MINISTRY OF NATIONAL EDUCATION

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

SYLLABUS

1. Study Program

1.1	Higher Education Institute	Technical University of Cluj-Napoca
1.2	Faculty	Electronics, Telecommunications and Information Technology
1.3	Department	Communications
1.4	Study domain	Electronics and Telecommunications Engineering
1.5	Study level	Master
1.6	Study program/ Qualification	Multimedia Technologies/ Telecommunications/ Master
1.7	Type of education	IF (Full-time learning)
1.8	Discipline code	TM-E01.00/ TC-E16.20

2. Discipline

2.1	Discipline name					Advanced systems for multimedia information coding and compression						
2.2	Subject area					Electronics and Telecommunications Engineering						
2.3	Responsible					Assistant Professor Camelia FLOREA, Ph.D. Camelia.Florea@com.utcluj.ro						
2.4	Titular					Assistant Professor Camelia FLOREA, Ph.D. Camelia.Florea@com.utcluj.ro						
2.5	Year of study	I	2.6	Semester	1	2.7	Evaluation	Exam	2.8	Type of discipline	DA/DI	

3. Total estimated time

Year/ Sem	Discipline name	No. of weeks	Course [hours/week]				Applications [hours/week]				Course	Applications	Indiv. study	TOTAL	ECTS
			C	S	L	P		S	L	P					
I/1	Advanced systems for multimedia information coding and compression	14	2	0	1	0	28	0	14	0	58	100			4

3.1	Number of hours per week	3	3.2	course	2	3.3	applications	1
3.4	Total hours per curriculum	42	3.5	course	28	3.6	applications	14

Individual study	Hours
Study based on manuals, course materials, references and notes	14
Supplementary documentation in libraries, electronic platforms and on field	10
Preparation of seminars/laboratories, homeworks, essays, portfolios	10
Tutorial work	7
Assessments	3
Other activities	14

3.7	Total hours of individual study	58
3.8	Total hours per semester	100
3.9	ECTS	4

4. Prerequisites (if necessary)

4.1	Curriculum	Information theory; Signal processing; Digital image processing
4.2	Competences	No

1. Requisites (if necessary)

5.1	Course	Video-projector, screen, whiteboard
5.2	Applications	PCs with Internet access

6 Specific competences acquired

Professional competences	Theoretical knowledge (What do the student should know)	1. Demonstrate mastery knowledge and innovation/generalization abilities in the topics related to: - basics principles for the compression of multimedia information, digital image and video lossless image compression; the basics of spatial and temporal prediction and prediction techniques used in image and video coding standards lossy image and video compression; most frequently used transform coding techniques for image and video compression international standards for still images and video sequences compression and their customization for practical applications; 2. Manage complex technical activities and projects, taking responsibility for decision-making in unpredictable work or study contexts, in application fields implying the use of color image processing, analysis and interpretation, object recognition, supervised learning methods/supervised classification. 3. Demonstrate the cognitive and practical skills required to develop creative solutions to problems that involve image analysis and/or interpretation, image classification, object recognition – virtually in any application that can benefit from a computer vision component 4. Demonstrate specialized problem-solving skills required in research and innovation in order to develop new procedures and to integrate interdisciplinary knowledge into color image processing, analysis and interpretation systems adapted to new practical applications, to build multi-modal data analysis and interpretation systems and to design and implement practical systems according to new user requirements (from fields other than engineering). 5. Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches, by applying and generalizing the knowledge and practice from the particular field of (unsupervised/supervised) image analysis and interpretation systems.
	Acquired skills (What the student is able to do)	
	Acquired abilities (what equipment/ instruments/ softwares the student is able to handle)	
Transversal competences		CT3 Adapting to new technologies, professional and personal development through continuing education using electronic documentation and printed sources, in Romanian and in at least one international language (English). Competencies for analysis and synthesis and optimization systems thinking. Flexibility in thinking and ability to work with interdisciplinary concepts and tools.

7 Discipline objectives (based on the grid of specific competences acquired)

7.1	General objective	Developing master level professional competences, from the point of view of understanding the theoretical fundamentals and of their integration in practical interdisciplinary applications, regarding the topics: basic concepts of multimedia information compression, a variety of lossless and lossy compression techniques/ algorithms, and some international standards for still images and video sequences compression.
7.2	Specific objectives	1. Recognizing and understanding basic concepts specific to the acquisition, coding/compression and analysis of multimedia information/ digital images and video sequences 2. Understanding the similarities and differences between the representation, processing and coding of digital images (2-D signals) and 1-D signals 3. Developing skills and abilities to generalize the theoretical concepts for multimedia information coding/compression and to apply them for the particular case of digital images and videos 4. Developing skills and abilities to combine basic image processing, analysis and coding algorithms for complex practical applications specific to multimedia communications systems

