Course guide
230918 - TRS - Signal Processing

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.
Degree: BACHELOR’S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).
(Compulsory subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: Catalan, Spanish

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
Content associated with Probability and Stochastics Processes
Content associated with Signals and Systems

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
CE21. (ENG) GREELEC: Capacitat de construir, explotar i gestionar sistemes de captació, transport, representació, processat, emmagatzament, gestió i presentació d’informació multimèdia, des del punt de vista dels sistemes electrònics. (Mòdul de tecnologia específica - Sistemes Electrònics).
CE22. (ENG) GREELEC: Capacitat per a seleccionar circuits i dispositius electrònics per a la transmissió, l’encaminament o enrutament i els terminals, tant en entorn fixs com mòbils. (Mòdul de tecnologia específica - Sistemes Electrònics).

Basic:
CBS. (ENG) GREELEC: Que els estudiants puguin desenvolupar habilitats d’aprenentatge per emprendre estudis superiors amb un alt grau d’autonomia.

TEACHING METHODOLOGY
Application lectures.
Lectures.
Lab lectures.
Group work.
Personal work.
Exams with exercises (Controls and Final Exam).
Lab sessions.
LEARNING OBJECTIVES OF THE SUBJECT

- Characterization of signals as stochastic processes.
- Detection theory.
- Estimation theory.
- Time-frequency analysis of signals.
- Optimal filtering.
- Adaptive filtering.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>13.0</td>
<td>8.67</td>
</tr>
<tr>
<td>Hours large group</td>
<td>52.0</td>
<td>34.67</td>
</tr>
<tr>
<td>Self study</td>
<td>85.0</td>
<td>56.67</td>
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</tbody>
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Total learning time: 150 h

CONTENTS

Lesson 1. Process characterization in discrete time.

Description:
- Vector notation and random variable.
- Characterization of stochastic processes (stationary and ergodic), correlation matrix and properties, power spectral density, discrete processes and linear systems.

Related activities:
- Modeling of an AR process.

Full-or-part-time: 10h
Theory classes: 8h
Laboratory classes: 2h

Lesson 2. Detection theory

Description:
- The problem of decision making: verification of hypothesis, terminology and examples
- MAP and Neyman-Pearson criteria
- Detection of deterministic signals and ROC

Full-or-part-time: 12h
Theory classes: 10h
Laboratory classes: 2h
Lesson 3. Estimation Theory.

Description:
- The problem of estimation.
- Estimation of parameters and MVUE estimator.
- Cramer-Rao limit and efficient estimator.
- Estimation of maximum likelihood, MAP and MMSE estimate.

Full-or-part-time: 17h
Theory classes: 15h
Laboratory classes: 2h

Lesson 4. Optimal filtering.

Description:
- Mean square linear estimation.
- Types of filtering: system identification, equalization, cancellation, prediction and interpolation.
- Wiener filter in frequency.
- Linear regression and least squares.

Full-or-part-time: 11h
Theory classes: 9h
Laboratory classes: 2h

Lesson 5. Adaptive filtering

Description:
- Gradient method for linear regression.
- Stochastic gradient methods (LMS).
- Convergence and mismatch. Normalized LMS

Full-or-part-time: 14h
Theory classes: 10h
Laboratory classes: 4h

GRADING SYSTEM

The completion of all lab sessions and presentation of the corresponding reports during the semester in which the course is taken are mandatory and, therefore, a necessary condition for passing the course. Failure to do so, the student will get a "No Presentat" (NP) for the course without considering the percentages set forth below. The lab is not reevaluable.

Un control tests consisting of exercises. (20%)
Follow-up of the work in the lab (25%)
Final exam (55%)

BIBLIOGRAPHY

Basic:

Complementary: