Course guide
230691 - SPEE - Signal Processing for Electronic Engineering

Last modified: 10/11/2022

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: 2022 **ECTS Credits:** 5.0 **Languages:** English

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

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
- Exercices
- 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

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

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: 15h
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: 23h
Theory classes: 4h
Laboratory classes: 3h
Self study : 16h

3. Scalar quantization

Description:
Uniform quantization
Dithering

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

4. Sigma-Delta modulation

Description:
Oversampling quantization
Sigma-Delta modulation

Full-or-part-time: 9h
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: 8h
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: 34h
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: 27h
Theory classes: 5h
Laboratory classes: 4h
Self study : 18h

GRADING SYSTEM

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

BIBLIOGRAPHY

Basic:
- Hayes, M.H. Digital signal processing. 2nd ed. New York: McGraw Hill, 2012. ISBN 9780071635097.
- Manolakis, D.G.; Ingle, V.K.; Kogon, S.M. Statistical and adaptive signal processing: spectral estimation, signal modeling, adaptive filtering, and array processing. Boston: Artech House, 2005. ISBN 1580536107.

RESOURCES

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