Course guide
804041 - SA-M - Audio Systems

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

Degree: BACHELOR’S DEGREE IN MULTIMEDIA STUDIES (Syllabus 2009), (Compulsory subject).

Academic year: 2022  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: Melenchón Maldonado, Javier

Others:

REQUIREMENTS

Mathematics
Physic

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Assess the state of current audiovisual technologies.
2. Describe sound in terms of signal theory, and interpret the temporal and frequency representations of an audio signal.
3. Identify the psychophysiological foundations of sound perception and voice production.
4. Distinguish between analogue and digital signals, and the conversion process from analogue to digital.
5. Apply the digitization parameters of an audio signal based on the characteristics of the analogue signal and the requirements for the digital signal.
6. Identify the concept of filtering, the basic filters and the situations in which filtering audio signals is useful, and design and apply the most appropriate filter based on the signal’s characteristics.
7. Assess the need and constraints of audio coding, and the technical foundations of the most important families of encoders.
8. Use the most suitable encoder in each specific situation from among those available.
9. Correctly use a sound studio and the equipment within it in their basic settings.
10. Design an interactive voice system.
11. Identify the fundamental aspects of speech recognition and text-to-speech systems.

Transversal:
12. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.
13. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
14. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
15. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

TEACHING METHODOLOGY

Classes are divided, in general, into 3 types.
1. Realization, explanation and discussion of the exercises during the previous session and resolution of doubts about them.
2. Exhibition activity directed by the teacher to introduce new knowledge (topics).
3. Explanation of next year and the supplementary materials.

These activities are modulated according to the complexity of the exercises and the corresponding content.
LEARNING OBJECTIVES OF THE SUBJECT

1. Evaluate the state of current audiovisual technologies 2.
2. Describe sound in terms of signal theory and interpret the temporal and frequency representations of 1 audio signal.
3. Identify the psychophysiological underpinnings of sound perception and voice production.
4. To differentiate between analog and digital signals, the analog-to-digital conversion process.
5. To apply the parameters of digitization of 1 audio signal according to the characteristics of the analog signal and to the requirements for the digital signal.
6. Identify the concept of filtering, the basic filters and the situations in which it is convenient to filter audio signals, and design and apply the most appropriate filter according to the characteristics of the signal.
7. To evaluate the need and the conditioning factors of audio coding, as well as the technical fundamentals of the most important encoder families.
8. To use the most suitable encoder for each specific situation from among those available.
9. Correctly use 1 sound studio and the equipment that form it in a basic super configuration.
10. To design a voice interactive system.
11. Identify the fundamentals of speech recognition and text-to-speech conversion systems.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>60,0</td>
<td>40.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

(ENG) Tema 1. Introducción a los sistemas de audio

Description:
Introducción a la asignatura. Sistemas de comunicación audiovisuales
Elementos de un sistema de comunicación de audio.
· Captura
· Registro
· Condicionamiento
· Transmisión
Percepción del sonido
· Fisiología del oído
· Intensidad, frecuencia

Specific objectives:
(ENG)
1. Conocer el estado de las tecnologías audiovisuales actuales.
4. Comprender los fundamentos de la percepción visual, del sonido y de la producción de voz.

Related activities:
Actividad 01

Related competencies:
CEM 11.3. Identify the psychophysiological foundations of sound perception and voice production.
CEM 11.1. Assess the state of current audiovisual technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal.
Choosing the best path for broadening one’s knowledge.

Full-or-part-time: 12h 30m
Practical classes: 5h
Self study : 7h 30m
**Tema 2. Representación frecuencial de los sonidos**

**Description:**
(ENG)
La transformación de Fourier
- Concepto
- Representación gráfica: FFT
- Representación gráfica: espectrograma
Aplicaciones de la representación frecuencial de los sonidos

**Specific objectives:**
(ENG)
3. Interpretar la representación temporal y frecuencial de las señales.
10. Conocer los sistemas para la captura y la representación de audio.

**Related activities:**
Actividad 02 i 03

**Related competencies:**
CEM 11.2. Describe sound in terms of signal theory, and interpret the temporal and frequency representations of an audio signal.
CEM 11.5. Apply the digitization parameters of an audio signal based on the characteristics of the analogue signal and the requirements for the digital signal.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

**Full-or-part-time:** 25h
Practical classes: 10h
Self study: 15h
(ENG) Tema 3. Digitalització d’àudio

Description:

(ENG)
Anchos de banda y calidad
Conversión A/D: muestreado
· Teorema de Nyquist: conclusiones y aplicaciones
Conversión A/D: cuantificación
· Niveles de cuantificación y calidad
· Saturación
Taxa de bits
Deltación e interpolación
Conversión D/A
Formatos de audio sin comprimir

Specific objectives:

(ENG)
2. Comprender los conceptos y procedimientos asociados al tratamiento de la señal de audio.
5. Convertir señales analógicas en digitales.