8. Contents

8.1. Course (titles)		Teaching methods	Obser-vations
1	Introduction in data compression. Motivation for data/ image/ video compression. Digital representation of multimedia information.	Presentation; explanation; demonstration; debates; conversation; learning through discovery	Video-projector; interactive teaching style: alternation of multimedia teaching tools with the classical teaching tools (whiteboard); use of applets during teaching, to illustrate the operation of the methods/algorithms discussed
2	Fundamentals in information, entropy and redundancy theory. Performance measures. Image/video formats, containers and compression standards.		
3	Lossless and lossy coding techniques (Basic techniques, statistical methods, dictionary methods)		
4	Lossless compression. Binary image compression, JPEG-LS		
5	Block transform coding		
6	JPEG image compression standard		
7	Sub-band coding, wavelet		
8	JPEG 2000 image compression standard		
9	Motion estimation and compensation coding		
10	MPEG video compression standard		
11	H.26x video compression standard		
12	Compressed domain processing of digital images and videos		
13	Applications for H.26x standards. Windows Media Video (WMV) Standard.		
14	Stereo Image Compression		
8.2. Applications (laboratory work)		Teaching methods	Obser-vations
1	Digital data representations. Image formats. Performance measures. Project assignment.	Simulations, experiments	PC, simulator
2	Lossless and lossy predictive coding. PCM, DPCM, Delta modulation, JPEG-LS		
3	Transform coding, JPEG standard		
4	Sub-band coding, wavelet, JPEG 2000		
5	Motion estimation and compensation coding, MPEG standard		
6	Compressed domain image and video manipulation/processing. H.26x in real-time systems		
7	Final evaluation, make-up missed lab sessions		

References:

1. A. Vlaicu, „Prelucrarea numerică a imaginilor”, Editura Albastră, Cluj-Napoca, 1997
2. B. Orza, „Codarea şi compresia informaţiilor multimedia”, ISBN – 978-973-650-212-5, Editura Albastră, 2007
3. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (3rd Edition), Prentice Hall, 2008

(nr.inventar UTCN - 522.190)
4. David Salomon, „Data Compression The Complete Reference”, Springer-Verlag, ISBN - 978-1-84628-602-5, 2007 (nr. Inv. UTCN – 522.269)
5. Vasudev Bhaskaran, Konstantinos Konstantinides, „Image and Video Compression Standards Algorithms and Architectures”, Kluwer Academic Publishers, 1997, ISBN - 0-7923-9952-8
6. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindbergh, Richard L. Baker, „Digital Compression for Multimedia”, Morgan Kaufmann Publishers, 1998, ISBN- 1-55860-369-7
7. Iain E. G. Richardson, „Video Codec Design”, John Wiley and Sons, 2007, ISBN-978-0-471-48553-7 (nr.inv. UTCN-522.193)
8. I. Pitas, „Digital Image Processing Algorithms and Applications”, John Wiley & Sons, 2000, ISBN-0-471-37739-2, (nr.inv. UTCN-522.260)
9. David S. Taubman, Michael W. Marcellin, „JPEG2000 Image Compression Fundamentals, Standards and Practice”, Kluwer Academic Publishers 2002, ISBN-0-7923-7519-X

On-line teaching materials:

C. Florea – lecture slides, sample exercises http://ctmtc.utcluj.ro:8080/sites/pni/saccdav

9. Discipline content corroborated with the expectations of the epistemic community representatives, associations, professional and related program employers

Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer; Security Systems Engineer) or in the new occupations proposed to be included in COR (Multimedia Applications Developer; Project Manager; Image and Sound Processing Engineer; Communications Systems Consultant).

10. Assessment

Type of activity	10.1	Evaluation criteria	10.2	Evaluation method	10.3	The weight of the final grade
Course		One written test in the exam session: three theoretical questions (short essays) and three exercises (design of a sub-system, or verification of a sub-system on test data, manually, by numerical computations) (E=0…10)		Written verification		E = 60%
Applications		The level of acquired abilities based on reports provided at the end of each lab session. Each laboratory report is graded (L=0…10) Project developed during the semester in the laboratory (P = 0 ... 10)		Average of the graded individual laboratory reports (L=40%) Project defended at the end of semester (P=60%) A = L+P		A = 40%
10.4 Minimum performance standard						
The final grade (N) is calculated as average of marks obtained in the evaluation of ongoing activities and application type: N = 0.6*E + 0.4*A. The condition for obtaining the ECTS credits is that both components of the final grade to be higher than or equal to 5 (five).						

Date
01.10.2018

Titular
Associate Professor
Camelia FLOREA, Ph.D.

Responsible
Associate Professor
Camelia FLOREA, Ph.D.

Date of approval
01.10.2018

Head of Department
Professor
Virgil DOBROTA, Ph.D.