Course guides
300257 - OPTIM - Optimization for Applied Engineering Design

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering.
Degree: MASTER’S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Compulsory subject).

Academic year: 2019  ECTS Credits: 3.0  Languages: English

LECTURER

Coordinating lecturer: Cristina Cervelló-Pastor
Others: Cristina Cervelló-Pastor

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
05 MTM. (ENG) Resolver problemas de optimización en el ámbito de las redes de comunicación.

Transversal:
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:
CB6. (ENG) CB6 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación.
CB10. (ENG) CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

TEACHING METHODOLOGY

* Laboratory learning sessions
  - Individual work delivered at the end of the session. Laboratory learning
  - activities linked to the concepts of the slides.
  - Reinforce the concepts using computer tools: problems solved at the laboratory.
  - Lab sessions provide students with the opportunity to analyse, discuss, and solve problems, in addition to fostering the development of practical, technical and engineering skills.
  - Students have to read and study the corresponding slides before coming to the lab.

* Project lab sessions
  - Individual work delivered at the end of the session.
  - Development of one project throughout the course.

LEARNING OBJECTIVES OF THE SUBJECT

The Optimization for Applied Engineering Design course is aimed at providing the participants with knowledge in applied optimization, with focus on the application of theory and methods in deterministic optimization and heuristic techniques for modeling and solving optimization problems originating from the area of communication and others areas.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Self study</td>
<td>48,0</td>
<td>64.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>27,0</td>
<td>36.00</td>
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</tbody>
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Total learning time: 75 h

CONTENTS

Introduction to Optimization

Description:
Definition of an Optimization Problem. Unconstrained and Constrained Optimization.

Specific objectives:
* Definition of an Optimization Problem
  - Components of an Optimization Problem

* Unconstrained Optimization
  - Statement of an Optimization Problem
  - Concepts
  - Concavity and Convexity
  - Conditions for local optimizers: Interior and Boundary cases

* Equality Constrained Optimization
  - Conditions for local optimizers

* Inequality and Equality Constrained Optimization
  - Conditions for local optimizers

Related activities:
Problems resolution
Control

Full-or-part-time: 15h
Practical classes: 5h
Self study: 10h
### Part I: Optimization with Engineering Applications

**Description:**
- Network Optimization
- Mixed Integer Programming
- Multi-Objective Optimization

**Specific objectives:**
- *Network Optimization*
  - Special type of linear Programming
  - Continuous and Discrete Models

- *Mixed Integer Programming*
  - Common IP Problems
  - Technique for formulating CO problems as ILP
  - Linearizing nonlinear functions

- *Multi-Objective Optimization*
  - Definition of a MOP
  - Pareto Optimal Solutions
  - Solving Multi-objective Optimization Problems

**Related activities:**
- Lab learning sessions
- Laboratory Project sessions
- Control

**Full-or-part-time:** 48h
- Practical classes: 18h
- Self study: 30h

### Part II: Metaheuristics Optimization Algorithms

**Description:**
- Introduction
- Analysis of different algorithms

**Specific objectives:**
- *Introduction*

- *Analysis of different algorithms depending on the progress of the course*
  - Evolutionary Algorithms
  - Genetic Algorithms
  - Differential Evolution Algorithms
  - Ant Colony Optimization
  - Particle Swarm Optimization
  - Biogeography-based Optimization

**Related activities:**
- Lab learning session
- Laboratory Project session

**Full-or-part-time:** 12h
- Laboratory classes: 4h
- Self study: 8h
GRADING SYSTEM

Lab Learning Sessions: 20%
Laboratory Project: 20%
Mid-course control: 20%
Final exam: 40%

BIBLIOGRAPHY

Basic:

Complementary: