editing.		
6. Preliminary verification of the project.		
7. Project presentation. Evaluation.		

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

Competence acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale / Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	*Written test (theory and problems)*	T, max 10 pct. 50%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	*Laboratory tests/ Project evaluation*	L, max. 10 pct. 25% P, max. 10 pct. 25%
10.6 Minimum standard of performance			
Qualitative level: *Minimal knowledge:*			

- ✓ Understanding basic concepts in video analysis, including classification, regression, and object detection.
- ✓ Knowledge of how neural networks are structured (MLP and CNN), along with the function of critical elements such as filters, activation functions, and loss functions.

Minimal competencies:

- ✓ Ability to train and evaluate simple neural network models for tasks such as image classification or object detection using predefined datasets.
- ✓ Ability to properly apply preprocessing and evaluation methods, including data preparation, appropriate method selection, and interpretation of performance metrics.

Quantitative level:

- ✓ Attendance of all laboratory and project sessions
- ✓ Evaluation in exam (T) and practical activities (L+P)/2 at least 4.5 points/out of 10.
- ✓ Final grade is computed with the formula: 0,5*T+0,25*L+0.25*P

Date of filling in:	**Responsible**	**Title First Name SURNAME**	**Signature**
16.06.2025	Course	Assist. Prof. Camelia FLOREA, Ph.D.	
	Applications	Assist. Prof. Camelia FLOREA, Ph.D.	

Date of approval in the Council of the Communications Department 18.06.2025	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 25.06.2025	Dean Prof. Ovidiu POP, Ph.D.