COURSE DATA

Data Subject	
Code	43848
Name	Multimedia systems and communications
Cycle	Master's degree
ECTS Credits	5.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2174 - M.U. en Ingeniería de Telecomunicación 13-V.2	School of Engineering	1	First term

Subject-matter

Degree	Subject-matter	Character
2174 - M.U. en Ingeniería de Telecomunicación 13-V.2	2 - Multimedia systems and communications	Obligatory

Coordination

Name	Department
COBOS SERRANO, MAXIMO	240 - Computer Science

SUMMARY

Multimedia Systems and Communications (SCM) presents multimedia coding systems with emphasis on audio-visual coding. It provides an introduction to the psycho-physical fundamentals of modern audiovisual coding systems, as well as an algorithmic presentation of current standards for the coding of multimedia signals.

The objective is for the student to acquire sufficient knowledge and skills to work with current multimedia communications systems, both from the psychophysical point of view and from the point of view of the fundamentals of information theory and related algorithmic, including the understanding of current audio and video coding standards and the parameters that define them.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

No previous knowledge is required apart from the official Master access requirements.

OUTCOMES

2174 - M.U. en Ingeniería de Telecomunicación 13-V.2

- To have critical thinking capabilities to investigate independently and self-critically, and to search and utilize information for documenting ideas.
- To have the ability of standing up for fair criteria with rigor and arguments, reporting them publicly in a clear way and in a multilingual environment.
- To have the ability to participate in diffusion forums, journals, conferences, etc. and to work cooperatively and effectively in transnational teams.
- To have the capability to identify and solve the critical points to conduct an effective technology transfer, transforming theoretical results into products and services that are useful for the society.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Be able to access to information tools in other areas of knowledge and use them properly.
- To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.
- Ability to apply information theory methods, adaptive modulation and channel coding techniques, as well as advanced signal processing techniques to audiovisual and communication systems.
- Ability to design and planning transport, diffusion and distribution networks for multimedia signals.

LEARNING OUTCOMES

At the end of the course, the student should be able to:

- Apply audio and image coding methods with a deep understanding of their fundamentals as well as their relation to basic signal processing techniques.
- Relate the characteristics of human and visual perception to the development of current multimedia compression techniques and standards.

To complement the above results, this subject also allows to acquire the following skills and social attitudes:

- Promotion of teamwork: collaboration, leadership, planning, interacting, consensus, negotiation, conflict resolution and respect the views of others.
- Promotion of individual working capabilities, organizing the own work efficiently into tasks and subtasks.
- Ability to present a teamwork research project orally in English.
- Making effective presentations.

DESCRIPTION OF CONTENTS

1. Introduction to multimedia communications.

Definition of multimedia. Importance of multimedia communications today. Applications. Quality of service and current challenges. Communication model. Source coding and channel coding.

2. Fundamentals of sound perception.

Importance of perception in the design of multimedia systems. Sound waves and sound pressure level. Auditory system. Hearing range. Loudness. Hearing threshold. Masking. Masking curves and Signal to Masking Ratio. Critical bands. MP3 encoding.

3. Fundamentals of visual perception.

Light and luminance. The human visual system. Photopic and scotopic vision. Color systems. Perceptual properties. Weber's Law. Contrast sensitivity function. Local contrast adaptation. Temporal effects.

4. Fundamentals and basic tools: information sources.

Spatial, spectral and temporal redundancy. Lossless and lossy coding. Modeling and coding. Information sources. Discrete memory-less source. Information and entropy. Source coding theorem. Huffman codes. Entropy coding. Dictionary-based techniques: LZ77, LZ78 and LZW.

5. Fundamentals and basic tools: distortion and quantification.

Rate-distortion theory. Distortion measures. Scalar quantization. Optimum scalar quantization. Vector quantization.

6. Fundamentals and basic tools: transforms and coding.

Discrete Fourier Transform (DFT) vs Discrete Cosine Transform (DCT) 1D and 2D. Processing and quantization of coefficients. DPCM coding. Discrete Wavelet Transform. Bit allocation. Multi-resolution Wavelet systems. EZW encoder.

7. Image standards

JPEG. Encoding modes. Baseline model. Compression steps. Progressive and hierarchical modes. Chroma sub-sampling. Quantification and coding of coefficients. JPEG 2000 vs JPEG.

8. Video standards

Motion estimation. Intra-frame vs inter-frame coding. Video formats. Evolution of video coding standards. MPEG-1, MPEG-2, MPEG-4. H.264. H.265 (HEVC).

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	23,00	100
Classroom practices	10,00	100
Laboratory practices	9,00	100
Tutorials	8,00	100
Development of individual work	10,00	0
Study and independent work	10,00	0
Preparation of evaluation activities	11,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	19,00	0
Resolution of case studies	10,00	0
TOTAL	**125,00**	

TEACHING METHODOLOGY

The training activities are conducted in accordance with the following distribution:

a) Theoretical activities.

AF1: Theory classes will provide a global and linked perspective on the different topics covered within the course, analyzing in detail those issues having higher complexity. Student participation will be consistently promoted.

b) Practical activities.

They complement the theoretical activities in order to apply the basic concepts and extend them with the acquired knowledge and experience. They include the following types of classroom activities.

AF2: Problems classes in the classroom

AF3: Labs

c) Personal work of the student.

AF4: Involves the solution of problems and questions outside the classroom, as well as the preparation of classes and exams (study). This task and tries to promote individual work.

d) Evaluation.

AF5: The evaluation includes, on the one hand, the performance of individual questionnaires in the classroom with the teacher, and, on the other hand, the assessment of other complementary activities such as the solving of practical cases. Labs are also evaluated.

e) Scheduled Tutoring (individual or group).

AF6: They are aimed at guiding students and solving any arising questions. The student should raise possible questions, thus allowing reviewing the work process.

E-learning platforms (Aula Virtual) will be used to support communication with students. Classroom materials, problems and exercises will be made available through this platform.

EVALUATION

The assessment takes into account the following items and ratings:

SE1 - Final exam (50% of the final grade)

SE2 - Write a paper on a related topic presenting it orally (10% de la nota final)

SE3 - Attending lab sessions and practical work (15% of the final grade)

SE4 - Problems / exercises (25% of the final grade)

In any case, the minimum score to get on the final exam must be equal or higher than 3.5 of a total of 10.

If a student is not able to attend the classes on a regular basis (being not eligible for this evaluation model), he/she should inform the teacher at the beginning of the course.

In any case, the system of evaluation will be ruled by the established in the Regulation of Evaluation and Qualification of the University of Valencia for Degrees and Masters:

http://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf

REFERENCES

Basic

- Introduction to digital audio coding and standards, M. Bossi, R.E. Goldberg, Kluwer academic publishers, 2003.
- Multidimensional signal, image, and video processing and coding, John W. Woods, Academic Press, 2006
- Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms and Standards, Third Edition. Yun-Qing Shi, Huifang Sun, CRC-Press, 2019

Additional

- Multimedia over IP and wireless networks [Recurs electronic, ús limitat a la U.V.]: compression, networking, and systems, edited by Philip A. Chou, Mihaela van der Schaar, Elsevier 2007.
- Lossless compression handbook, edited by Khalid Sayood, Academic Press, 2003
- Introduction to data compression, Khalid Sayood, Elsevier 2006
- Multimedia wireless networks [Recurs electronic, ús limitat a la U.V.]: technologies, standards, and QoS, Aura Ganz, Zvi Ganz, Kitti Wongthavarawat, Prentice Hall, 2004.
- The multimedia Internet (Information technology: Transmission, Processing and Storage), Stephen Weinstein, Springer, 2005.