Related activities:

Actividad 02

Related competencies:

CEM 11.2. Describe sound in terms of signal theory, and interpret the temporal and frequency representations of an audio signal.
CEM 11.4. Distinguish between analogue and digital signals, and the conversion process from analogue to digital.
CEM 11.5. Apply the digitization parameters of an audio signal based on the characteristics of the analogue signal and the requirements for the digital signal.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 25h
Practical classes: 10h
Self study: 15h
### (ENG) Tema 4. Filtrado

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>Concepto de filtrado</td>
</tr>
<tr>
<td>Filtros básicos:</td>
</tr>
<tr>
<td>· Pasabajas</td>
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<tr>
<td>· Pasaaltas</td>
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<tr>
<td>· Pasaancha</td>
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<tr>
<td>· Banda eliminada</td>
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<tr>
<td>Aplicaciones del filtrado en audio</td>
</tr>
</tbody>
</table>

#### Specific objectives:

(ENG)

6. Conocer los conceptos de filtrado, los filtros básicos y diseñar y aplicar correctamente los filtros más adecuados en la situación propuesta.

#### Related activities:

Actividades 03

#### Related competencies:

CEM 11.6. Identify the concept of filtering, the basic filters and the situations in which filtering audio signals is useful, and design and apply the most appropriate filter based on the signal's characteristics.

06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

#### Full-or-part-time: 25h

Practical classes: 10h

Self study: 15h
(ENG) Tema 5. Codificación

**Description:**
Condicionants de la codificació d'àudio: qualitat, amplada de banda, taxa de bits, taxa de compressió, retard
Tipus de codificadors
· Codificadors sense pèrdues
· Codificadors amb pèrdues
· Codificadors psicoacústics (emmascarament, sonoritat, bandes críptiques)
Estàndards de codificació d'àudio comprimit

**Specific objectives:**
(ENG)
7. Conocer la necesidad, los condicionantes y los fundamentos básicos de la codificación de audio.
11. Tener una perspectiva de diferentes sistemas de difusión de contenidos audiovisuales, conociendo sus características y las situaciones en las que se utiliza cada uno de ellos.

**Related activities:**
Actividad 04

**Related competencies:**
CEM 11.3. Identify the psychophysiological foundations of sound perception and voice production.
CEM 11.7. Assess the need and constraints of audio coding, and the technical foundations of the most important families of encoders.
CEM 11.8. Use the most suitable encoder in each specific situation from among those available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

**Full-or-part-time:** 25h
Practical classes: 10h
Self study: 15h
(ENG) Tema 6. Sistemas interactivos por voz

Description:
(ENG)
Fisiologia de l'aparell fonador
Definición y características
Sistemas de síntesis de voz
Sistemas de reconocimiento de voz

Specific objectives:
(ENG)
4. Comprender los fundamentos de la percepción visual, del sonido y de la producción de voz.
9. Conocer los fundamentos de los sistemas de reconocimiento de voz y la conversión de texto a voz.

Related activities:
(ENG) Actividad 05

Related competencies:
CEM 11.10. Design an interactive voice system.
CEM 11.11. Identify the fundamental aspects of speech recognition and text-to-speech systems.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 25h
Practical classes: 10h
Self study: 15h
(ENG) Tema 7. El estudio de sonido

Description:
Descripción general de un estudio de sonido
Equipos electroacústicos
· Micrófonos
· Altavoces
Amplificadores
Acústica de Salas

Specific objectives:
8. Conocer algunas piezas para medir la respuesta acústica de un recinto

Related activities:
Actividad 06

Related competencies:
CEM 11.9. Correctly use a sound studio and the equipment within it in their basic settings.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 12h 30m
Practical classes: 5h
Self study: 7h 30m

ACTIVITIES

(ENG) ACTIVITAT 01 - Introducció a l'àudio digital

Description:
Experimentació, percepció i caracterització de diferents qualitats i tipus de sons.

Material:
Enunciado Actividad 01

Delivery:
Entrega a través del campus virtual ATENEA

Related competencies:
CEM 11.1. Assess the state of current audiovisual technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

Full-or-part-time: 7h
Practical classes: 1h
Self study: 6h
**ACTIVITAT 02 - Síntesi de sons simples**

**Description:**
Visualització de formes d’ona, edició bàsica de senyals d’àudio i utilització de l’espectre i l’espectrograma com a eina d’identificació de característiques freqüencials dels sons.

**Material:**
(ENG) Enunciado Actividad 02

**Delivery:**
(ENG) Entrega a través del campus virtual ATENEA

**Full-or-part-time:** 14h
Practical classes: 2h
Self study: 12h

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**ACTIVITAT 03 - Filtratge i efectes d’àudio**

**Description:**
Percebre i analitzar diferents tipus de filtratge d’audio. Eliminació de soroll i disseny de filtres per eliminar o amplificar el contingut desitjat.

**Material:**
(ENG) Enunciado Actividad 03

**Delivery:**
(ENG) Entrega a través del campus virtual ATENEA

**Related competencies:**
CEM 11.2. Describe sound in terms of signal theory, and interpret the temporal and frequency representations of an audio signal.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.

