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: