

## Course guides

### 804249 - ADIG - Digital Audio

Last modified: 07/04/2021

<b>Unit in charge:</b>	Image Processing and Multimedia Technology Centre	
<b>Teaching unit:</b>	804 - CITM - Image Processing and Multimedia Technology Centre.	
<b>Degree:</b>	BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).	
<b>Academic year:</b> 2021	<b>ECTS Credits:</b> 6.0	<b>Languages:</b> Catalan

#### LECTURER

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<b>Coordinating lecturer:</b>	Tarres Ruiz, Francisco
<b>Others:</b>	Font Moragas, David Quijada Ferrero, Raúl

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### Specific:

CEVJ 6. Analyse, decide upon and apply graphic programming techniques, physics, artificial intelligence, interaction, augmented reality and networks to a video game project.

CEVJ 7. Master the wide range of professional tools in the sector for developing all kinds of digital content.

##### Generical:

CGFC1VJ. Design, develop, select and evaluate applications and computer systems from 0 for video games, ensuring their reliability, security and quality, in accordance with ethical principles and current legislation and regulations.

CGFB4VJ. Interpret the basics of the use and programming of computers, operating systems, databases and in general, computer programs with applications for engineering.

CGFC4VJ. Apply basic algorithmic procedures of information technology to designing solutions for problems, analysing the suitability and complexity of the proposed algorithms.

##### Transversal:

06 URI N3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

04 COE N3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

#### TEACHING METHODOLOGY

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The lectures can be of three types in three bands of activity:

1. Realization, exposure, advocacy and discussion of exercises during the previous session and resolution of doubts about them.
2. Activity exhibition by the teacher headed to introduce new knowledge (subjects).
3. Explanation of the next financial year and supplementary materials.

These activities are modulated according to the complexity of the exercises and relevant content.



## LEARNING OBJECTIVES OF THE SUBJECT

Learn the basics of physics of sound  
Understand the principles of representation of audio signals in digital systems  
Learn the basic tools for digital signal processing, filtering and generation effects  
Understand the tools of production and editing of audio signals and musical games  
Learn digital technologies and computer music  
Learn compression systems and types of digital audio files  
Understand audio engines  
Understand interactive music technology or dynamic  
Knowledge of speaker systems and multichannel sound systems  
Understand the technology of recording and editing audio signals

## STUDY LOAD

Type	Hours	Percentage
Hours large group	18,0	12.00
Guided activities	10,0	6.67
Self study	90,0	60.00
Hours medium group	32,0	21.33

**Total learning time:** 150 h

## CONTENTS

### Sound Physics Fundamentals

**Description:**

Basic principles of sound generation and musical signals. Time and frequency representation. representation

**Specific objectives:**

Production of sound. Type of waves. Characterization of the waves. Propagation of pressure waves. Representations of the waves in the time and frequency domain.

The concept of resonance. Examples resonance strings and wind instruments.

Interpretation of the audio signal in the time domain and frequency. Basic parameters of the digital audio signal: sampling rate and quantification. The PCM signal. The concept of dynamic range. Representation in frequency. Evolution of the spectrum over time: Short-Time Fourier Transform and spectrogram.

Applications: Fingerprinting of music signals - Shazam

Measurement of acoustic power. Concepts sound intensity, sound pressure level, basic units and decibels.

**Related activities:**

practice 1

**Full-or-part-time:** 19h

Theory classes: 4h

Self study : 15h



### Psychoacoustics of sound perception

**Description:**

Description and perception of human hearing perception

**Specific objectives:**

The concept of psychoacoustics. Parts of the hearing. Basilar membrane and low-level hearing. Perception of the direction of sounds. Perception of Pitch in and inharmonic overtones. Resolution and sensitivity pitch. Just noticeable Pitch Differences. Shepard illusion and perception intervals. MEL scale. Range Phones. Range Sons. Curves Fletcher-Mun. Masking frequency. Masking sequentially. Critical bands.

