300257 - OPTIM - Optimization for Applied Engineering Design

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Teaching unit Compulsory)
ECTS credits: 3
Teaching languages: English

Teaching staff
Coordinator: Cristina Cervelló-Pastor
Others: Cristina Cervelló-Pastor

Degree competences to which the subject contributes

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.

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.

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>Total learning time: 75h</th>
<th>Hours large group:</th>
<th>0h</th>
<th>0.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>27h</td>
<td>36.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>48h</td>
<td>64.00%</td>
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Content

**Introduction to Optimization**

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

**Related activities:**
Problems resolution
Control

**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

**Learning time:** 15h
  - Practical classes: 5h
  - Self study: 10h
<table>
<thead>
<tr>
<th>Part I: Optimization with Engineering Applications</th>
<th>Learning time: 48h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Practical classes: 18h</td>
</tr>
<tr>
<td>Network Optimization</td>
<td>Self study: 30h</td>
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<tr>
<td>Mixed Integer Programming</td>
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<tr>
<td>Multi-Objective Optimization</td>
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<tr>
<td><strong>Related activities:</strong></td>
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</tr>
<tr>
<td>Lab learning sessions</td>
<td></td>
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<tr>
<td>laboratory Project sessions</td>
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<tr>
<td>Control</td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>* Network Optimization</td>
<td></td>
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<tr>
<td>- Special type of linear Programming</td>
<td></td>
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<tr>
<td>- Continuous and Discrete Models</td>
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<tr>
<td>* Mixed Integer Programming</td>
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<tr>
<td>- Common IP Problems</td>
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<tr>
<td>- Technique for formulating CO problems as ILP</td>
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<tr>
<td>- Linearizing nonlinear functions</td>
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<tr>
<td>* Multi-Objective Optimization</td>
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<tr>
<td>- Definition of a MOP</td>
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<tr>
<td>- Pareto Optimal Solutions</td>
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<tr>
<td>- Solving Multi-objective Optimization Problems</td>
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</tbody>
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### Part II: Metaheuristics Optimization Algorithms

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<tr>
<td></td>
<td>Self study: 8h</td>
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**Related activities:**
- Lab learning session
- Laboratory Project session

**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

### Qualification system

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

Basic:


Complementary:


