# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 34809 |
| **Name** | Multimedia Electronic Systems |
| **Cycle** | Grade |
| **ECTS Credits** | 6.0 |
| **Academic year** | 2020 - 2021 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1402 - Degree in Telecommunications Electronic Engineering | School of Engineering | 3 | Second term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 1402 - Degree in Telecommunications Electronic Engineering | 14 - Applications of electronic systems | Obligatory |

**Coordination**

| Name | Department |
|---|---|
| FRANCES VILLORA, JOSE VICENTE | 242 - Electronic Engineering |

# SUMMARY

'Multimedia Electronic Systems' is part of the subject 'Applications of Electronic Systems'. It is a quarterly and obligatory matter, taught in the 2nd quarter of the third year of the Degree in Electronic Engineering in Telecommunications. It comprises a total of 6 ECTS.

This course is intended for students to delve into the domain of devices that enables multimedia. To do this, and taking as a starting point to study the characteristics of visual and auditory perceptual systems humans, establish the characteristics, components, techniques and peculiarities of the systems acquisition and reproduction of audio data, image and digital video, emphasizing noise considerations and signal quality. Also describe techniques and digital processing algorithms commonly used in the scope of audio and image.

The subject has a mixed theoretical and practical, so that over the theoretical contents are added a practical level. As problems resolution as the realization of practical laboratory work, exercise the concepts and techniques studied familiarizing the student with the scope.

This course complements the course Digital Signal Processing, studied in the first quarter of the third year of the degree of grade, providing a real vision systems that perform digital processing within the scope of multimedia.

## 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, but is recommended that students have taken the course of Digital Signal Processing, which is taught in the first semester of the third year of the degree.

## OUTCOMES

### 1402 - Degree in Telecommunications Electronic Engineering

- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G7 - Ability to analyze and assess the social and environmental impact of technical solutions.
- TE1 - Ability to construct, operate and manage systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the perspective of electronic systems.
- TE2 - Ability to select specialized electronic circuits and devices for transmitting, routing and the terminals, both in fixed and mobile environments.
- TE4 - Ability to apply electronics as support technology in other fields and activities, not only in the field of Information Technology and Communications.
- TE7 - Ability to design interface, data acquisition and storage devices, and terminals for telecommunication services and systems.

## LEARNING OUTCOMES

Students will possess the ability to analyze, dessign, specify and select interface, acquisition, playback and recording systems of quality audio and image, using as conventional as oversampling converters (TE1, TE7). Also, students will know and will be able to apply basic techniques of compression and digital processing in the scope of audio and image (TE1).

Students will be able to construct, operate and manage systems of acquisition, transportation, representation, processing, storage, management and presentation of multimedia information from the point of view of electronic systems (TE1). Be able to apply electronically and supporting technology in other fields and activities, not only in the field of Information Technology and Communications (TE4).

## DESCRIPTION OF CONTENTS

### 1. Basical multimedia foundations.

Historical evolution. Media classification. Digital media integration. Multimedia system definition.

Global estructure. Devices domain.

### 2. Devices domain

Processing conversion estructure. Sampling and aliasing. Sampling Theorem. Quantization. Frequency sampling selection.

### 3. Hearing perception.

Physics of sound. Psychoacustics. The human hearing. Intensity perception. Rang of frequencies. Atributes of sound. Sensibility to the phase. Location. Psicoacustical keys of spatial location of sounds.

### 4. Recording process.

Coding systems. Dither generation. Antialiasing filtering. Sample and hold circuits. Jitter. A/D conversion. Channel coding.

### 5. Reprodution process.

Signal reproduction. D/A conversion. Distorsion by lineaty errors.

### 6. Oversampling.

Oversampling. Delta modulation. Sigma-Delta modulation.

### 7. Digital Audio Effects.

Digital delay. Echo and digital reverberation. Enhancements. Chorus. Ping-pong. Equalization. Aurealization.

### 8. Image perception.

Human eye. Response to the ilumination and discrimination. Color perception. Coordinate color systems.

### 9. Image acquisition foundations.

Bidimensional sampling. Spatial and temporal aliasing. Estructure and characteristics of an image digitizer. Light sensor. Modulator transference function: MTF

### 10. Acquisition devices.

Video signal digitizing. Solid state cameras: fotodiodes array, charge coupling devices (CCD) and charge injection devices (CID). Bayer masks. Other sensors.

### 11. Digital image processing.

Basical concepts. Enhancements techniques. Digital filters. Edge detection. The bidimensional transfer function. Pseudocolor.

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 30,00 | 100 |
| Laboratory practices | 20,00 | 100 |
| Classroom practices | 10,00 | 100 |
| Study and independent work | 20,00 | 0 |
| Preparation of evaluation activities | 10,00 | 0 |
| Preparing lectures | 50,00 | 0 |
| Preparation of practical classes and problem | 10,00 | 0 |
| **TOTAL** | **150,00** | |

## TEACHING METHODOLOGY

This course is structured around theory and problems classes, labs and office hours.

The **lectures** (outcomes TE1, TE7, G3, G4 y G9) will use in general a model of cooperative learning, although some sessions the subjects do not lend themselves to be taught in lecture form:

- *Cooperative Learning*. In the theoretical sessions, the class will be structured in small groups, in which students work to build and improve learning for themselves and others.

This methodology requires the student to read comprehensively the theoretical content of the session prior to the session. For this, the teacher will communicate well in advance the theoretical contents of the next session and will specify in detail the study material (fonts, pages, paragraphs or sub-items). In addition, the teacher will hang in the Virtual Classroom any resources (videos, screencasts, presentations, ...) that may consider can help students in the preparation of the theory session. The student will also have a list of issues on which theoretical work during the session.

The list of issues will be divided into three parts. Each group member will be designated as "expert" of a group and will participate in expert meetings and group activities following the cooperative "puzzle" methodology (Aronson).

Thus, it generates a positive interdependence between each "expert" and the other members of his group, which implies a degree of personal responsibility, and that each group member is responsible for its part, teaching what they know their colleagues (problem solving, nature of the concepts, connections between past and present learnings, ...), and being responsible of the correct learning of his part.

During the theoretical sessions, the teacher will be available to orient and answer any questions.

Finally, the evaluation of cooperative work of the session will be done by the realization of an individual examination by a member of each group being assigned the note to all members of the group.

- *Theoretical classes*. At the topics that do not lend to use the cooperative work, will be use the model of theoretical classes. The teacher will teach the class by presenting and explaining the contents of each issue, focusing on key aspects for understanding it, and may use other kinds of media (presentations, transparencies, blackboard, ... ).

In the **class of problems** (outcomes TE1, TE4, TE7, G4 and G9), we will use the cooperative learning model, similar to that presented for the theoretical classes. However, these will emphasize on problem solving.

For **laboratory practice sessions** (outcomes TE4 and TE7), students will have scripts to conducte the session, under the supervision of the teacher. At the beginning of each practice will be done an introduction and explanation of the most complex issues. Its estimated time is 3 hours, and practice groups will consist of two persons.

In addition, students will have a schedule of **office hours** aimed at solving the problems and questions, etc.. The schedule of these office hours will be indicated at the beginning of the academic year and will be as broad as possible so that students can attend. However, they also have the opportunity to clarify some questions via email.

## EVALUATION

The evaluation of student learning will take place following one of two models:

A) Assessing the results of continuous evaluation tests at theoretical and problems sessions (ACONT), plus the note of the labs (LAB).

B) From a single examination to be held on the official date (EXT), and the results obtained in the laboratory practice sessions (LAB).

To qualify for category A) assessment, the student must have attended classes regularly, and must have participated actively in the dynamics of cooperative work. Thus, if the rating exceeds of 6 in theory and problems, and exceeds of 5 in lab, there will be the weighted average of both to obtain the final grade (ACONT and LAB).

Laboratory practices contribute to the final qualification with a weight of 25%. For the assessment of learning in the labs will be considered both the ability shown in the laboratory and the evaluation of reports made. Theory weights 75% of the total qualification.

Final qualification = 0.25 * Lab qualification (LAB) + 0.75 * Theory and problems qualification (ACONT)

The B) modality corresponds to the official examinations. These examinations will consist of a theoretical part as a test, in which the student must demonstrate knowledge of concepts and relationships seen in class, and/or another part of issues and problems. Each part may have assigned a different percentage in the exam.

The labs also contribute in the B modality. Their contribution to the final grade is 25%, and only will be averaged if both parts exceed the rating of 5. Lab qualification will be a non recoverable assessment, so this qualification will be mantained to calculate the total grade of any of both official examinations.

Final qualification = 0.25 * Lab qualification (LAB) + 0.75 * Theory and problems qualification (EXT)

Students who choose and don't pass option A), will be submitted to the first or second official examination, B).

ACONT evaluates the outcomes TE1, TE4, TE7, G3, G4 i G9. EXT evaluates the outcomes TE1, TE7 y G3. LAB evaluates the outcomes TE1, TE4, G4.

In any case, the evaluation system will be subordinate to the Evaluation and Qualification Regulation of the University of Valencia for Masters and Degrees (https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639).

# REFERENCES

## Basic

- Referencia b1: Watkinson, John. Audio Digital. Paraninfo. 1996
Referencia b2: Pohlmann, Ken C. Principles of Digital Audio, Cuarta Edición. McGraw-Hill. 2000
Referencia b3: Smith S.W. Scientist & Engineers Guide to Digital Signal Processing. California Technical Publishing, 1997. http://www.dspguide.com/

Referencia b4: Castlemann, Kenneth R. Digital Image Processing. Prentice-Hall. 1996
Referencia b5: Watkinson, John. Vídeo Digital. Paraninfo. 1996
Referencia b6: Luther, A. "Principles of digital audio and video". Springer. 1998.
Referencia b7: Cuello, F.F.; Rueda, J.C. Compresión de vídeo digital.

## Additional

- Referencia c1: González, Javier. Visión por computador. Paraninfo. 2000
Referencia c2: Jain, Anil J. Fundamentals of digital image processing. Prentice-Hall. 1989
Referencia c3: Burrus, C.S.; et al. Ejercicios de tratamiento de la señal utilizando Matlab Prentice-Hall. 1998
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Referencia c5: Symes, Peter. Video Compression Demystified. McGraw-Hill. 2000
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Referencia c8: Orfanidis, S.J. Introduction to Signal Processing. Prentice-Hall. 1996
Referencia c9: Rabiner, L.R.; Schafer, R.W. Digital Processing of Speech Signals. Prentice-Hall. 1978
Referencia c10: Goldstein, E.B. "Sensación y Percepción" (6ª edición). Thomson. 2002.
Referencia c11: Marven, C.; Ewers, G. "A simple approach to digital signal processing". Texas Instruments. 1994.
Referencia c12: White, R. "Cómo funcionan las cámaras digitales". Anaya Multimedia. 2006.
Referencia c13: Bosi, M.; Goldberg, R.E. "Introduction to digital audio coding and standards". Kluwer Academic Pub. Group. 2002.
Referencia c14: Coulter, D. "Digital Audio Processing". CMP Books. 2000.
Referencia c15: Zoelzer, Udo. "Digital audio signal processing". Wiley. 2008.
Referencia c16: Faller, C. "Spatial audio processing:MPEG surroun

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

**Contents**

The contents initially included in the teaching guide are maintained.

**Workload and temporary teaching planning**

The different activities described in the teaching guide are maintained with the planned dedication.

The material for the follow-up of the classes of theory/practices allows to continue with the professor of temporary planning so much in days as in schedule, so much if the teaching is face-to-face in the classroom or if it is not.

**Teaching methodology**

In classroom theory and practices, students will tend to have the maximum physical attendance possible, always respecting the sanitary restrictions that limit the capacity of the classrooms as indicated by the competent public health authorities to the estimated percentage of their usual occupation.

Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend classroom theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces.

The rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.

In any case, the collaborative work described in the initial Teaching Guide is dispensed with. The group activities that are proposed will imply interindividual interaction through telematic means.

With respect to laboratory practices, attendance at sessions scheduled in the schedule will be totally face-to-face.

Once the actual enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing in said model the specific conditions in which it will be developed teaching the subject.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.

**Evaluation**

Given the impossibility of carrying out collaborative group work in the classroom, the continuous evaluation system described in the Teaching Guide is canceled. Thus, for the evaluation only modality B described in the Teaching Guide of the subject will be followed, without prejudice to the possibility of conducting partial exams or other assessable activities that would be eliminatory of matter for the final exam of the subject.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the Universitat de Val ncia.

The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.

**Bibliography**

The bibliography recommended in the teaching guide.