

## 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.



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### Study load

Total learning time: 75h	Hours large group:	0h	0.00%
	Hours medium group:	27h	36.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	48h	64.00%



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### Content

#### Introduction to Optimization

Learning time: 15h

Practical classes: 5h

Self study : 10h

#### 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



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<p>Part I: Optimization with Engineering Applications</p>	<p>Learning time: 48h Practical classes: 18h Self study : 30h</p>
<p>Description: Network Optimization Mixed Integer Programming Multi-Objective Optimization</p> <p>Related activities: Lab learning sessions laboratory Project sessions Control</p> <p>Specific objectives:</p> <ul style="list-style-type: none"><li>* Network Optimization<ul style="list-style-type: none"><li>- Special type of linear Programming</li><li>- Continuous and Discrete Models</li></ul></li> <li>* Mixed Integer Programming<ul style="list-style-type: none"><li>- Common IP Problems</li><li>- Technique for formulating CO problems as ILP</li><li>- Linearizing nonlinear functions</li></ul></li> <li>* Multi-Objective Optimization<ul style="list-style-type: none"><li>- Definition of a MOP</li><li>- Pareto Optimal Solutions</li><li>- Solving Multi-objective Optimization Problems</li></ul></li></ul>	

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<p>Part II: Metaheuristics Optimization Algorithms</p>	<p>Learning time: 12h Laboratory classes: 4h Self study : 8h</p>
<p>Description: Introduction Analysis of different algorithms</p> <p>Related activities: Lab learning session Laboratory Project session</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> <li>* Introduction</li> <li>* Analysis of different algorithms depending on the progress of the course</li> <li>- Evolutionary Algorithms</li> <li>- Genetic Algorithms</li> <li>- Differential Evolution Algorithms</li> <li>- Ant Colony Optimization</li> <li>- Particle Swarm Optimization</li> <li>- Biogeography-based Optimization</li> </ul>	

### Qualification system

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

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### Bibliography

#### Basic:

Chong, Edwin Kah Pin; Zak, Stanislaw H. An Introduction to optimization [on line]. 2a ed. New York: Wiley-Interscience, 2001 [Consultation: 03/10/2018]. Available on: <<https://onlinelibrary.wiley.com/doi/book/10.1002/9781118033340>>. ISBN 0471391263.

Oki, Eiji. Linear programming and algorithms for communication networks : a practical guide to network design, control, and management. First edition. Boca Raton: CRC Press, [2012]. ISBN 9781138034099.

#### Complementary:

Guenin, B. A Gentle introduction to optimization. Cambridge: Cambridge University Press, 2014. ISBN 9781107053441.

Deb, Kalyanmoy. Multi-objective optimization using evolutionary algorithms. Chichester ; New York: John Wiley & Sons, 2001. ISBN 9780470743614.

Simon, Dan. Evolutionary optimization algorithms : biologically inspired and population-based approaches to computer intelligence. New Jersey: John Wiley, 2013. ISBN 9780470937419.

Rao, S. S. Engineering optimization : theory and practice. 4a ed. Hoboken, New Jersey: John Wiley & Sons, cop. 2009. ISBN 9780470183526.

Hart, William E. Pyomo – Optimization modeling in Python. Second edition. New York [etc]: Springer, [2017]. ISBN 9783319588193.