**Full-or-part-time:** 7h
Practical classes: 1h
Self study: 6h
### (ENG) ACTIVITAT 04 - Codificació d’àudio

**Description:**
Codificar diferents senyals d’àudio en els formats objectiu, segons requisits donats. Anàlisi de diferents formats i conveniència en l’ús dels mateixos.

**Material:**
(ENG) Enunciado Actividad 04

**Delivery:**
(ENG) Entrega a través del campus virtual ATENEA

**Related competencies:**
- CEM 11.6. Identify the concept of filtering, the basic filters and the situations in which filtering audio signals is useful, and design and apply the most appropriate filter based on the signal's characteristics.
- 06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
- 07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.
- 04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 7h
- Practical classes: 1h
- Self study: 6h

### (ENG) ACTIVITAT 05 - Sistemes interactius per veu

**Description:**
Experimentació amb la senyal de veu: síntesi i reconeixement.

**Material:**
(ENG) Enunciado Actividad 05

**Delivery:**
(ENG) Entrega a través del campus virtual ATENEA

**Related competencies:**
- CEM 11.6. Identify the concept of filtering, the basic filters and the situations in which filtering audio signals is useful, and design and apply the most appropriate filter based on the signal's characteristics.
- 07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.
- 06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
- 04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 7h
- Practical classes: 1h
- Self study: 6h
(ENG) ACTIVIDAD 06 - Estudi de gravació

Description:
Ventajas e inconvenientes de la grabación en estudio. Comparativa de cualidades conseguidas en estudio y sin estudio y análisis de las potencialidades de la grabación en estudio.

Material:
(ENG) Enunciado Actividad 06

Delivery:
(ENG) Entrega a través del campus virtual ATENEA

Related competencies:
CEM 11.7. Assess the need and constraints of audio coding, and the technical foundations of the most important families of encoders.
CEM 11.8. Use the most suitable encoder in each specific situation from among those available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Full-or-part-time: 13h
Practical classes: 1h
Self study: 12h

GRADING SYSTEM

The final grade of the course is composed of five elements:

- Partial 1 (20%)
- Partial 2 (20%)
- Final exam (25%)
- Practical exercises (25%)
- Participation and attitude (10%)

The partial tests and the final exam evaluate the competencies acquired by the student throughout the different periods of the course. The practicals consist of solving situations in which the student has to apply the skills that are developed prior to the course. Student participation includes the attitude, follow-up, quality of the interventions, as well as the interventions, as well as the capacity of autonomous resolution of the questions formulated throughout the course in a context of synchrony in the classroom.

Reassessment. Students who have not passed the course through continuous assessment will have the option of taking the re-evaluation exam. It will consist of a two-hour exam and the grade obtained will replace the grades of the Partial exams and the Final exam (65% of the final grade of the course). In order to be able to take the exam, it is to have taken the continuous assessment process and to have failed the course by means of the usual assessment.
EXAMINATION RULES.

(ENG)Prácticas:
Los ejercicios de prácticas se inician durante el horario de clase en la franja destinada para estas y se completan al margen del horario previsto de clase siguiendo las instrucciones que se dan en el documento Hoja de Práctica correspondiente y las indicaciones que a tal efecto se dan en la parte de la clase correspondiente.
La resolución de los ejercicios de prácticas se entregará utilizando el campus Atenea en el espacio de entrega habilitado para cada práctica, siguiendo las indicaciones descritas en el documento Hoja de Práctica correspondiente, siguiendo los términos indicados. Al final de la práctica se entregaran los archivos que se requieran. La correcta gestión de la documentación aportada es un aspecto relacionado con las competencias a adquirir y es, por tanto, objeto de evaluación.
La evaluación de las prácticas no comporta solamente la resolución de los ejercicios propuestos, sino también la defensa que se haga de los resultados cuando el/la alumno/a sea requerido para ello al inicio de las clases.
Cualquier incidencia que no permita resolver la práctica en el plazo indicado debe ser comunicada al profesor correspondiente mediante mensaje por el Campus Virtual; con posterioridad a esta comunicación, se resolverá la pertinencia o no de las causas que motivan la no presentación del ejercicio y se establecerán las alternativas para completar la evaluación si las causas son justificadas. También se considerarán justificadas las causas de no presentación de ejercicios que sean comunicadas al profesorado por la Jefatura de Estudios.

Exámenes:
Los exámenes de la asignatura se realizan en laboratorio con ordenadores mediante documento electrónico que el/la alumno/a debe completar. Las preguntas y problemas propuestos en los exámenes hacen referencia tanto al contenido teórico de la asignatura como a los ejercicios resueltos en las diferentes prácticas. Al margen de cada pregunta o problema consta la contribución en puntos a la nota total del examen.
Las revisiones y/o reclamaciones respecto de los exámenes se realizarán exclusivamente en las fechas y horarios establecidos en el Calendario Académico.

BIBLIOGRAPHY

Basic: