



## Course guides

# 230695 - ACO - Applied Convex Optimization

Last modified: 10/05/2021

**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). (Optional subject).  
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

**Academic year:** 2021    **ECTS Credits:** 5.0    **Languages:** Spanish, English

### LECTURER

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**Coordinating lecturer:** Perez Neira, Ana Isabel

**Others:** Perez Neira, Ana Isabel

### PRIOR SKILLS

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Basic Algebra

### TEACHING METHODOLOGY

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Classroom sessions

### LEARNING OBJECTIVES OF THE SUBJECT

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The so-called optimization problems rise in very different fields and applications. In all of them the function to be optimize is the so-called cost or objective function and the variables that we control to carry out the optimization are many times confined, which it is called the constraints of the problem. Convex optimization arise frequently in engineering problems but often go unrecognized. This course shows that there is a substantial and useful theory for such problems. The course will give students the tools and training to recognize convex optimization problems that arise in wireless communications and networks. The basic theory of such problems is presented together with the required background to use the methods in their own research or engineering work.

### STUDY LOAD

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

**Total learning time:** 125 h



## CONTENTS

### Introduction

**Description:**

Modern optimization vs classical one: Efficient solvable programmes

**Full-or-part-time:** 2h

Theory classes: 2h

### Convex Sets and functions

**Description:**

Definitions and properties

**Full-or-part-time:** 4h 20m

Theory classes: 4h 20m

### Convex programming and class of convex problems

**Description:**

Formulation of a convex optimization problem

Study of: LP, QP, SOCP, SDP, GP

Problem relaxation

Applications: norm minimization, filter design, low rank optimization problems (eg. Netflix, video security, image restoration)

Convex software tool programming

**Full-or-part-time:** 8h 40m

Theory classes: 4h 20m

Practical classes: 4h 20m

### Duality

**Description:**

Lagrange Duality and KKT conditions

Primal-Dual decomposition

Applications: Radio resource management for satellite and wireless comm (power control, waterfilling, MIMO transceiver design), cloud computing

**Full-or-part-time:** 6h

Theory classes: 4h

Practical classes: 2h

### Algorithms

**Description:**

Basic algorithms: interior point method

Simple methods for extremely large problems

Applications: compressed sensing, ML decoding and SDP relaxation, 5G beamforming

**Full-or-part-time:** 9h

Theory classes: 9h



## Multi-Objective optimization

### Description:

Theory

Applications: interference networks, portfolio optimization, SVM and classification

### Full-or-part-time: 9h

Theory classes: 9h

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## GRADING SYSTEM

Individual assessment 60%

Group assessment 40%

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## BIBLIOGRAPHY

### Basic:

- Boyd, S.; Vandenberghe, L. Convex optimization. Cambridge: Cambridge University Press, 2004. ISBN 0521833787.

- Ehrgott, M. Multicriteria optimization [on line]. 2nd ed. Berlin, Heidelberg: Springer, 2005 [Consultation: 08/09/2021]. Available on: <http://dx.doi.org/10.1007/3-540-27659-9>. ISBN 3540213988.

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## RESOURCES

### Other resources:

Class notes and problems