Course guides  
230691 - SPEE - Signal Processing for Electronic Engineering

Unit in charge: Barcelona School of Telecommunications Engineering  
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree:  
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Compulsory subject).  
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2019  
ECTS Credits: 5.0  
Languages: English

LECTURER

Coordinating lecturer: Lamarca Orozco, M. Meritxell

Others:

PRIOR SKILLS

Characterization of discrete-time signals and systems, both in the time domain and in the transformed domain (Fourier transform, Z transform, DFT)  
Analog signal sampling and reconstruction (sampling theorem)  
Random variables

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:  
CEE22. Ability to characterize deterministic and random signals in time or space, and in the frequency domain.  
CEE21. Ability to process continuous variable signals using digital techniques.  
CEE23. Ability to analyze, model, identify and simulate linear systems, especially digital filters and adaptive systems.

Transversal:  
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
TEACHING METHODOLOGY

Activities:
- Lectures
- Application examples
- Lab work with Matlab
- Exercises
- Team work (at home)
- Individual work (at home)
- Final exam

Activities planning:
- Exercises to strengthen theoretical knowledge.
- Lab work to implement processing techniques in Matlab.
- Final exam with theoretical questions and exercises.

LEARNING OBJECTIVES OF THE SUBJECT

Understanding the concepts and techniques of the field of statistical signal processing, and their use in real applications.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>39,0</td>
<td>31.20</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

CONTENTS

1. Fundamentals of digital signal processing

Description:
Introduction and applications
Random variables and stochastic processes

Full-or-part-time: 15 h
Theory classes: 4h
Laboratory classes: 1h
Self study : 10h

2. Estimation theory fundamentals

Description:
Bias, variance, mean square error
Maximum likelihood estimation

Full-or-part-time: 23 h
Theory classes: 4h
Laboratory classes: 3h
Self study : 16h
### 3. Scalar quantization

**Description:**
- Uniform quantization
- Dithering

**Full-or-part-time:** 9 h
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 6h

### 4. Sigma-Delta modulation

**Description:**
- Oversampling quantization
- Sigma-Delta modulation

**Full-or-part-time:** 9 h
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 6h

### 5. Impulsive noise

**Description:**
- Impulsive noise modeling
- Outlier detection
- Impulsive noise filtering

**Full-or-part-time:** 8 h
- Theory classes: 2h
- Self study: 6h

### 6. Spectral estimation

**Description:**
- Periodogram and autocorrelation estimates
- Smoothing the periodogram
- Parametric spectral estimation: AR processes
- Spectrogram

**Full-or-part-time:** 34 h
- Theory classes: 7h
- Laboratory classes: 3h
- Self study: 24h
### 7. Wiener filtering

**Description:**  
Problem formulation and applications  
Optimum filter coefficients  
Adaptive filtering, LMS algorithm

**Full-or-part-time:** 27 h  
Theory classes: 5h  
Laboratory classes: 4h  
Self study: 18h

### GRADING SYSTEM

Final exam (including Lab work): 50%  
Individual/team assignments: 50%

### BIBLIOGRAPHY

**Basic:**  

### RESOURCES

**Audiovisual material:**  
- Teacher’s material: notes, problem sets, laboratory guides. Resource