Course guide

230089 - IPAV - Introduction to Audiovisual Processing

<table>
<thead>
<tr>
<th>Unit in charge:</th>
<th>Barcelona School of Telecommunications Engineering</th>
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<tbody>
<tr>
<td>Teaching unit:</td>
<td>739 - TSC - Department of Signal Theory and Communications.</td>
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<tr>
<td>Degree:</td>
<td>BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Compulsory subject).</td>
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<tr>
<td>Academic year:</td>
<td>2022</td>
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<tr>
<td>ECTS Credits:</td>
<td>6.0</td>
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<tr>
<td>Languages:</td>
<td>Catalan, Spanish</td>
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**LECTURER**

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

**PRIOR SKILLS**

See "requisites" section

**REQUIREMENTS**

- Probability and Statistics (PIE) - prerequisite
- Signals and Systems (SSIS) - prerequisite

**DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES**

**Generical:**

3. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.

**TEACHING METHODOLOGY**

- Lectures
- Laboratory classes
- Individual (learning)
- Mid-term exam
- Final Exam
- Laboratory sessions
LEARNING OBJECTIVES OF THE SUBJECT

Develop the intuition on the behaviour of audiovisual systems and the characteristics of signals with special emphasis on audiovisual signals. Introduce the fundamental elements of the perception of audiovisual signals. Provide useful additional tools for processing in the time and transformed domains generic and audiovisual discrete signals. Illustrate practical applications of audiovisual signal processing.

Learning outcome:
- She/he knows the human visual and auditory system. She/he knows how to characterize audiovisual signals in time and frequency. She/he knows how to represent them and she/he knows the principles of perception of audiovisual signals. She/he knows how to analyse and extract characteristics of audiovisual signals.
- She/he knows how to characterize analogue and discrete signals and systems in the time and frequency domains. She/he knows how to use the Fourier's transform of analog and discrete signals, and she/he knows the sampling theorem. Especially, she/he knows how to apply this knowledge to audiovisual signals and systems.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
<td>52,0</td>
<td>34.67</td>
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<tr>
<td>Self study</td>
<td>85,0</td>
<td>56.67</td>
</tr>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>8.67</td>
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Total learning time: 150 h

CONTENTS

1. Human Perceptive System

Description:
- User’s importance
- Human Auditory System
- Human Visual System

Related activities:
Practice I. Signal analysis with DFT. Application to speech signals

Full-or-part-time: 16h
- Theory classes: 6h
- Self study: 10h

2. The signal in the time and spatial domains

Description:
- Sequences x[n] and x[m,n]
- Quantization
- 1D: Non uniform quantization. Dynamic margin control
- 2D: Grey transformations. Histogram. Histogram equalization

Related activities:
Practice II. Quantization of audio-visual signals
Practice III. Image histogram and 2D-DFT

Full-or-part-time: 22h
- Theory classes: 8h
- Self study: 14h
3. The signal in the frequency domain

Description:
- Short-term 1D Fourier Transform
- Spectrogram. Time-frequency analysis
- 2D Fourier Transform
- 2D-DFT
- Importance of the phase

Related activities:
Practice III. Image histogram and 2D-DFT

Full-or-part-time: 26h
Theory classes: 10h
Self study: 16h

4. Sampling, decimation and interpolation

Description:
- 2D Sampling
- Decimation and interpolation
- Change of sampling rate

Related activities:
Practice IV: Decimation and interpolation of 1D signals
Practice V: Decimation, interpolation and filtering of 2D signals

Full-or-part-time: 26h
Theory classes: 10h
Self study: 16h

5. 2D convolution and correlation

Description:
- 2D convolution.
- Correlation (1D). Periodicity estimation.
- Correlation (2D). Pattern detection.

Related activities:
Practice IV. Filtering and equalization

Full-or-part-time: 11h
Theory classes: 4h
Self study: 7h

6. Linear time-invariant systems and filtering

Description:
- Z transform
- Systems defined by means of finite difference equations
- Filtering. Filter specification, linear phase, design of filter with Matlab, equalization.

Full-or-part-time: 26h
Theory classes: 10h
Self study: 16h
7. Audio-visual signal format

Description:
- Information compression
- Audio signal formats
- Image signal formats. Colour representation

Related activities:
Practice II. Quantization of audio-visual signals
Practice III. Image histogram and 2D-DFT

Full-or-part-time: 10h
Theory classes: 4h
Self study: 6h

ACTIVITIES

Mid-term exams

Description:
Continuous Assessment

Full-or-part-time: 4h
Theory classes: 2h
Laboratory classes: 2h

Practice I. Signal analysis with DFT. Application to speech signals

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

Practice II. Quantization of audio-visual signals

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

Practice III. Image histogram and 2D-DFT

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

Practice IV. Decimation and interpolation of 1D signals

Full-or-part-time: 2h
Laboratory classes: 2h
Practice V. Decimation, interpolation and filtering of 2D signals

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

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**Final exam**

**Description:**
Final Exam

**Full-or-part-time:** 3h
Theory classes: 3h

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**GRADING SYSTEM**

Partial exam (CNT): 30%
Laboratory work and quiz (LAB): 20%
Final exam (FNL): 50%

Formula: \( \max \left( 0.30 \times CNT + 0.20 \times LAB + 0.50 \times FNL, 0.20 \times LAB + 0.80 \times FNL \right) \)

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**