Curricular Unit Form (FUC)

Course:	**FIRST CYCLE IN MECHANICAL ENGINEERING**					
Curricular Unit (UC)	**Mechanical Design**			Mandatory	**X**	
				Optional		
Scientific Area:	**Mechanical Project, Manufacturing and Industrial Maintenance**					
Year: **3**	Semester: **6**	ECTS: **6,0**		Total Hours: **4,5**		
Contact Hours:	T:	TP:**67,5**	PL:	S:	OT:	TT:
Professor in charge		Academic Degree		Position		
Joaquim Infante Barbosa		**Doutor**		**Professor Coordenador Principal**		

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

Entry into Force	Semester: **Winter**	Academic Year: **2012/2013**

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

Identify a problem or situation, defining all its parameters;

Synthesize and analyze all possible hypotheses of its solution using their know-how and the knowledge acquired in the discipline;

Combine and organize the previously received knowledge in order to obtain a system that solves the problem;

Search standards, books, Internet, etc ..

Present and criticize the developed system, which solves the problem;

Modelling and design mechanical systems and equipment;

Exhibit and present solutions.

Syllabus (max. 1000 characters)

1 - Technical Data Package. Mechanical Design: organization, planning ; regulations ; codes and standards; safety coefficients, systematization of tolerances and adjustments.

2 - Fracture / fatigue. Modes of failure. impact tests; stress intensity factor; curve R concept. initiation and propagation. Fatigue under high number of cycles. Cycle fatigue. SN curves. Goodman diagram. Palgrem-Miner rule. Law of Paris. Fluency. Parameter Orr-Sherby-Dorn. Larsson-Miller parameter.

3 - Introduction to the Finite Element Method (FEM). key stages of the FEM; approximation of functions; element types: application fields; formulation components; stiffness matrix and vector

forces; global equilibrium equations; commercial applications.
4 - Eurocodes in metallic construction. Structural Eurocodes. Combination of actions. ultimate states. Check excessive deformation, loss of static equilibrium, fire resistance and fatigue resistance.

Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)

The proposed topics are considered adequate, allowing the deepening of knowledge about the structural design of different types of mechanical structures and systems of real relevance to the most advanced training of engineers. It is intended therefore to provide a comprehensive knowledge of the most important aspects associated with the design of structures and mechanical systems, using computer commercial software and building codes and standards. It also provided to the students proper training of the most important aspects of fatigue components by estimating the life FATIGUE of components under the high number of cycles, as well as the appropriate training to understand and perform static and dynamic finite element analysis, using library elements available in the FEM programs using the most appropriate boundary conditions. It also made the approach to structural

Teaching methodologies (including evaluation) (max. 1000 characters)

The teaching will be carried out through practical classes. The classes work with brief presentations on each topic, followed by practical examples. The works are performed using the commercial programs of FEM and symbolic computation.
The assessment will involve:

- Work on Technical Data Package (TT1)
- Work on Eurocodes in metallic construction (TT2)
- Pre-presentation of interim project work (AI)
- Project work (P), fundamental pedagogically (P ≥ 10)
- Final exam on the subjects taught (EF)

The project is evaluated on several components being considered pre-presentation and the formal aspects of the public presentation of the project work done. The final grade (NF) in this UC in regular exams is the result of:

NF = **0.05**x**TT1** + **0.05**x**TT2**+**0.10**x**AI**+**0.50**x**P**+**0.30**x**EF;** Approval**: NF ≥ 10**

The final grade (NF) in the course in special exam is the result of::

NF = **0.05**x**TT1** + **0.05**x**TT2**+**0.60**x**P**+**0.30**x**EF;** Approval**: NF ≥ 10**

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
In the teaching methodologies used are different pathways that enable the objectives of the course. Depending on the characteristics of the concepts are used to broadcast lectures, theoretical and practical, which are a group that aims harmonious, in order to enable students to understand the fundamental concepts associated with the syllabus. It is particularly relevant the analysis and proper definition of the boundary conditions of the problems. Students are also informed and required to carry out tests to check the conformity of the analysis performed using the computer aided design possibilities. Addresses the characteristics, capabilities, limitations and application fields of different elements , which are usually in the library of elements of the commercial finite element programs. Particular attention is paid to the use of enlightened commercial finite element programs trying to avoid it utilization as "black box ". In class lectures and practices are used the potential of new multimedia systems and conducted training in the use of commercial software for modeling and simulation of static and dynamic behavior of structures and mechanical systems. Emphasis is on the formal aspects of the presentation of the project, including the use of various constituent components of the technical documentation and standards. Particular prominence is given to the use of structural Eurocodes, including mandatory for use in metal structures. They are therefore used and presented the different fundamental tools and concepts that allow the student to make an autonomous project of structures and mechanical systems.

Main Bibliography (max. 1000 characters)
• Oden, JT. And Ripperger EA., , Mechanics of Elastic Structures, Hemisphere Corporatian. • SHIGLEY, J., MISCHKE, Mechanical Engineering Design, McGraw-Hill. • Método dos Elementos Finitos, Ferramentas para Análise Estrutural, Raul Duarte S G Campilho, Publindústria, Porto, 2012. • Moaveni, S., "Finite Element Analysis: Theory and Application with ANSYS" • Eurocódigos. Normas e Regulamentos. • Travassos, J., Complementos de Projecto • Barbosa, JI, Slides das aulas