**Full-or-part-time:** 11h

Practical classes: 4h

Self study : 7h

### Representation and processing of digital audio signals

**Description:**

Principles of sampling and quantification of signals, filtering and effects

**Specific objectives:**

Digital representation of the audio signal in PCM. Digital filters. Concept and types of filters. Stability. Low pass filters, band pass and high passes. Concatenation filters. Equalizers.

Audio effects: Effects filtering, delay effects, modulation effects, distortion effects.

3D representation of sounds. MPEG Audio-H 3D. Audio 3D models representation. Auralització. Audio objects. Metadata. Vector Base Amplitude Panning. Higher Order Ambisonics.

**Related activities:**

Practice 2

**Full-or-part-time:** 15h

Practical classes: 3h

Guided activities: 2h

Self study : 10h

### Principles of information representation and data compression

**Description:**

We present the principles of information theory and key technologies for data compression standards and formats used in digital audio

**Specific objectives:**

Introduction to information theory, Shannon. Measuring the Information. Entropia. Variable length codes: Shannon-Fano, Huffman. Golomb-Rice. Arithmetic codes. Application coding lossless audio: FLAC

Standard audio coding loss. MPEG-1 Layer I, II and III, MPEG-2 and MPEG-4 AAC.

The most significant container formats

**Related activities:**

Practice 3

**Full-or-part-time:** 16h

Practical classes: 2h

Guided activities: 2h

Self study : 12h



### Game Design Document i Audio Petitions

**Description:**

Game Design Document i Audio Petitions

**Specific objectives:**

Game Design Document i Audio Petitions

**Related activities:**

Practice 4

**Full-or-part-time:** 10h

Practical classes: 2h

Guided activities: 2h

Self study : 6h

### Audio Systems Evolution

**Description:**

Introduction to digital audio and review of the whole history of digital audio applied to video games

**Specific objectives:**

Familiarization with the different hardware and software techniques that have been featured in history to situate themselves with the current state of technology.

**Full-or-part-time:** 8h

Practical classes: 2h

Guided activities: 2h

Self study : 4h

### Practical aspects on digital audio

**Description:**

practical digitalization, coding and audio formats

**Specific objectives:**

Discussion of practical aspects on the sampling and coding formats

**Related activities:**

Practice 6

**Full-or-part-time:** 10h

Theory classes: 3h

Guided activities: 3h

Self study : 4h



### Game Audio Design

**Description:**

Description of the structure and characteristics of the documentation necessary for the audio part of the Game Design Document and the communication with external audio equipment.

**Specific objectives:**

Familiarization with the different hardware and software techniques that have been featured in history to situate themselves with the current state of technology.

**Related activities:**

practice 1

**Full-or-part-time:** 10h

Guided activities: 4h

Self study : 6h

### Network resources

**Description:**

Concepts on the different types of licenses for the use of material, free or copyrighted  
On-line resources to find audio and music samples to use in our projects  
Creative Commons

**Specific objectives:**

Know where to get audio content for projects and the conditions of different types of licenses

**Full-or-part-time:** 6h

Guided activities: 2h

Self study : 4h

### Waveform Edition

**Description:**

Theory and practices with Audacity of all theoretical concepts

**Specific objectives:**

Familiarization with Audacity as a wave editor example  
Editing in freeware temporal domain  
Basic edition (copy, cut, paste)  
Channel operations (separate and link channels, mute, phase inversion)  
Tone, rhythm and speed playback operations  
Dynamic operations (compression, expansion, limitation, ducking)  
Generation of basic signals  
Fairies and envelopes  
Reverberations and echoes  
Equalization, step filters, noise-gates, reduction of noise in 2 steps  
Frequency analysis through FFT

**Related activities:**

Practice 2

**Full-or-part-time:** 13h

Guided activities: 3h

Self study : 10h



## Recording

### Description:

Description of the basic material of a recording studio: Anaecoica camera, types of cables, microphones, mixers, audio adapters.

### Specific objectives:

Learn the basic notions of recording in study and experiment creating and recording realistic and acoustic sounds.

### Related activities:

Practice 3

### Full-or-part-time: 16h

Practical classes: 5h

Guided activities: 5h

Self study : 6h

## Audio Motors

### Description:

Theory on Advanced Audio Motors and Audio Design Practices with Wwise

### Specific objectives:

General concepts shared by all advanced audio engines

Specific exercises with Wwise, level equivalent to the Wwise 101 certification:

Integration of a sound with Wwise

Design sound panorama

Game syncs

2D and 3D spatialization

Flow of the audio signal to the motor

Mix

Optimization

### Related activities:

Practica 4

### Full-or-part-time: 16h

Practical classes: 5h

Guided activities: 5h

Self study : 6h

## ACTIVITIES

### Practice 1

### Description:

Representation of waveforms. Identifying the frequency. Analysis of spectrograms

### Full-or-part-time: 1h

Laboratory classes: 1h



### Practice 2

**Description:**

Efectes i Filtratge amb Audacity

**Full-or-part-time:** 1h

Laboratory classes: 1h

### Pràctice 3

**Description:**

Compression and formats comparison

**Full-or-part-time:** 1h

Laboratory classes: 1h

### Practice 4

**Description:**

Audacity, Nyquist

**Full-or-part-time:** 1h

Laboratory classes: 1h

### Practice 5

**Description:**

Elaboració del GDD tècnic d'àudio

**Full-or-part-time:** 1h

Laboratory classes: 1h

### Practice 6a and 6b

**Description:**

Aplicació en Unity del motors i sistemes interactius

**Full-or-part-time:** 2h

Laboratory classes: 2h

### Practice 7

**Full-or-part-time:** 1h

Laboratory classes: 1h

### Practice 8

**Full-or-part-time:** 1h

Laboratory classes: 1h

## GRADING SYSTEM

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Practical Exercises (20%). Practice exercises, problems and testing software.

Exams. There will be two partial exams and final. Every partial exams have a weight of 20% and the final exam has a weight of 30%.

Participation and attitude is (10%)

The evaluation of student participation / training activities in the field, and attitudes are evaluated by monitoring their interventions in class, questions, resolution of the issues raised in the autonomous exercises studies, etc. This assessment corresponds to 10% of the final grade.

Reassessment. Students who have not passed the subject by continuous assessment have the option to be submitted to the reassessment. This will be an exam of 2 hours and the qualification will substitute those of the partial exams and the final exam. To be eligible you need to have presented the process of continuous assessment.

## EXAMINATION RULES.

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Practices:

Practical exercises are started during class hours in the Gaza aimed at this and are completed outside class hours scheduled by following the instructions given in the corresponding document Full Practice and indications that such have taken effect in the corresponding class.

The resolution of practical exercises will be delivered using the Athena campus Space delivery enabled for each practice, following the instructions described in the document Leaf corresponding practice in the periods indicated. At the end of practice can deliver files required. The proper management of documentation provided is an aspect related skills acquired and is therefore subject to assessment.

The evaluation of the practice does not involve only the resolution of the exercises, but the defense is made of the results when the / the student will be required for this to the start of classes.

Any incident that it would end the practice within the period specified will be notified by mail by the corresponding professor Campus; after this communication will resolve any relevance or not because it will motivate the presentation of the year and established alternatives to complete the assessment if the reasons are justified. Also consider justified the reasons for not presenting exercises that teachers be communicated by the Head of Studies.

Exams:

The examinations will be conducted in the laboratory with computers through electronic document that the student must complete.

The questions and problems posed in examinations refer to both the theoretical content of the course and the exercises solved in different practices. Besides each question or problem consists in the contribution to the total grade points of the exam.

Reviews and / or complaints regarding examinations will be conducted solely on the dates and times established in the Academic Calendar.

## BIBLIOGRAPHY

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**Basic:**

- Pohlmann, Ken C. Principles of digital audio. 6th ed. New York: McGraw-Hill, cop. 2011. ISBN 9780071663465.
- Gold, Bernard [et al.]. Speech and audio signal processing: processing and perception of speech and music. 2a ed. New York [etc.]: John Wiley & Sons, cop. 2011. ISBN 978-0470195369.
- Blackstock, David T. Fundamentals of physical acoustics. New York [etc.]: John Wiley & Sons, cop. 2000. ISBN 9780471319795.