ISEL
ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**INDUSTRIAL ENGINEERING MANAGEMENT**					
Curricular Unit (UC)	**Industrial Optimization Methods**			Mandatory	**X**	
				Optional		
Scientific Area:	Energy and Systems Control					
Year: **1º**	Semester: **1º**	ECTS: **6**		Total Hours: **4,5**		
Contact Hours:	T:	TP:**67,5**	PL:	S:	OT:	TT:
Professor in charge		Academic Degree /Title		Position		
José Manuel P. V. Cardoso Igreja		**PhD**		**Associate Professor**		

T- Theoretical ; TP – Theory and practice ; PL – Laboratory ; S – Seminar ; OT –Tutorial ; TT – Total of contact hours

Entry into Force	Semester: **Winter**	Academic Year: **2016/2017**

Objectives of the curricular unit and competences (max. 1000 characters)

At the end of the curricular unit the student should be able to:
1. Formulate optimization engineering problems mathematically.
2. Analyze the optimization outputs and criticize the results.
3. Calculate optimum solutions in industrial engineering problems.
4. Understand linear and nonlinear algorithms applied in optimization techniques.
5. Understand the use of artificial intelligence techniques in complex engineering problems.
6. Model and simulate engineering systems.
7. Use intelligent systems in the modeling and optimization of industrial engineering

Syllabus (max. 1000 characters)

1. Introduction to Optimization
History. Introduction to formalization. Examples.
2. Linear Programming
Definitions and basic concepts. Linear programming hypotheses. Basic definitions. Graphical Solution. Simplex Algorithm. Artificial variables. The Big M method. Duality.
3. Non-classical Methods in Optimization.
Meta-heuristics. Genetic Algorithms (GA). Populations. Fitness. Selection, Mutation and Elitism.
4. Computational Intelligence. Evolutionary Computing. Particles Swarm Optimization (PSO) Artificial Bee Colonies (ABC). Variants.

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Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)
The curricular unit is focused essentially in optimization algorithms. The use of optimization techniques in engineering problems (production, transports, and resources) can lead to decision taking that improves the efficiency of the problem. The correct use of these tools is very important in engineering. In the first part of the curricular unit the development of mathematical models is taught. The development of mathematical systems and their linear optimization is the focus during chapter 2. Computational intelligence methods are used to optimize different and complex engineering problems. The capability of learning towards an optimum solution makes genetic and affine algorithms good solutions to complex problems. Chapter 3 and 4 presents the use of evolutionary computing methods in nonlinear complex optimization problems.

Teaching methodologies (including evaluation) (max. 1000 characters)
The curricular unit addresses theoretical and technical concepts, and uses practical engineering cases to demonstrate the effectiveness of the techniques. Afterwards useful dedicated software is explained to the students, in order to optimize complex engineering problems. The evaluation is one final exam with scores from 0 to 20. To get positive evaluation the student must have a grade equal or greater than 10

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
Knowing that the curricular unit has a strong application in engineering systems, laboratory classes where computer software is used to solve practical cases helps to developing the student ability to solve different types of problems that can be applied directly on a working environment. Several proposed project increases the notion of analysis and criticism of a given solution. The student has to decide what data and problem solutions should be implemented and what outputs should be expected. The student is able to reach the objectives, working with different types of application problems. The theoretical learning of each one of the proposed methods is reinforced with real practical applications, motivating the student towards the importance of the curricular unit in the future of the industrial engineer.

Main Bibliography (max. 1000 characters)
L. Valadares Tavares et al., Investigação Operacional, McGraw-Hill, 1997 Hillier / Lieberman, Introduction to operation research, 8th Edition, McGraw-Hill,2005 Wayne L. Winston, Operations Research – Applications and Algoridthms, 4th Edition, Duxbury Press, 2004

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Alexander M. Meystel, James S. Albus; Intelligent Systems - Architecture, Design, and Control, John Wiley &
Sons, Inc., 2002