Course guide
804249 - ADIG - Digital Audio

Last modified: 12/09/2025

Unit in charge:	Image Processing and Multimedia Technology Centre
Teaching unit:	804 - CITM - Image Processing and Multimedia Technology Centre.

Degree: BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).

Academic year: 2025   **ECTS Credits:** 6.0   **Languages:** Spanish, English

LECTURER

Coordinating lecturer:	Sarabia, David
Others:	Sarabia, David
	Martínez, David
	Palet, Marc
	Buxeda, Martí

TEACHING METHODOLOGY

Class sessions can be of two types:

1. Exhibition teaching
The teacher presents the students with information in an organized way. This methodology allows students to develop relationship, classification and analysis skills.

2. Active exhibition teaching
Students work in small groups on learning activities. This type of learning allows the student to develop analysis, synthesis and evaluation skills as well as encourages collaboration and teamwork.

These activities are modulated according to the complexity of the exercises and the corresponding contents.

LEARNING OBJECTIVES OF THE SUBJECT

- Program interactive 3D elements within a video game scene.

- Create objects, characters, textures, scenes, effects and 2D and 3D animations for inclusion in video game projects.

- Identify the principles of representation of audio signals in digital systems.

- Apply the production and editing tools of audio and musical signals for video games.

STUDY LOAD

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

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: 24h
Theory classes: 9h
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 inharmonious 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: 16h
Theory classes: 6h
Self study : 10h

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: 21h
Theory classes: 6h
Guided activities: 5h
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: 20h
Theory classes: 5h
Guided activities: 5h
Self study : 10h

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: 11h
Guided activities: 5h
Self study : 6h

Network resoruces

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: 4h
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: 5h
Guided activities: 3h
Self study : 2h

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: 8h
Self study : 8h

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
Guided activities: 4h
Self study : 12h

Middleware

Description:
Audio middleware theory applied with Wwise.

Specific objectives:
General concepts of audio middleware. Integration of a sound with Wwise. Wwise tools to enrich the sound. Integration with game state. 2D and 3D spatialization in Wwise. Mixing and optimization.

Related activities:
Practice 4

Full-or-part-time: 25h
Guided activities: 10h
Self study : 15h

ACTIVITIES

Practice 1

Description:
Audacity Edition Exercises:
- Delete audio selective components
- Create a stereo file by separating over mono file
- Testing Audio ritmo options
- Create an audio according to technical description and the art concept by using pre-recorded samples.
- Clean up and cut dialogue tracks using phase cancellation and 2-phase noise reduction
- Create smooth loops from real recordings
- Creation of preview montages in various contexts
- Use of auto-ducking, envelopes, equalization, reverb, amplification and other effects

Full-or-part-time: 2h
Practical classes: 2h

Practice 2

Description:
Generation of audio documentation for a production with hybrid or external audio equipment
- Project overview with visual references
- Description of the required assets (sound effects, music, dubbing) with visual and audio references and technical characteristics
- Production planning defining priorities and deliveries
- Description of the sound characteristics of the target platforms and the audio integration tools to be used during the project

Full-or-part-time: 2h
Practical classes: 2h

Pràctice 3

Description:
Sound of a 3D scene with a generic video game engine (Unity or Unreal)
- Search and edition of assets
- Import of assets in the engine
- Introduction of 3D and 2D static emitters with looping sounds
- Configuration of sounds synchronized with animations
- Combined use of triggers and mixers or audio volumes for indoor/outdoor effects
- Use of mixers for vertical interactive music changes
- Asset load configuration to optimize memory usage

Full-or-part-time: 2h
Practical classes: 2h

Practice 4

Description:
Video Game sound using a middleware (Wwise)
- Assets searching and edition.
- Assets Import
- Sound Effects basic setting up.
- Hierarchy optimization to improve project structure and efficiency
- Use of mixing and simulation tools from the editing tool
- Asset load configuration to optimize memory usage

Full-or-part-time: 2h
Practical classes: 2h

GRADING SYSTEM

- Practical Exercises (30%). Practice exercises, problems and testing software.

- Exams:
- 1st Exam (20%). Several questions of the theory section.
- 2nd Exam (10%). Individual evalution of the practical section.
- Final Exam (20%). Several questions of the theory and practical section.

- Working Groups (10%). Solving issues by working groups.

- 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.

Irregular actions that may lead to a significant variation of the grade of one or more students constitute a fraudulent performance of an evaluation act. This action entails the descriptive grade of failure and a numerical grade of 0 for the ordinary global evaluation of the course, without the right to re-evaluation.

If the lecturers have indications of the use of AI tools not allowed in the evaluation tests, they may summon the students concerned to an oral test or a meeting to verify the authorship.

EXAMINATION RULES.

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

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.

- Zölzer, Udo. DAFX: digital audio effects. 2nd ed. Chichester: Wiley, 2011. ISBN 9781119991298.

- Zölzer, Udo. Digital audio signal processing [on line]. 2a ed. Chichester, [etc.]: John Wiley & sons, 2008 [Consultation: 16/07/2024]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9780470680018. ISBN 9780470997857.

- Rossing, Thomas D. The Science of sound. 2nd ed. Reading, Mass.: Addison-Wesley Pub. Co, cop. 1990. ISBN 9780201157277.

- Ballou, Glen. Handbook for sound engineers [on line]. 5th edition. Burlington, MA: Focal Press, 2015 [Consultation: 14/07/2025]. Available on: https://doi-org.recursos.biblioteca.upc.edu/10.4324/9780203758281. ISBN 9780240804545.