

Course guide

230918 - TRS - Signal Processing

Last modified: 11/06/2024

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: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: MONTSERRAT NAJAR MARTON

Others: Segon quadrimestre:
VICENTE JIMENEZ SERRES - 11, 12, 13
MONTSERRAT NAJAR MARTON - 11, 12, 13

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 dispositiu electrònics per a la transmissió, l'encaminament o enrutament i els terminals, tant en entorn fix com mòbils. (Mòdul de tecnologia específica - Sistemes Electrònics).

Basic:

CB5. (ENG) GREELEC: Que els estudiants pugin 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.
- Optimal filtering.
- Adaptive filtering.

STUDY LOAD

Type	Hours	Percentage
Self study	85,0	56.67
Hours large group	52,0	34.67
Hours small group	13,0	8.67

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.

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: 15h

Theory classes: 13h

Laboratory classes: 2h

Lesson 4. Optimal filtering.

Description:

- Mean square linear estimation.
- Types of filtering: system identification, equalization, cancellation, prediction and interpolation.
- 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: 12h

Theory classes: 8h

Laboratory classes: 4h

ACTIVITIES

Control test

Description:

Control test consisting of exercises

Full-or-part-time: 2h

Theory classes: 2h

Final exam

Full-or-part-time: 3h

Theory classes: 3h

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:

- 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.
- Kay, S.M. Fundamentals of statistical signal processing. Englewood Cliffs: Prentice-Hall, 1993-2013. ISBN 0130422681.

Complementary:

- Theodoridis, S. Machine learning : a bayesian and optimization perspective [on line]. 2nd ed. London: Elsevier Academic Press, 2020 [Consultation: 17/03/2021]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=6118601>. ISBN 9780128188033.