# uc3m | Universidad Carlos III de Madrid

| Multimedia information processing |
|---|

**Academic Year: ( 2023 / 2024 )**                    **Review date: 25/04/2023 18:13:51**

**Department assigned to the subject: Signal and Communications Theory Department**

**Coordinating teacher: DIAZ DE MARIA, FERNANDO**

**Type: Electives  ECTS Credits : 6.0**

**Year : 4 Semester :**

## OBJECTIVES

Mathematical basis of signal processing
General knowledge on potential speech, audio, image, and video processing applications
Basic subsystems of speech, audio, image, and video processing applications
Use of speech, audio, image, and video processing software
Mastering of basic speech, audio, image, and video processing tools
Solving speech, audio, image, and video processing problems by using several basic tools
Individual- and team-work
Analysis and problem-solving capabilities

## DESCRIPTION OF CONTENTS: PROGRAMME

The goal of this subject is to provide the student with an introduction to speech, audio, image, and video processing. The emphasis is put on lab exercises, so that the student can be assessed according to her work on a final project. The course will finish with an introduction to Convolutional Neural Networks (CNNs), which represent the state-of-the are in many applications.

1.- Introduction

2.- Fundamentals of Multimedia Digitalization
-           Digital representation of signal and images
-           Digital compression fundamentals

3.- Introduction to speech and audio technologies
-           Speech and audio. Production and perception
-           An outlook of Speech and Audio Applications

4.- Basic Speech and Audio Processing Techniques
-           Short-term time and frequency analysis

5.- Speech coding
-           Fundamentals and specifications
-           Coding strategies
-           Standards (for digital mobile telephony and voice over IP)

6. Audio Coding
-           Psychoacoustic principles and perceptual coding
-           Transform-domain coding
-           Standards (MP3 and beyond)

7.- Shazam (audio): identificación de contenidos musicales

8. Introduction to image and video processing
-           Digital images

-           Color spaces
-           Pseudocolor and PCA

9. Basic image and video processing techniques
-           Point operations
-           Filters
-           Transforms

10. Edge Detection

11. Image Segmentation

12. Mathematical Morphology

13. Detectors and Descriptors

14. Introduction to CNNs and its applications in Computer Vision

## LEARNING ACTIVITIES AND METHODOLOGY

Two teaching activities are proposed: theoretical classes with examples and lab exercises.

THEORETICAL CLASSES WITH EXAMPLES  (3 ECTS)

The theoretical class will be given in the blackboard, with slides or by any other means to illustrate the concepts of the lectures. In these classes the explanation will be completed with examples.

In these sessions the student will acquire the basic concepts of the course. It is important to highlight that these classes require the initiative and the personal and group involvement of the students (there will be concepts that the students should develop by themselves).

LABORATORY EXERCISES (3 ECTS)

Some basic selected concepts learnt during the course are applied in the lab. The students should participate actively in the exercise implementation.

There will be two types of lab exercises:
-           Guided lab exercises: getting used to image processing with MATLAB
-           Project: image processing problem to be solved in groups.

## ASSESSMENT SYSTEM

| | |
|---|---|
| **% end-of-term-examination/test:** | 0 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 100 |

The final project will account for the 100% of the final grade.

## BASIC BIBLIOGRAPHY

- Ken C. Pohlmann Principles of Digital Audio, McGraw-Hill/TAB Electronics, 5ª ed, 2005

- N. Morgan and B. Gold Speech and Audio Signal Processing: Processing and Perception of Speech and Music, John Wiley & Sons, Inc. New York, NY, USA, 1999

- Rafael C. Gonzalez and Richard E. Woods Digital Image Processing (Forth Edition), Pearson, 2018

- Wilhelm Burger and Mark J. Burge Principles of Digital Image Processing: Fundamental Techniques, Springer-Verlag, 2009

- Wilhelm Burger and Mark J. Burge Principles of Digital Image Processing: Core Techniques, Springer-Verlag, 2009

- Wilhelm Burger and Mark J. Burge Principles of Digital Image Processing: Fundamental Techniques, Springer-Verlag, 2009

ADDITIONAL BIBLIOGRAPHY

- Gonzalez and Woods Digital Image Processing  3rd Ed., Prentice Hall, 2008